

# Trent Jaeger

## E Personal Data

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### Home Address:

153 Brothers Court  
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**Birth Date:** June 14, 1962

**Family Status:** Married with two sons

**Citizenship:** USA

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## Education

- Ph.D., Computer Science and Engineering, University of Michigan, Ann Arbor, 1997  
Thesis: *Flexible Control of Downloaded Executable Content*  
Advisor: Dr. Atul Prakash
  - M.S.E., Computer Science, University of Michigan, Ann Arbor, 1993
  - B.S., Chemical Engineering, California State Polytechnic University, Pomona, 1985
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## Research Interests

Operating system security, access control systems, access control policy analysis, virtual machine systems, trusted computing systems, source code analysis, and operating systems design and implementation

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## Professional Experience

### The Pennsylvania State University, University Park, PA

*2005-current Associate Professor, Computer Science and Engineering Department (Tenured, 2008)*  
Co-director of the System Infrastructure and Internet Security Lab leading projects in Linux security, virtual machine system security, integrity measurement systems, distributed security architectures, retrofitting of legacy code for security, mobile phone system security, etc.

### IBM Thomas J. Watson Research Center, Hawthorne, NY

*2001-2005 Research Staff Member, Research Division, Security Department*  
Research Liaison to the IBM Linux Technology Center leading group of researchers to improve Linux security through contributions to the Linux Security Modules framework, SELinux, and Labeled IPsec.

*2000-2001 Research Staff Member Manager, Research Division, Systems Department*  
Led microkernel-based operating systems group in development of SawMill Linux multiserer.

*1996-2000 Research Staff Member, Research Division, Systems Department*  
Member of L4 systems research group. My main interest was security mechanisms and policies and their implementation in operating systems and applications.

# Trent Jaeger

## University of Michigan, Ann Arbor, MI

1992-1996 *Graduate Student Research Assistant, EECS Department*

Research access control for mobile code and software engineering support for workflow systems.

## Bell Communications Research, Morristown, NJ

1995 *Student Intern, Research Division, Network Security Department*

Research cryptographic protocols for verifying downloaded code.

## General Motors, Warren, MI

1994 *Student Intern, North American Ops, Manufacturing Information Systems*

Research mechanisms for adaptive, multi-agent systems.

## Electronic Data Systems, Troy, MI

1989-1991 *Advanced Knowledge Engineer, AI Services Department*

1986-1989 *Knowledge Engineer, AI Services Department*

Built knowledge-based systems for gear set design, process planning, and manufacturing processes.

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## Awards and Honors

- Cisco University Research Program, 2007 (with La Porta and McDaniel)
- IBM Faculty Partnership Award, 2006
- Second patent plateau, IBM, 2005
- ACM CCS papers invited for ACM TISSEC journal publication, 2000 and 2002
- ACM SACMAT papers invited for ACM TISSEC journal publication, 2001 and 2007
- USYSA "D" certificate (soccer coach), 2005
- Best student paper, USENIX Security Symposium, 1996

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## Expert Witness Activities

- *The PacID Group LLC v. Apple, Inc. et al.*, United States District Court for the Eastern District of Texas
- *Novell, Inc. v. Information Protection and Authentication of Texas, LLC*, United States District Court for the Eastern District of Texas
- *Finjan Software Ltd. v. Secure Computing Corp.*, United States District Court for the District of Delaware

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## Grants Awarded

- **Co-PI**, *National Science Foundation (TC)*, CNS-1057312, Workshop on Trustworthy Computing Program (w/ Adam Smith, Penn State), September 2010-June 2011, \$254,019
- **PI**, *National Science Foundation (TC:Medium)*, CNS-0905343, Techniques to Retrofit Legacy Code with Security (w/ Michael Hicks of Maryland, Somesh Jha of Wisconsin, and Ninghui Li of Purdue), September 2009-September 2012, \$1.2 million (\$300,000 for Penn State)

# Trent Jaeger

- **Co-PI**, *National Science Foundation (CPS:Small)*, CPS-0931914, Establishing Integrity in Dynamic Networks of Cyber Physical Devices (w/ Vinod Ganapathy and Uli Kremer, both of Rutgers), September 2009-August 2012, \$540,000 (\$185,000 for Penn State)
- **Co-PI**, *Defense University Research Instrumentation Program (DURIP)*, *Army Research Office (ARO)*, Characterizing and Mitigating Wireless Systems Vulnerabilities, May 2009-May 2010, \$150,000
- **PI**, *Air Force Research Lab (AFRL)*, Policy Analysis Tools for XSM/Flask, January 2009-January 2010, \$193,000
- **Co-PI**, *Ben Franklin Technology Partners*, Center of Excellence (Penn State NSRC), 2008-2009, \$75,000
- **Co-PI**, *National Science Foundation (MRI)*, Acquisition of a Scalable Instrument for Discovery through Computing (w/ Raghavan, Chen, Hudson, Kandemir, Smith), July 2008-June 2012, \$1,255,500
- **PI**, *Air Force Research Lab (AFRL)*, Policy Design and Analysis for XSM/Flask, June 2008-June 2009, \$200,000
- **Co-PI**, *National Science Foundation (NETS)*, CNS-0721579, Protecting Services for Emerging Wireless Telecommunications Infrastructure (w/ McDaniel and La Porta), September 2007-September 2010, \$658,200
- **PI**, *National Science Foundation (CT:Small)*, CNS-0627551, Shamon: Systems Approaches to Composing Distributed Trust (w/ McDaniel), September 2006-August 2010, \$400,000
- **PI**, *Disruptive Technology Office* (now IARPA), System-Wide Information Flow Enforcement (w/ McDaniel), February 2007-August 2008, \$500,000
- **Co-PI**, *Ben Franklin Technology Partners*, Center of Excellence (Penn State NSRC), 2007-2008, \$75,000
- **Co-PI**, *Cisco Corporation*, University Research Program, Security Testbed for IMS/Internet Convergence (w/ Thomas La Porta and Patrick McDaniel), 2007, \$100,000
- **PI**, *Samsung Electronics Corporation*, Integrity Protection for Linux Cellphones, January 2007-December 2007, \$92,717
- **Co-PI**, *Raytheon via the Penn State Network Security Research Center*, Symbian Cellphone Attacks, January-December 2007, \$50,000
- **PI**, *IBM Faculty Partnership Award*, Distributed Access Control and Attestation Mechanisms, 2006, \$30,000
- **Co-PI**, *Raytheon via the Penn State Network Security Research Center*, Symbian Cellphone Attacks, May-August 2006, \$50,000
- **PI**, *Technology Collaborative via the Penn State Cyber Security Research*, An End-Host Security Analysis and Training Environment, January-May 2006, \$5,000

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## Major Software Systems

### Penn State University

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|----------------------------|---|
| • Process Firewall         | Protect processes from vulnerabilities due to ambiguities in system state   |
| • Mediation Placement*     | Automatically place runtime access control code (authorization, declassification and endorsement) into legacy Java and C code.                      |
| • Hippocrates*             | Tool for compliance analysis of hierarchical software systems with multiple mandatory access control policies at multiple layers (network, VMM, OS) |
| • VM Verifier              | Measure and build proofs of VM integrity for remote attestation according to CW-Lite integrity for Xen and SELinux systems.                         |
| • Async Attestation        | Bind all web content (static and dynamic) with current system attestations  |
| • PALMS*                   | Information flow compliance checking tool for SELinux policies  |
| • Root of Trust Installer* | Bind integrity of a system to its installer to attest code and site-specific data   |
| • Shamon                   | Shared Reference Monitor System built using Xen, SELinux, Labeled IPsec, Linux IMA, to create a verifiable, distributed access control system       |
| • Flowwolf                 | Information flow-aware web browser client built using Java and Jif and mechanisms (VM and SELinux) to ensure compliance with system policy          |

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- High-Integrity Phones      Build Linux phones systems capable of protecting high-integrity processes from downloaded code (also supports integrity measurement via PRIMA)

\* - check for availability (some are available via open-source)

## IBM Research

- Labeled IPsec      Authorize network access via SELinux using IPsec SAs (as of Linux 2.6.18)
- Xen sHype      Reference monitor for Xen (in Xen 3.0)
- PRIMA/IMA      Integrity measurement using secure hardware for Linux
- Gokyo      Graph-based policy analysis tool (applied to SELinux, written in C)
- Vali      Tools for static and dynamic analysis of Linux security hooks (C)  
[www.research.ibm.com/vali](http://www.research.ibm.com/vali)
- SawMill multiserver      Linux multiserver on L4 including servers for ext2 file system, TCP networking, and various drivers (C) [www.research.ibm.com/sawmill](http://www.research.ibm.com/sawmill)
- L4 microkernel      Kernel security extensions, including policy server architecture, IPC redirection, and synchronous IPC over redirection (assembler, C)
- Lava Hit Server      Maximum possible Ethernet throughput software stack (C)
- FlexxGuard      Java authorization mechanism and policy model (Java)

## University of Michigan

- UARC      Access control mechanisms and policy models for collaboration (Tcl/Java)
- File Distribution      Download and authenticate files over untrusted network (Tcl/C) -- Bellcore
- BizSpec      Business process reengineering system (LISP/C++)

## EDS

- GMGear      Knowledge-based gear set design tool (LISP)
- Stacker      Knowledge-based configuration of manufacturing equipment (C/OPS83)

# Trent Jaeger

## Publications

### Books, Books Edited, and Book Chapters

1. Trent Jaeger. Reference Monitor. In *Encyclopedia of Cryptography and Security*, H. van Tilborg (Ed.), Springer, to appear.
2. Trent Jaeger. *Operating Systems Security*. Morgan & Claypool Publishers Series: Synthesis Lectures on Information Security, Privacy and Trust, Morgan & Claypool, 2008 (218 pages).
3. Trent Jaeger, editor. *Proceedings of the 2<sup>nd</sup> ACM Computer Security Architectures Workshop*, ACM, October 2008.
4. Trent Jaeger, editor. *Proceedings of the 2<sup>nd</sup> USENIX Workshop on Hot Topics in Security*, USENIX, July 2007.
5. Trent Jaeger and Elena Ferrari, editors. *Proceedings of the 9<sup>th</sup> ACM Symposium on Access Control Models and Technologies*, ACM, June 2004.
6. Sushil Jajodia, Vijayalakshmi Atluri, and Trent Jaeger, editors. *Proceedings of the 10<sup>th</sup> ACM Conference on Computer and Communications Security*, ACM, October 2003.
7. Ravi Sandhu and Trent Jaeger, editors. *Proceedings of the 6<sup>th</sup> ACM Symposium on Access Control Models and Technologies*, ACM, June 2001.
8. Trent Jaeger. Access control in configurable operating systems. In *Secure Internet Programming: Security Issues for Mobile and Distributed Objects*, J. Vitek and C. Jensen (Eds.), Springer. 1999.

### Refereed Journal Publications

1. Joshua Schiffman, Trent Jaeger, Reiner Sailer. Proving comprehensive system integrity with remote attestation. In preparation for submission to the ACM Transactions on Internet Technology.
2. Vinod Ganapathy, Trent Jaeger, Somesh Jha. Mining security-sensitive operations in legacy code using concept analysis. In preparation for submission to IEEE Transactions on Software Engineering.
3. Glenn Wurster, Paul van Oorschot, Trent Jaeger. Protecting commodity kernels from execution of unauthorized code. In preparation for submission to Computers and Security.
4. Thomas Moyer, Kevin Butler, Joshua Schiffman, Patrick McDaniel, Trent Jaeger. Scalable web content attestation. Accepted for publication to *IEEE Transactions on Computers* in January 2011.
5. Joshua Schiffman, Trent Jaeger, Patrick McDaniel. Network-based root of trust for installation. *IEEE Security & Privacy*, special issue on Systems Security for January/February 2011.
6. Patrick Traynor, Vikhyath Rao, Trent Jaeger, Thomas La Porta, Patrick McDaniel. From mobile phones to responsible devices. *Security and Communication Networks*, online 2010 (to appear in proceedings).
7. Divya Muthukumaran, Joshua Schiffman, Mohamed Hassan, Anuj Sawani, Vikhyath Rao, Trent Jaeger. Protecting the integrity of trusted applications on mobile phone systems, *Security and Communication Networks*, online May 2010 (to appear in proceedings).
8. Boniface Hicks, Sandra Rueda, Luke St. Clair, Trent Jaeger, and Patrick McDaniel. A logical specification and analysis for SELinux MLS policy. *ACM TISSEC 13(3)*, July 2010.
9. Trent Jaeger and Joshua Schiffman. Outlook: Cloudy with a chance of security challenges and improvements. *IEEE Security & Privacy*, January/February 2010.
10. Trent Jaeger, Antony Edwards, Xiaolan Zhang. Consistency analysis of authorization hook placement in the Linux Security Modules framework. *ACM TISSEC 7(2)*, May 2004.
11. Trent Jaeger, Antony Edwards, Xiaolan Zhang. Policy management using access control spaces. *ACM TISSEC 6(3)*, August 2003.
12. Trent Jaeger and Jonathon Tidswell. Practical safety in flexible access control models. *ACM TISSEC 4(3)*, August 2001.
13. Trent Jaeger, Atul Prakash, Jochen Liedtke, Nayeem Islam. Flexible control of downloaded executable content. *ACM TISSEC 2(2)*, May 1999.

# Trent Jaeger

14. Nayeem Islam, Rangachari Anand, Trent Jaeger, Josyula R. Rao. A flexible security system for using Internet content. *IEEE Software* 14(5), September/October 1997.

## Refereed Conference and Workshop Publications

1. Joshua Schiffman, Thomas Moyer, Hayawardh Vijayakumar, Trent Jaeger, Patrick McDaniel. Seeding clouds with trust anchors. In *Proceedings of the ACM Cloud Computing Security Workshop (CCSW 2010)*, October 2010.
2. Divya Muthukumar, Sandra Rueda, Hayawardh Vijayakumar, Trent Jaeger. Cut me some security! In *Proceedings of the 3<sup>rd</sup> ACM Workshop on Configurable and Usable Security (SafeConfig 2010)*, October 2010.
3. Boniface Hicks, Sandra Rueda, David H. King, Thomas Moyer, Joshua Schiffman, Yogesh Sreenivasan, Patrick McDaniel, Trent Jaeger. An architecture for enforcing end-to-end access control over web applications. In *Proceedings of the 15th Symposium on Access Control Models and Technologies (SACMAT)*, June 2010. (acceptance rate: 25%)
4. David H. King, Susmit Jha, Divya Muthukumar, Trent Jaeger, Somesh Jha, Sanjit A. Seshia. Automating security mediation placement. In *Proceedings of the 19<sup>th</sup> European Symposium on Programming (ESOP)*, March 2010. (acceptance rate 25%)
5. Joshua Schiffman, Thomas Moyer, Christopher Shal, Trent Jaeger, Patrick McDaniel. Justifying integrity using a Virtual Machine Verifier. In *Proceedings of the 25<sup>th</sup> Annual Computer Security Applications Conference (ACSAC)*, December 2009. (acceptance rate 19%)
6. Thomas Moyer, Kevin Butler, Joshua Schiffman, Patrick McDaniel, Trent Jaeger. Scalable asynchronous web content attestation. In *Proceedings of the 25<sup>th</sup> Annual Computer Security Applications Conference (ACSAC)*, December 2009. (acceptance rate 19%)
7. Patrick Traynor, Michael Lin, Machigar Ongtang, Vikhyath Rao, Trent Jaeger, Thomas La Porta, Patrick McDaniel. On cellular botnets: Measuring the impact of malicious devices on the cellular network core. In *Proceedings of the 16<sup>th</sup> ACM Conference on Compute and Communications Security (ACM CCS)*, November 2009. (acceptance rate: 18%)
8. Liang Xie, Xinwen Zhang, Ashwin Chaugule, Trent Jaeger, and Sencun Zhu. Designing system-level defenses against cellphone malware (short paper). In *Proceedings of the 28<sup>th</sup> International Symposium on Reliable Distributed Systems (SRDS)*, September 2009.
9. Sandra Rueda, Hayawardh Vijayakumar, and Trent Jaeger. Analysis of virtual machine system policies. In *Proceedings of the 14th Symposium on Access Control Models and Technologies (SACMAT)*, June 2009. (acceptance rate: 31%)
10. Vikhyath Rao and Trent Jaeger. Dynamic access control for multiple stakeholders. In *Proceedings of the 14th Symposium on Access Control Models and Technologies (SACMAT)*, June 2009. (acceptance rate: 31%)
11. David H. King, Boniface Hicks, Michael Hicks, and Trent Jaeger. Implicit Flows: Can't live with 'em, can't live without 'em. In *Proceedings of the Fourth International Conference on Information Systems Security (ICISS)*, December 2008.
12. William Enck, Patrick McDaniel, and Trent Jaeger. PinUP: Pinning user files to known applications. In *Proceedings of the 24<sup>th</sup> Annual Computer Security Applications Conference (ACSAC)*, December 2008. (acceptance rate: 24%)
13. Albert Tannous, Jonathan Trostle, Mohamed Hassan, Stephen E. McLaughlin, and Trent Jaeger. New side channel attacks targeting passwords. In *Proceedings of the 24<sup>th</sup> Annual Computer Security Applications Conference (ACSAC)*, December 2008. (acceptance rate: 24%)
14. David H. King, Trent Jaeger, Somesh Jha, and Sanjit Seshia. Effective blame for information-flow violations. In *Proceedings of the Sixteenth ACM SIGSOFT International Symposium on Foundations of Software Engineering (FSE)*, November 2008. (acceptance rate: 20%)
15. Sandra Rueda, Yogesh Sreenivasan, and Trent Jaeger. Flexible security configuration for virtual machines. In *Proceedings of the 2<sup>nd</sup> Computer Security Architecture Workshop (CSAW)*, October 2008.

# Trent Jaeger

16. Sandra Rueda, David H. King, and Trent Jaeger. Verifying compliance of trusted programs. In *Proceedings of the 17<sup>th</sup> USENIX Security Symposium*, August 2008. (acceptance rate: 16%).
17. Divya Muthukumaran, Anuj Sawani, Joshua Schiffman, Brian M. Jung, and Trent Jaeger. Measuring integrity on mobile phone systems. In *Proceedings of the 13th Symposium on Access Control Models and Technologies (SACMAT)*, June 2008. (acceptance rate: 22%)
18. Luke St. Clair, Joshua Schiffman, Trent Jaeger, and Patrick McDaniel. Establishing and sustaining system integrity via root of trust installation. In *Proceedings of the 23rd Annual Computer Security Applications Conference (ACSAC)*, December 2007. (acceptance rate: 23%)
19. William Enck, Sandra Rueda, Yogesh Sreenivasan, Joshua Schiffman, Luke St. Clair, Trent Jaeger and Patrick McDaniel. Protecting users from “themselves.” In *Proceedings of the First Computer Security Architectures Workshop (CSAW)*, November 2007. (acceptance rate: 30%)
20. Boniface Hicks, Sandra Rueda, Trent Jaeger, Patrick McDaniel. From trusted to secure: Building and executing applications that enforce system security. In *Proceedings of the 2007 USENIX Annual Technical Conference*, June 2007. (acceptance rate: 19%)
21. Boniface Hicks, Sandra Rueda, Luke St. Clair, Trent Jaeger, Patrick McDaniel. A logical specification and analysis for SELinux MLS. In *Proceedings of the 12<sup>th</sup> ACM Symposium on Access Control Models and Technologies (SACMAT)*, invited for ACM TISSEC publication. June 2007. (acceptance rate: 35%)
22. Trent Jaeger, Reiner Sailer, Yogesh Sreenivasan. Managing the risk of covert information flows in virtual machine systems. In *Proceedings of the 12<sup>th</sup> ACM Symposium on Access Control Models and Technologies (SACMAT)*. June 2007. (acceptance rate: 35%)
23. Vinod Ganapathy, David H. King, Trent Jaeger, Somesh Jha. Mining security-sensitive operations in legacy code using concept analysis. In *Proceedings of the 2007 IEEE International Conference on Software Engineering (ICSE)*, May 2007. (acceptance rate: 15%)
24. Boniface Hicks, Sandra Rueda, Trent Jaeger, Patrick McDaniel. Integration of SELinux and security-typed languages. In *Proceedings of the 2007 Security-Enhanced Linux Workshop*, March 2007.
25. Jonathon McCune, Stefan Berger, Ramon Caceres, Trent Jaeger, Reiner Sailer. Shamon: A system for distributed mandatory access control. In *Proceedings of the 2006 Annual Computer Security Applications Conference (ACSAC)*, December 2006. (acceptance rate: 30.3%)
26. Luke St. Clair, Lisa Johansen, William Enck, Matthew Pirretti, Patrick Traynor, Patrick McDaniel, Trent Jaeger. Password Exhaustion: Predicting the end of password usefulness. *Proceedings of the 2nd International Conference on Information Systems Security (ICISS)*, December 2006.
27. Trent Jaeger, Kevin Butler, David H. King, Serge Hallyn, Joy Latten, Xiaolan Zhang. Leveraging IPsec for mandatory access control across systems. In *Proceedings of the Second International Conference on Security and Privacy in Communication Networks (SecureComm)*, August 2006. *To appear*. (acceptance rate: 25.4%)
28. Trent Jaeger, Patrick McDaniel, Luke St. Clair, Ramon Caceres, Reiner Sailer. Shame on trust in distributed systems. In *Proceedings of the 2006 Workshop on Hot Topics in Security (HotSec)*, August 2006. (acceptance rate: 19.6%)
29. Xiaolan Zhang, Larry Koved, Marco Pistoia, Sam Weber, Trent Jaeger, Guillaume Marceau. The case for analysis preserving language transformation. In *Proceedings of the 2006 International Symposium on Software Testing and Analysis (ISTSA)*, July 2006. (acceptance rate: 26%)
30. Trent Jaeger, Reiner Sailer, Umesh Shankar. PRIMA: Policy-reduced integrity measurement architecture. In *Proceedings of the 11<sup>th</sup> Symposium on Access Control Models and Technologies (SACMAT)*, June 2006. (acceptance rate: 29%)
31. Vinod Ganapathy, Trent Jaeger, Somesh Jha. Retrofitting legacy code for authorization policy enforcement. In *Proceedings of the 2006 IEEE Symposium on Security and Privacy (IEEE S&P)*, May 2006. (acceptance rate: 12.7%)
32. Vinod Ganapathy, Trent Jaeger, Somesh Jha. Towards automated authorization policy enforcement. In *Proceedings of the 2nd SELinux Symposium*, March 2006.
33. Trent Jaeger. SELinux protected paths revisited. In *Proceedings of the 2nd SELinux Symposium*, March 2006.

# Trent Jaeger

34. Umesh Shankar, Trent Jaeger, Reiner Sailer. Towards automated information-flow integrity verification for security-critical applications. In *Proceedings of the 2006 Annual Network and Distributed Systems Symposium (NDSS)*, February 2006. (acceptance rate: 13.4%)
35. Reiner Sailer, Enriquillo Valdez, Trent Jaeger, Ronald Perez, Leendert van Doorn, John L. Griffin, Stefan Berger. Building a MAC-based security architecture for the Xen opensource hypervisor. In *Proceedings of the 2005 Annual Computer Security Applications Conference (ACSAC)*, December 2005. (acceptance rate: 22.8%)
36. Vinod Ganapathy, Trent Jaeger, Somesh Jha. Automatic placement of authorization hooks in the Linux Security Modules framework. In *Proceedings of the 12<sup>th</sup> ACM Conference on Compute and Communications Security (ACM CCS)*, October 2005. (acceptance rate: 15.2%)
37. John L. Griffin, Trent Jaeger, Ronald Perez, Reiner Sailer, Leendert van Doorn, Ramon Caceres. Trusted Virtual Domains: Towards secure, virtual services. In *Proceedings of the First Workshop on Hot Topics in Systems Dependability (HotDep)*, May 2005.
38. Reiner Sailer, Trent Jaeger, Xiaolan Zhang, Leendert van Doorn. Attestation-based policy enforcement for remote access. In *Proceedings of the 11<sup>th</sup> ACM Conference on Compute and Communications Security (ACM CCS)*, October 2004. (acceptance rate: 13.9%)
39. Xiaolan Zhang, Trent Jaeger, Larry Koved. Applying static analysis to verifying security properties. In *Proceedings of the 2004 Grace Hopper Conference*, October 2004.
40. Reiner Sailer, Xiaolan Zhang, Trent Jaeger, Leendert van Doorn. Design and implementation of a TCG-based integrity measurement architecture. In *Proceedings of the 13th USENIX Security Symposium*, August 2004. (acceptance rate: 12.0%)
41. Trent Jaeger, Reiner Sailer, Xiaolan Zhang. Resolving constraint conflicts. In *Proceedings of the 9<sup>th</sup> Symposium on Access Control Models and Technologies (SACMAT)*, June 2004. (acceptance rate: 28%)
42. Trent Jaeger, Reiner Sailer, Xiaolan Zhang. Analyzing integrity protection in the SELinux example policy. In *Proceedings of the 12th USENIX Security Symposium*, August 2003. (acceptance rate: 16.4%)
43. Antony Edwards, Trent Jaeger, Xiaolan Zhang. Runtime verification of the Linux Security Modules framework. In *Proceedings of the 9th ACM Conference on Computer and Communications Security (ACM CCS)*, invited for ACM TISSEC publication, November 2002. (acceptance rate: 17.6%)
44. Trent Jaeger, Antony Edwards, Xiaolan Zhang. Gaining and maintaining confidence in operating systems security. In *Proceedings of the ACM SIGOPS European Workshop*, September 2002.
45. Xiaolan Zhang, Leendert van Doorn, Trent Jaeger, Ron Perez, Reiner Sailer. Secure coprocessor-based intrusion detection. In *Proceedings of the ACM SIGOPS European Workshop*, September 2002.
46. Xiaolan Zhang, Antony Edwards, Trent Jaeger. Using CQUAL for static analysis of authorization hook placement. In *Proceedings of the 11th USENIX Security Symposium*, August 2002. (acceptance rate: 16.9%)
47. Trent Jaeger, Antony Edwards, Xiaolan Zhang. Managing access control policies using access control spaces. In *Proceedings of the 7th Symposium on Access Control Models and Technologies (SACMAT)*, invited for ACM TISSEC special issue, June 2002.
48. Trent Jaeger. Managing access control complexity using metrics. In *Proceedings of the 6th ACM Symposium on Access Control Models and Technologies (SACMAT)*, May 2001.
49. Mohit Aron, Yoonho Park, Trent Jaeger, Kevin Elphinstone, Jochen Liedtke, Luke Deller. The SawMill framework for virtual memory diversity. In *Proceedings of the 2001 Australian Computer Science Conference*, January 2001.
50. Jonathon Tidswell and Trent Jaeger. An access control model for simplifying constraint expression. In *Proceedings of the 7th ACM Conference on Computer and Communication Security Technologies (ACM CCS)*, invited for ACM TISSEC special issue, November 2000. (acceptance rate: 21.2%)
51. Alain Gefflaut, Trent Jaeger, Yoonho Park, Jochen Liedtke, Kevin Elphinstone, Volkmar Uhlig, Jonathon Tidswell, Luke Deller, Lars Reuther. The SawMill multiserver approach. In *Proceedings of the 8th ACM SIGOPS European Workshop*, September 2000.
52. Trent Jaeger, Jonathon Tidswell, Alain Gefflaut, Yoonho Park, Jochen Liedtke, Kevin Elphinstone. Synchronous IPC over transparent monitors. In *Proceedings of the 8th ACM SIGOPS European Workshop*, September 2000.

# Trent Jaeger

53. Jonathon Tidswell and Trent Jaeger. Integrated constraints and inheritance in DTAC. In *Proceedings of the 5th ACM Workshop on Role-based Access Control*, July 2000.
54. Trent Jaeger. On the increasing importance of constraints. In *Proceedings of the 4th ACM Workshop on Role-based Access Control*, November 1999.
55. Trent Jaeger, Tony Michailidis, Roy Rada. Access control in a virtual university. In *Proceedings of the 8th IEEE International Workshop on Enabling Technologies*, June 1999.
56. Jochen Liedtke, Volkmar Uhlig, Kevin Elphinstone, Trent Jaeger, Yoonho Park. How to schedule unlimited memory pinning of untrusted processes or provisional ideas about service-neutrality. In *Proceedings of the 6th Workshop on Hot Topics in Operating Systems (HotOS)*, March 1999.
57. Trent Jaeger, Kevin Elphinstone, Jochen Liedtke, Vsevolod Panteleenko, Yoonho Park. Flexible access control using IPC redirection. In *Proceedings of the 6th Workshop on Hot Topics in Operating Systems (HotOS)*, March 1999.
58. Trent Jaeger, Jochen Liedtke, Vsevolod Panteleenko, Yoonho Park, Nayeem Islam. Security architecture for component-based operating systems. In *Proceedings of the 7th ACM SIGOPS European Workshop*, September 1998.
59. Jochen Liedtke, Nayeem Islam, Trent Jaeger, Vsevolod Panteleenko, Yoonho Park. An unconventional proposal: Using the x86 architecture as the ubiquitous virtual standard architecture. In *Proceedings of the 7th ACM SIGOPS European Workshop*, September 1998.
60. Jochen Liedtke, Nayeem Islam, Trent Jaeger, Vsevolod Panteleenko, Yoonho Park. Irreproducible benchmarks might be sometimes helpful. In *Proceedings of the 7th ACM SIGOPS European Workshop*, September 1998.
61. Jochen Liedtke, Vsevolod Panteleenko, Trent Jaeger, Nayeem Islam. High-performance caching with the Lava hit-server. In *Proceedings of the 1998 USENIX Annual Technical Conference*, June 1998.
62. Trent Jaeger, Jochen Liedtke, Nayeem Islam. Fine-grained protection in operating systems. In *Proceedings of the 6th USENIX Security Symposium*, January 1998.
63. Trent Jaeger, Frederique Giraud, Nayeem Islam, Jochen Liedtke. A role-based access control model for protection domain derivation and management. In *Proceedings of the 2nd ACM Workshop on Role-based Access Control*, November 1997.
64. Rangachari Anand, Nayeem Islam, Trent Jaeger, Josyula R. Rao. A flexible security model for using Internet content. In *Proceedings of the 1997 Symposium on Reliable Distributed Systems (SRDS)*, September 1997.
65. Jochen Liedtke, Kevin Elphinstone, Sebastian Schönberg, Hermann Härtig, Gernot Heiser, Nayeem Islam, Trent Jaeger. Achieved IPC performance. In *Proceedings of the IEEE Workshop on Hot Topics in Operating Systems (HotOS)*, May 1997.
66. Jochen Liedtke, Nayeem Islam, Trent Jaeger. Preventing denial of service attacks on a  $\mu$ -kernel for WebOSes. In *Proceedings of the IEEE Workshop on Hot Topics in Operating Systems (HotOS)*, May 1997.
67. Jang Ho Lee, Atul Prakash, Trent Jaeger, Gwobaw Wu. Supporting multi-user, multi-applet workspaces in CBE. In *Proceedings of ACM Computer Supported Cooperative Work '96 Conference (CSCW)*, November 1996.
68. Trent Jaeger, Atul Prakash, Avi Rubin. A system architecture for flexible control of downloaded executable content. In *Proceedings of the IEEE International Workshop on Object-oriented Operating Systems*, October 1996.
69. Trent Jaeger, Avi Rubin, Atul Prakash. Building systems that flexibly control downloaded executable content. In *Proceedings of the 6th USENIX Security Symposium*, July 1996 (awarded "Best Student Paper").
70. Trent Jaeger and Avi Rubin. Preserving integrity in remote file location and retrieval. In *Proceedings of the Internet Society 1996 Symposium on Network and Distributed System Security*, February 1996.
71. Trent Jaeger and Atul Prakash. Requirements of Role-based Access Control for Collaborative Systems. In *Proceedings of the 1st ACM Workshop on Role-based Access Control*, November 1995.
72. Trent Jaeger and Atul Prakash. Management and Utilization of Knowledge for the Automatic Improvement of Workflow Performance. In *Proceedings of the 1995 Conference on Organizational Computing Systems*, August 1995.

# Trent Jaeger

73. Trent Jaeger and Atul Prakash. Implementation of a Discretionary Access Control Model for Script-based Systems. In *Proceedings of the 8th IEEE Computer Security Foundations Workshop (CSFW)*, June 1995.
74. Trent Jaeger and Atul Prakash. Representation and Adaptation of Organization Coordination Knowledge for Autonomous Agent Systems. In *Proceedings of the 9th Int'l Conference on Software Engineering and Knowledge Engineering*, June 1995.
75. Trent Jaeger and Atul Prakash. Support for the File System Security Requirements for Computational E-Mail Systems. In *Proceedings of the 2nd ACM Conference on Computer and Communications Security (CCS)*, November 1994.
76. Trent Jaeger, Atul Prakash, Masayoki Ishikawa. A Framework for the Automatic Improvement of Workflows to Meet Performance Goals. In *Proceedings of the 6th IEEE Conference on Tools with Artificial Intelligence*, November 1994.
77. Trent Jaeger and Atul Prakash. BizSpec: A Business-oriented Model for Specification and Analysis of Office Information Systems. In *Proceedings of the 7th Int'l Conference on Software Engineering and Knowledge Engineering*, June 1993.
78. Trent Jaeger. Using AI Paradigms in Solving Manufacturing Problems as Demonstrated by the CPC Stacking/Destacking Advisor. In *Proceedings of the 3rd Int'l Conference on CAD/CAM, Robotics, and Factories of the Future*, Volume 2, August 1988.

## Other Publications

1. Trent Jaeger, David Safford, and Hubertus Franke, Linux security for the enterprise: Executive Summary. Web publication at [http://download.boulder.ibm.com/ibmdl/pub/software/dw/library/os-ltc-security/les\\_summary.pdf](http://download.boulder.ibm.com/ibmdl/pub/software/dw/library/os-ltc-security/les_summary.pdf), 2002.
2. Trent Jaeger, Antony Edwards, Xiaolan Zhang. Maintaining the correctness of the Linux Security Modules framework. In *Proceedings of the 2002 Ottawa Linux Symposium*, June 2002.
3. Elisa Bertino, Trent Jaeger, Jonathan D. Moffett, Sylvia Osborn, Ravi Sandhu. Making access control more usable. In *Proceedings of the 7th Symposium on Access Control Models and Technologies* (panel statement), June 2002.
4. Trent Jaeger and Jonathon Tidswell. Rebuttal to the NIST RBAC model proposal. In *Proceedings of the 5th ACM Workshop on Role-based Access Control*, July 2000.
5. Trent Jaeger and Atul Prakash. Using simulation and performance improvement knowledge for redesigning business processes. *University of Michigan Tech Report, CSE-TR-278-96*, January 1996.
6. Trent Jaeger and Aviel Rubin. Protocols for authenticated download to mobile information appliances. *University of Michigan Tech Report, CSE-TR-275-95*, December 1995.
7. Trent Jaeger and Aviel Rubin. An API for secure document download and distribution. *Bellcore Technical Memorandum, TM-25393*, December 1995.

# Trent Jaeger

## Recent External Presentations

- Tackling System-Wide Integrity, *Purdue University*, West Lafayette, IN, November 2010.
- High Integrity Computing for Embedded Systems, *Trusted Computing for Embedded Systems, Carnegie-Mellon University*, Pittsburgh, PA, November 2010.
- Cloud Security: Challenges and Opportunities, *USENIX HotCloud Workshop*, Panel Session, Boston, MA, June 2010.
- Virtualization Security, Invited Lecture, *Trusted Infrastructure Workshop, Carnegie-Mellon University*, Pittsburgh, PA, June 2010.
- Designing Systems To Manage Attack Surfaces, *Georgia Institute of Technology*, Atlanta, GA and *Carleton University*, Ottawa, ON, CA, April 2010.
- Building Systems to Enforce Measurable Security Goals, *University of Michigan*, Ann Arbor, MI, and *Telcordia Technologies*, Piscataway, NJ, October 2009.
- Analysis of Virtual Machine Policies, *SELinux Summit*, Portland, OR, September 2009.
- Building Systems to Enforce Measurable Security Goals, *Microsoft Research*, Redmond, WA, and *Galois, Inc.*, Portland, OR, September 2009.
- Towards Automatic Retrofitting of Programs for Security, *IBM Research*, Hawthorne, NY, August 2009.
- A Case for Integrity-Verified Channels, Invited talk for the *Trusted Infrastructure Workshop (at CMU)*, Pittsburgh, PA, June 2009.
- Building Integrity Verified Channels, Invited talk for *ICT-FORWARD Workshop*. Beaulieu sur Mar, France, May 2009.
- Building Systems to Enforce Measurable Security Goals, Invited talk for the *Zurich Information Security Center (ZISC) Workshop on Advanced Concepts in Access and Usage Control*, Zurich, Switzerland, September 2008.
- Verifying Compliance for Trusted Programs, *IBM Research*, Hawthorne, NY, June 2008.
- Building High-Integrity Phone Systems, *Samsung Digital Corporation*, Suwon, South Korea, June 2008.
- Verifying Compliance for Trusted Programs, *Cornell University*, Ithaca, NY, April 2008.
- Building High-Integrity Phone Systems, *NSF Wireless Security Workshop*, Atlanta, GA, April 2008.
- Building High-Integrity Phone Systems, *Penn State ACM Chapter*, University Park, PA, March 2008.
- Building Shared Reference Monitors, *Johns Hopkins University*, Baltimore, MD, October 2007.
- A Logical Specification and Analysis for SELinux MLS and Managing the Risk of Covert Information Flows in Virtual Machine Systems, *12<sup>th</sup> ACM Symposium on Access Control Models and Technologies*. Sophia Antipolis, France, June 2007.
- Building Shared Reference Monitors, *Dartmouth College*, Hanover, NH, April 2007.
- Cell Phone System Integrity, *Penn State Applied Research Lab*, University Park, PA, April 2007.
- From Trusted to Secure, *Georgia Institute of Technology*, Atlanta, GA, January 2007.
- Leveraging IPsec for Mandatory Access Control across Systems, *Second International Conference on Security and Privacy in Communication Networks*, Baltimore, MD, August 2006.
- Shame on Trust in Distributed Systems, *2006 Workshop on Hot Topics in Security*, Vancouver, BC, Canada, August 2006.
- Towards a Shared Reference Monitor System, *Air Force Research Lab*, Rome, NY, July 2006.
- PRIMA: Policy-reduced Integrity Measurement Architecture, *11<sup>th</sup> Symposium on Access Control Models and Technologies*, Lake Tahoe, CA, June 2006.
- SELinux Protected Paths Revisited, *2<sup>nd</sup> SELinux Symposium*, Baltimore, MD, March 2006.
- Computer Security Heresies Revisited, *University of Wisconsin, Madison*, Madison, WI, January 2006.
- Leveraging IPsec for Network Access Control in Linux, *2005 Annual Computer Security Applications Conference*, Tucson, AZ, December 2005.
- Leveraging IPsec for Network Access Control in Linux, *2005 SELinux Symposium*, Silver Spring, MD, March 2005.

# Trent Jaeger

## Professional Service

- **Associate Editor**, ACM Transactions on Internet Technology, 2007-present
- **Guest Editor**, ACM Transactions on Information Systems Security, November 2002
- **Program Chair**, Second Computer Security Architectures Workshop, 2008
- **Program Chair**, USENIX Workshop on Hot Topics in Security, 2007
- **Program Vice Chair**, Reliable Software Systems track, IEEE International Conference on Sensor Networks, Ubiquitous and Trustworthy Computing, 2008
- **Program Chair**, ACM Conference on Computer and Communications Security, Industry Track, 2003
- **Program Chair**, ACM Symposium on Access Control Models and Technologies, 2001
- **Program Chair**, ACM Workshop on Role-based Access Control, 1998
- **General Chair**, ACM Symposium on Access Control Models and Technologies, 2004
- **Organizing Committee**, First Computer Security Architecture Workshop, 2007
- **Steering Committee**, ACM Symposium on Access Control Models and Technologies, 2001-2007
- **Panels Chair**, ACM Symposium on Access Control Models and Technologies, 2002-2003
- **Member**, EuroSys Conference, 2011
- **Member**, USENIX Security Symposium, 1999-2001, 2005-2006, 2008-2009 (official reader in 1998)
- **Member**, IEEE Symposium on Security and Privacy, 2003-2004, 2007-2008, 2011
- **Member**, ACM Conference on Computer and Communication Security, Research Track: 2000-2003, 2006, 2009-2010; Industry Track: 2004-2005
- **Member**, ISOC Network and Distributed System Security Symposium, 2007
- **Member**, European Symposium on Research in Computer Security, 2002-2003
- **Member**, Annual Computer Security Applications Conference, 2005, 2010-2011
- **Member**, ACM Symposium on Access Control Models and Technologies, 2002-2010
- **Member**, International Conference on Distributed Computing Systems (Security and Privacy), 2008
- **Member**, International World Wide Web Conference, Security and Privacy Track, 2003-2005
- **Member**, International Conference on Information System Security, 2009
- **Member**, USENIX Workshop on Hot Topics in Security, 2010
- **Member**, Information Security Conference, 2007
- **Member**, SELinux Symposium, 2005-2007
- **Member**, Program Analysis for Security and Safety Workshop, 2006
- **Member**, Workshop on Trusted Collaboration, 2006 (in association with CollaborateCom)
- **Member**, ACM Workshop on Role-based Access Control, 1997-2000
- **Member**, Distributed Object Security Workshop, 1999 (in association with OOSPLA)
- **Member**, European Workshop on Distributed Object Security, 1998 (in association with ECOOP)
- **External reviewer** for journals: ACM Transactions on Information Systems Security, ACM Transactions on Computer Systems, Journal of Computer Security, IBM Systems Journal, IEEE Transactions on Parallel and Distributed Systems, IEEE Transactions on Knowledge and Data Engineering, Journal of Digital Libraries, International Journal of Information and Computer Security
- **External reviewer** for conferences: USENIX Symposium on Operating System Design and Implementation, ACM Symposium on Operating Systems Principles, IEEE Hot Topics in Operating Systems, USENIX Annual Technical Conference, IEEE Workshop on Policies for Distributed Systems and Networks, ACM Computer-Supported Collaborative Work, Principles of Distributed Computing. IEEE Infocom, International Conference on Distributed Systems and Networks
- **Member of Advisory Board** for SecurUsTek Corporation

# Trent Jaeger

## Patents

### IBM Research

- Pau-Chen Cheng et al, "System and Method for *Fuzzy MLS Model*", US Patent Number 7,530,110 (May 5, 2009).
- Trent Jaeger, Lawrence Koved, Liangzhao Zeng, Xiaolan Zhang, "Methods and Arrangements for *Unified Program Analysis*," US Patent Number 7,493,602 (February 17, 2009)
- Pau-Chen Cheng et al, "System and *Method for Security Planning with Soft Security Constraints*", filed January 2007.
- Stefan Berger, Trent Jaeger, Ronald Perez, Reiner Sailer, Enriqueillo Valdez, "Method and Apparatus to *Protect Policy State Information During the Life-Time of Virtual Machines*," filed March 2006.
- Kay Anderson et al, "Method of *Managing and Mitigating Security Risks Through Planning*", filed January 2006.
- Stefan Berger, Kenneth Goldman, Trent Jaeger, Ronald Perez, Reiner Sailer, Enriqueillo Valdez, "Method, System, and Program Product for *Remotely Attesting to a State of Computer System*," filed November 2005.
- Trent Jaeger, Reiner Sailer, Leendert van Doorn, "Method, system and program product for *remotely verifying integrity of a system*", filed in November 2005.
- Trent Jaeger, John Earnshaw Tidswell. "Mechanism for *Synchronous Interprocess Communication over Transparent External Monitors*," US Patent Number 6,862,734 (March 1, 2005).
- Kevin Elphinstone, Trent Jaeger. "Flexible *Interprocess Communication via Redirection*," US Patent Number 6,748,452 (June 8, 2004).
- Nayeem Islam, Trent Jaeger, Jochen Liedtke, Vsevelod Pantelenko. "Powerful and Flexible *Server Architecture*," US Patent Number 6,490,625 (December 2, 2002).
- Rangachari Anand, Frederique Giraud, Nayeem Islam, Trent Jaeger, Jochen Liedtke. "Flexible and *Dynamic Derivation of Permissions*," US Patent Number 6,044,466 (March 28, 2000).
- Nayeem Islam, Trent Jaeger, Jochen Liedtke, Vsevelod Pantelenko. "Flexible *Cache-Coherency Mechanism*," US Patent Number 6,032,228 (February 29, 2000).

### General Motors

- Kent Kienzle, Mark Jeffery, Trent Jaeger, Karon Barber, "Expert System for *Automatically Generating Gear Designs*," US Patent Number 5,297,054 (March 22, 1994).

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## Teaching Experience

### The Pennsylvania State University, University Park, PA

*Associate Professor*

Fall 2005	CSE 598A – Systems Security
Spring 2006	CSE 497C – Intro to Computer and Network Security
Fall 2006	CSE 543 – Computer Security: <a href="http://www.cse.psu.edu/~tjaeger/cse543-f06/">www.cse.psu.edu/~tjaeger/cse543-f06/</a>
Spring 2007	CSE 497B – Intro to Computer and Network Security: <a href="http://www.cse.psu.edu/~tjaeger/cse497b-s07/">www.cse.psu.edu/~tjaeger/cse497b-s07/</a>
Fall 2007	CSE 543 – Computer Security: <a href="http://www.cse.psu.edu/~tjaeger/cse543-f07/">www.cse.psu.edu/~tjaeger/cse543-f07/</a>
Spring 2008	CMPSC 473 – Operating Systems: <a href="http://www.cse.psu.edu/~tjaeger/cse473-s08/">www.cse.psu.edu/~tjaeger/cse473-s08</a>
Fall 2008	CSE 597A – Topics in Prog and Systems Security: <a href="http://www.cse.psu.edu/~tjaeger/cse597-f08/">www.cse.psu.edu/~tjaeger/cse597-f08</a>
Spring 2009	CMPSC 473 -- Operating Systems: <a href="http://www.cse.psu.edu/~tjaeger/cse473-s09/">www.cse.psu.edu/~tjaeger/cse473-s09</a>
Spring 2010	CSE 544 – Advanced Systems Security: <a href="http://www.cse.psu.edu/~tjaeger/cse544-s10/">www.cse.psu.edu/~tjaeger/cse544-s10</a>

# Trent Jaeger

## Professional Affiliations

- Member of USENIX, IEEE, ACM SIGOPS and SIGSAC

## University Service

### Advisees

- Sandra Rueda Rodriguez, CSE Ph.D. program, expected graduation Fall 2010 (comp Sept 2009)
- Joshua Schiffman, CSE Ph.D. program, expected graduation Spring 2012
- Divya Muthukumar, CSE Ph.D., expected graduation Spring 2012
- Hayawardh Vijayakumar, CSE Ph.D., expected graduation Spring 2013

### Ph.D. Advisor for

- David H. King, Ph.D., CSE, August 2009 (co-advised with John Hannan)

### Graduates Advised

- Craig Suchanec, B.S., CMPSC, Schreyer Honors College, Fall 2006
- Curtis Walker, M.S.E. CSE, Defended Summer 2007 (co-advised with Padma Raghavan, CSE)
- Vikhyath Rao, M.S., EE, Fall 2007 (co-advised with Ken Jenkins, EE)
- Albert Tannous, M.S., CSE, Spring 2008
- Chandrika Gopalakrishna, M.S., CSE, Spring 2008 (co-advised with Jim Jansen, IST)
- Radhesh Kamath, M.S., CSE, Summer 2008
- Yogesh Sreenivasan, M.S., CSE, Summer 2008
- Mohamed Hassan, M.S., CSE, Summer 2008
- Anuj Sawani, M.S., EE, Summer 2008 (co-advised with George Kesidis, EE)
- Luke St. Clair, M.S., CSE, Summer 2008 (co-advised with Patrick McDaniel, CSE)
- Dhivarkar Mani, M.S., CSE, Spring 2009
- Christopher Shal, B.S. and M.S., CMPSC and CSE, Spring 2009
- Vikhyath Rao, M.S., CSE, Fall 2009
- Guruprasad Jakka, M.S., CSE, Summer 2010

### Ph.D. Thesis Committee Member for (all Computer Science and related)

- Patrick McDaniel, University of Michigan, Ann Arbor. Completed in 2001.
- Paolo Perlasca, University of Milan. Completed in 2004.
- Vinod Ganapathy, University of Wisconsin, Madison. Completed in 2007.
- Boniface Hicks, Pennsylvania State University. Completed in 2007.
- Kameswari Kotapati, Pennsylvania State University. Completed in 2007.
- Patrick Traynor, Pennsylvania State University. Completed in 2008.
- Hung-Yuan Hsu, Pennsylvania State University. Completed in 2008.
- Yan Sun, Pennsylvania State University. Completed in 2009.
- Glenn Wurster, Carleton University. Completed in 2010.
- Christian Payne, Murdoch University. Completed in 2010.
- Yi Yang, Pennsylvania State University. Current.
- Kevin Butler, Pennsylvania State University. Current.
- William Enck, Pennsylvania State University. Current.
- Machigar Ongtang, Pennsylvania State University. Current.

# Trent Jaeger

## Committees

Penn State, College of Engineering service

- Undergraduate Advising, College of Engineering, Fall 2006
- Sabbatical Leave Committee, 2007-2008, 2008-2009
- College of Engineering Representative to the Graduate Studies and Research Committee, 2009-2010

Penn State, Computer Science and Engineering Department committees

- Lab Space, 2005-2010
- Security, 2006-2010
- Graduate Admissions, 2006-2008, 2010
- Faculty Recruiting, 2007-2009
- Chair, Faculty Recruiting, 2008-2009
- Promotion and Tenure, 2008-2009, 2009-2010, 2010-2011