

Patrick Tague

Curriculum Vitae

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Research Interests

Patrick directs the Mobile, Embedded, & Wireless Security (MEWS) research group at Carnegie Mellon University. The MEWS group focuses on various aspects of security and privacy in wireless communications, networking, computing, control, and data management. Topics of interest include designing reliable networking protocols for intelligent mobile devices and cyber-physical systems; secure computing and data management in sensing systems and the Internet of Things; robust wireless communication protocols; and developing secure services for smartphones and other mobile platforms.

Education

- **University of Washington**, Electrical Engineering, PhD, 2009, Dissertation: *Identifying, Modeling, and Mitigating Attacks in Wireless Ad-Hoc and Sensor Networks*, Advisor: Prof. Radha Poovendran
- **University of Washington**, Electrical Engineering, MS, 2007, Thesis: *Modeling Adaptive Node Capture Attacks in Multi-hop Wireless Networks*
- **University of Minnesota**, Computer Engineering, BCompE (cum laude), 2003
- **University of Minnesota**, Mathematics, BS, 2003

Employment & Academic Appointments

- *Chief Technology Officer*, BitClave; since 01/2017
- *Associate Director*, Information Networking Institute, Carnegie Mellon University; since 09/2013
- *Associate Research Professor*, Electrical and Computer Engineering / Information Networking Institute, Carnegie Mellon University; since 07/2014
- *Assistant Research Professor*, Electrical and Computer Engineering / Information Networking Institute, Carnegie Mellon University; 08/2009-06/2014
- *Research Assistant*, Network Security Lab, University of Washington; 06/2004-07/2009
- *Instructor*, Electrical Engineering, University of Washington; Computer-Communication Networks I (EE 565); 01/2008-03/2008
- *Teaching Assistant*, Electrical Engineering, University of Washington; Fundamentals of Electrical Engineering (EE 215), Digital Circuits and Systems (EE 271), Introduction to Computer-Communication Networks (EE 461); 09/2003-06/2004
- *Teaching Assistant & Instructor*, ITCEP/UMTYMP, University of Minnesota; 10/1999-08/2003

Teaching

- Fall 2010-2018: *14-829 - Mobile & IoT Security (prev. Mobile Security)*, Carnegie Mellon University
- Fall 2015-2018: *14-850 - INSuRE Cybersecurity Research*, Carnegie Mellon University
- Spring 2011-2017: *14-814 - Wireless Network Security*, Carnegie Mellon University
- Spring 2010: *96-822 - The Mobile Ecosystem*, Carnegie Mellon University
- Winter 2008: *EE 565 - Computer Communication Networks*, University of Washington

Advising

- PhD Students Advised:

- Prof. Jun Han, Spring 2015 - Summer 2018, currently Assistant Prof. of CS at National University of Singapore
- Dr. Emmanuel Owusu, Fall 2014 - Fall 2018
- Prof. Yuan Tian, Fall 2012 - Fall 2017, currently Assistant Prof. of CS at Univ. Virginia
- Dr. Xiao Wang, Fall 2011 - Spring 2017, currently Research Scientist at Facebook
- Dr. Le T. Nguyen (co-advised w/ Prof. Joy Zhang), Fall 2013 - Spring 2016, currently Data Scientist at Uber
- Dr. Eric Chen (co-advised w/ Prof. Collin Jackson), Fall 2013 - Spring 2015, currently researcher at Google
- Prof. Bruce DeBruhl, Spring 2010 - Spring 2015, currently Assistant Prof. of CS at CalPoly SLO
- Dr. Yu Seung Kim, Fall 2010 - Fall 2014, currently Automotive Cybersecurity Research Engineer at Ford RIC
- Brian Ricks, Fall 2013 - present (co-advised at UTD)
- Madhumitha Harishankar, Spring 2016 - present
- Manisha Mukherjee, Fall 2017 - present
- Dimitrios-Georgios Akestoridis, Fall 2017 - present
- Michael Weber, Fall 2017 - present
- Arjun P. Athreya, Spring 2011 - Fall 2012 (transferred to UIUC)
- PhD Committee Membership: Dr. Jonathan Becker, Dr. Irina Brinster, Dr. Lin-Shung Huang, Dr. Faisal Luqman, Dr. Aanjhan Ranganathan (ETH), Dr. Tim Vidas, Dr. Jiang Zhu
- INI MSIT Advising: Academic advisor for MSIT Information Security Track, 2010 - present
- CMU MS RA Advising: Advised/mentored 50+ MS research/project assistants

Research Funding

- Grants:
 - “Adaptive Strategies for Cross-Layer Jamming and Anti-Jamming”, CMU CyLab, PI, 2010-2012, \$135,000.
 - “Adaptive Strategies for Cross-layer Attack and Defense in Wireless Communication Systems”, Northrop Grumman Cybersecurity Research Consortium, PI, 2010-2013, \$418,663.
 - “Integrated Statistical Analysis for Attack Detection and Tracking in Anonymized Wireless Networks”, Northrop Grumman Cybersecurity Research Consortium, PI, 2013-2014, \$196,418.
 - “Misbehavior Detection in Mobile Networks through Collaborative Network-Application Analytics”, Northrop Grumman Cybersecurity Research Consortium, PI (Co-PI Bob Iannucci), 2014-2015, \$200,000.
 - “Inference-Based Adaptation Techniques for Next Generation Jamming and Anti-Jamming Capabilities”, NSF CAREER Award, PI, 2012-2017, \$512,424.
 - “Multi-Sensory Event Detection for Cross-Platform Coordination and Verification”, NSF CPS, PI, 2017-2019, \$450,001.
 - “Trustworthy Data Sharing and Ownership in the Internet of Things”, Northrop Grumman, 2017-2018, \$186,482.
- Gifts:
 - Research and course project gifts from multiple industry partners totaling more than \$750,000.

Publications

- *Journal Papers*
 - Jun Han, Shijia Pan, Manal Kumar Sinha, Hae Young Noh, Pei Zhang, and Patrick Tague, “Smart Home Occupant Identification via Sensor Fusion Across On-Object Devices”, to appear in ACM Transactions on Sensor Networks (TOSN), 2018.
 - Xinlei Chen, Aveek Purohit, Shijia Pan, Carlos Ruiz, Jun Han, Zheng Sun, Frank Mokaya, Patrick Tague, and Pei Zhang, “Design Experiences in Minimalistic Flying Sensor Node Platform through SensorFly”, ACM Transactions on Sensor Networks (TOSN), Dec 2017.

- Xiao Wang, Tong Yu, Ming Zeng, and Patrick Tague, “XRec: Behavior-Based User Recognition Across Mobile Devices”, Proc. ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies (IMWUT), Sep 2017.
 - Yu Seung Kim, Patrick Tague, Heejo Lee, and Hyogon Kim, “A Jamming Approach to Enhance Enterprise Wi-Fi Secrecy through Spatial Access Control”, Wireless Networks, Apr 2015.
 - Bruce DeBruhl and Patrick Tague, “Keeping up with the Jammers: Observe-and-Adapt Algorithms for Studying Mutually Adaptive Opponents”, Elsevier Pervasive and Mobile Computing, June 2014.
 - Patrick Tague, Sidharth Nabar, James A. Ritcey, and Radha Poovendran, “Jamming-Aware Traffic Allocation for Multiple-Path Routing Using Portfolio Selection”, IEEE/ACM Transactions on Networking, February 2011.
 - Patrick Tague, Mingyan Li, and Radha Poovendran, “Mitigation of Control Channel Jamming under Node Capture Attacks”, IEEE Transactions on Mobile Computing, September 2009.
 - David Slater, Radha Poovendran, Patrick Tague, and Brian J. Matt, “Tradeoffs Between Jamming Resilience and Communication Efficiency in Key Establishment”, ACM Mobile Computing and Communications Review, April 2009.
 - Patrick Tague, David Slater, Jason Rogers, and Radha Poovendran, “Evaluating the Vulnerability of Network Traffic Using Joint Security and Routing Analysis”, IEEE Transactions on Dependable and Secure Computing, Apr-Jun 2009.
 - Patrick Tague and Radha Poovendran, “A Canonical Seed Assignment Model for Key Predistribution in Wireless Sensor Networks”, ACM Transactions on Sensor Networks, October 2007.
 - Patrick Tague and Radha Poovendran, “Modeling Adaptive Node Capture Attacks in Multi-hop Wireless Networks”, Ad Hoc Networks, August 2007.
- *Conference/Workshop Papers*
 - Bruce DeBruhl and Patrick Tague, “Optimizing a Misinformation and Misbehavior (MIB) Attack Targeting Connected Cars”, IEEE CAVS 2018.
 - Brian Ricks, Patrick Tague, and Bhavani Thuraisingham, “Large-Scale Realistic Network Data Generation on a Budget”, IEEE IRI 2018, (**best student paper**).
 - Jun Han, Albert Jin Chung, Manal Kumar Sinha, Madhumitha Harishankar, Shijia Pan, Hae Young Noh, Pei Zhang, and Patrick Tague, “Do You Feel What I Hear? Enabling Autonomous IoT Device Pairing using Different Sensor Types”, IEEE S&P (Oakland) 2018.
 - Madhumitha Harishankar, Nagarjun Srinivasan, Carlee Joe-Wong, and Patrick Tague, “To Accept or Not to Accept: The Question of Supplemental Discount Offers in Mobile Data Plans”, IEEE INFOCOM 2018.
 - Shijia Pan, Carlos Ruiz, Jun Han, Adeola Bannis, Patrick Tague, Hae Young Noe, and Pei Zhang, “UniVerseSense: IoT Device Pairing Using Heterogeneous Sensing Signals”, ACM HotMobile 2018.
 - Jun Han, Shijia Pan, Manal Kumar Sinha, Hae Young Noh, Pei Zhang, and Patrick Tague, “SenseTribute: Smart Home Occupant Identification via Fusion Across On-Object Sensing Devices”, ACM BuildSys 2017.
 - Yuan Tian, Nan Zhang, Yueh-Hsun Lin, Xiaofeng Wang, Blase Ur, Xianzheng Guo, and Patrick Tague, “SmartAuth: User-Centered Authorization for the Internet of Things”, USENIX Security 2017.
 - Xiao Wang, Tong Yu, Ole Mengshoel, and Patrick Tague, “Towards Continuous and Passive Identification Across Mobile Devices: An Empirical Study”, ACM WiSec 2017.
 - Paul Dan Marinescu, Chad Parry, Marjori Pomarole, Yuan Tian, Patrick Tague, and Ioannis Papagiannis, “IVD: Automatic Learning and Enforcement of Authorization Rules in Online Social Networks”, IEEE Symposium on Security and Privacy (Oakland) 2017.
 - Jun Han, Albert Jin Chung, and Patrick Tague, “PitchIn: Eavesdropping via Intelligible Speech Reconstruction using Non-Acoustic Sensor Fusion”, IPSN 2017.
 - Jun Han, Madhumitha Harishankar, Xiao Wang, Albert Jin Chung, and Patrick Tague, “Convoy: Physical Context Verification for Vehicle Platoon Admission”, HotMobile 2017.
 - Yuan Tian, Shuo Chen, Eric Chen, Xiaojun Ma, Xiao Wang, and Patrick Tague, “Swords and Shields - A Study of Mobile Game Hacks and Existing Defenses”, ACSAC 2016.
 - Brian Ricks and Patrick Tague, “Isolation of Multiple Anonymous Attackers in Mobile Networks”, NSS 2015.
 - Yuan Tian, Bin Liu, Weisi Dai, Blase Ur, Patrick Tague, and Lorrie Faith Cranor, “Supporting Privacy-

- Conscious App Update Decisions with User Reviews”, ACM CCS SPSM Workshop 2015.
- Le T. Nguyen, Ming Zeng, Patrick Tague, and Joy Zhang, “I Did Not Smoke 100 Cigarettes Today! Avoiding False Positives in Real-World Activity Recognition”, UbiComp 2015.
 - Le T. Nguyen, Ming Zeng, Patrick Tague, and Joy Zhang, “Recognizing New Activities with Limited Training Data”, ISWC 2015.
 - Le T. Nguyen, Ming Zeng, Patrick Tague, and Joy Zhang, “SuperAD: Supervised Activity Discovery”, UbiComp HASCA Workshop 2015.
 - Bruce DeBruhl, Sean Weerakkody, Bruno Sinopoli, and Patrick Tague, “Is Your Commute Driving you Crazy? A Study of Misbehavior in Vehicular Platoons”, ACM WiSec 2015.
 - Xiao Wang and Patrick Tague, “Non-Invasive User Tracking via Passive Sensing: Privacy Risks of Time-Series Occupancy Measurement”, ACM CCS AISEC Workshop 2014.
 - Timothy Vidas, Jiaqi Tan, Jay Nahata, Chaur-Lih Tan, Nicolas Christin, and Patrick Tague, “A5: Automated Analysis of Adversarial Android Applications”, ACM CCS SPSM Workshop 2014.
 - Eric Chen, Yutong Pei, Shuo Chen, Yuan Tian, Robert Kotcher, and Patrick Tague, “OAuth Demystified for Mobile Application Developers”, CCS 2014.
 - Yu Seung Kim, Yuan Tian, Le Nguyen, and Patrick Tague, “LAPWiN: Location-Aided Probing for Protecting User Privacy in Wi-Fi Networks”, CNS 2014.
 - Yu Seung Kim, Bruce DeBruhl, and Patrick Tague, “JADE: Jamming-Averse Routing on Cognitive Radio Mesh Networks”, CRESS 2014.
 - Su Mon Kywe, Christopher Landis, Yutong Pei, Justin Satterfield, Yuan Tian, and Patrick Tague, “PrivateDroid: Private Browsing Mode for Android”, TrustCom 2014.
 - Le Nguyen, Yu Seung Kim, Joy Zhang, and Patrick Tague, “IdentityLink: User-Device Linking through Visual and RF-Signal Cues”, UbiComp 2014.
 - Yu Seung Kim and Patrick Tague, “Proximity-Based Wireless Access Control through Considerate Jamming”, SPME 2014.
 - Bruce DeBruhl, Christian Kroer, Anupam Datta, Tuomas Sandholm, and Patrick Tague, “Power Napping with Loud Neighbors: Optimal Energy-Constrained Jamming and Anti-Jamming”, WiSec 2014.
 - Yuan Tian, Ying-Chuan Liu, Amar Bhosale, Lin-Shung Huang, Patrick Tague, and Collin Jackson, “All Your Screens Are Belong to Us: Attacks Exploiting the HTML5 Screen Sharing API”, Oakland 2014.
 - Arjun Athreya, Harry Chan-Maestas, Edward Katz, Patrick Tague, and Bob Iannucci, “Energy-Governed Resilient Networked Systems”, CCNC 2014.
 - Arjun Athreya, Bruce DeBruhl, and Patrick Tague, “Designing for Self-Configuration and Self-Adaptation in the Internet of Things”, C-IOT Workshop 2013.
 - Yu Seung Kim, Bruce DeBruhl, and Patrick Tague, “MeshJam: Intelligent Jamming Attack and Defense in IEEE 802.11s Wireless Mesh Networks”, MASS 2013.
 - Arjun Athreya, Xiao Wang, Yu Seung Kim, Yuan Tian, and Patrick Tague, “Resistance is Not Futile: Detecting DDoS Attacks without Packet Inspection”, WISA 2013.
 - Le Nguyen, Yuan Tian, Sungho Cho, Wookjong Kwak, Sanjay Parab, Yu Seung Kim, Patrick Tague, and Joy Zhang, “UnLocIn: Unauthorized Location Inference on Smartphones without Being Caught”, PRISMS 2013.
 - Arjun Athreya and Patrick Tague, “Network Self-Organization in the Internet of Things”, IoT-NC Workshop 2013.
 - Bruce DeBruhl and Patrick Tague, “How to Jam Without Getting Caught: Analysis and Empirical Study of Stealthy Periodic Jamming”, SECON 2013.
 - Xiao Wang and Patrick Tague, “ASIA: Accelerated Secure In-network Aggregation in Vehicular Sensing Networks”, SECON 2013.
 - Yu Seung Kim, Bruce DeBruhl, and Patrick Tague, “Stochastic Optimization of Flow-Jamming Attacks in Multichannel Wireless Networks”, ICC 2013.
 - Shrikant Adhikarla, Min Suk Kang, and Patrick Tague, “Selfish Manipulation of Cooperative Cellular Communications via Channel Fabrication”, ACM WiSec 2013.
 - Arjun Athreya and Patrick Tague, “Self-Organization of a Mesh Hierarchy for Smart Grid Monitoring in Outage Scenarios”, ISGT 2013.

- Bruce DeBruhl, Yu Seung Kim, Zachary Weinberg, and Patrick Tague, “STIR-ing the Wireless Medium with Self-Tuned, Inference-Based, Real-Time Jamming”, MASS 2012.
 - Bruce DeBruhl and Patrick Tague, “Living with Boisterous Neighbors: Studying the Interaction of Adaptive Jamming and Anti-Jamming”, D-SPAN workshop 2012.
 - Yu Seung Kim, Frank Mokaya, Eric Chen, and Patrick Tague, “All Your Jammers Belong to Us Localization of Wireless Sensors Under Jamming Attack”, ICC 2012.
 - Yu Seung Kim, Patrick Tague, Heejo Lee, and Hyogon Kim, “Carving Secure Wi-Fi Zones with Defensive Jamming”, AsiaCCS 2012.
 - Bruce DeBruhl and Patrick Tague, “Mitigation of Periodic Jamming in a Spread Spectrum System by Adaptive Filter Selection”, PECCS 2012.
 - Xin Zhang, Zongwei Zhou, Hsu-Chun Hsiao, Tiffany Hyun-Jin Kim, Adrian Perrig, and Patrick Tague, “ShortMAC: Efficient Data-Plane Fault Localization”, NDSS 2012.
 - Arjun Athreya and Patrick Tague, “Survivable Smart Grid Communication: Smart-Meter Meshes to the Rescue”, ICNC SGCom Workshop 2012.
 - Bruce DeBruhl and Patrick Tague, “Digital Filter Design for Jamming Mitigation in 802.15.4 Communication”, ICCCN 2011.
 - Senaka Butthipitiya, Feng-Tso Sun, Heng-Tze Cheng, Patrick Tague, Martin Griss, and Anind K. Dey, “Anubis: An Attestation Protocol for Distributed Context-Aware Applications”, ISSNIP 2010.
 - Patrick Tague, “Improving Anti-Jamming Capability and Increasing Jamming Impact with Mobility Control”, WSNS 2010.
 - David Slater, Patrick Tague, Mingyan Li, and Radha Poovendran, “A Game-Theoretic Framework for Jamming Attacks and Mitigation in Commercial Aircraft Wireless Networks”, AIAA Infotech@Aerospace 2009.
 - David Slater, Patrick Tague, Radha Poovendran, and Brian J. Matt, “A Coding-Theoretic Approach for Efficient Message Verification Over Insecure Channels”, WiSec 2009.
 - Patrick Tague and Radha Poovendran, “Modeling Node Capture Attacks in Wireless Sensor Networks”, Allerton 2008.
 - Patrick Tague, Sidharth Nabar, James Ritcey, David Slater, and Radha Poovendran, “Throughput Optimization for Multipath Unicast Routing Under Probabilistic Jamming”, PIMRC 2008.
 - Patrick Tague, David Slater, Jason Rogers, and Radha Poovendran, “Vulnerability of Network Traffic under Node Capture Attacks using Circuit Theoretic Analysis”, INFOCOM 2008.
 - Patrick Tague, David Slater, Guevara Noubir, and Radha Poovendran, “Linear Programming Models for Jamming Attacks on Network Traffic Flows”, WiOpt 2008.
 - Patrick Tague, Mingyan Li, and Radha Poovendran, “Probabilistic Mitigation of Control Channel Jamming via Random Key Distribution”, PIMRC 2007, (**best student paper**).
 - Patrick Tague and Radha Poovendran, “A General Probabilistic Model for Improving Key Assignment in Wireless Networks”, WiOpt 2006.
 - Patrick Tague, Jooyoung Lee, and Radha Poovendran, “A Set-Covering Approach for Modeling Attacks on Key Predistribution in Wireless Sensor Networks”, ICISIP Bangalore 2005.
- *Posters/Demos with Published Abstracts*
 - Yu Seung Kim and Patrick Tague, “Wireless Mesh Network Simulator for Studying Cross-Layer Jamming Effects”, MASS 2013 demo.
 - Jason Wu, Lin Qi, Nishant Kumar, Ram Shankar Siva Kumar, and Patrick Tague, “S-SPAN: Secure Smart Posters in Android using NFC”, WoWMoM 2012 demo.
 - Bruce DeBruhl, Yu Seung Kim, and Patrick Tague, “A Toolbox to Explore the Interaction of Adaptive Jamming and Anti-Jamming”, INFOCOM 2012 demo.
 - Yu Seung Kim and Patrick Tague, “Jamming-resistant Distributed Path Selection on Wireless Mesh Networks”, INFOCOM 2012 demo.
 - Arjun Athreya and Patrick Tague, “Towards Secure Multi-path Routing for Wireless Mobile Ad-Hoc Networks: A Cross-layer Strategy”, SECON 2011 poster.
 - *Technical Reports*

- Bob Iannucci, Patrick Tague, Ole Mengshoel, and Jason Lohn, “CROSSMobile: A Cross-Layer Architecture for Next-Generation Wireless Systems”, Carnegie Mellon University Silicon Valley, Technical Report CMU-SV-14-001, 2014.
- Ryan Caney, Christopher Dorros, Stuart Kennedy, Gregory Owens, and Patrick Tague, “Mobile Pickpocketing: Exfiltration of Sensitive Data through NFC-enabled Mobile Devices”, Carnegie Mellon University CyLab, Technical Report CMU-CyLab-13-015, 2013.
- Yu Seung Kim, Patrick Tague, Heejo Lee, and Hyogon Kim, “Carving Secure Wi-Fi Zones with Defensive Jamming (Extended Version)”, Carnegie Mellon University, MEWS Technical Report TR-DefJam, 2012.
- Patrick Tague, David Slater, Guevara Noubir, and Radha Poovendran, “Quantifying the Impact of Efficient Cross-Layer Jamming Attacks via Network Traffic Flows”, Network Security Lab (NSL) Technical Report #005, 2009.

Patents

- Yu Seung Kim, Jun Han, and Patrick Tague, “Inter-Vehicle Authentication using Visual Contextual Information”, US Patent Number 9,842,263, issued December 2017.
- Mingyan Li, Patrick Tague, and Radha Poovendran, Probabilistic Mitigation of Control Channel Jamming Via Random Key Distribution in Wireless Communications Networks, US Patent 8,391,493 B2, issued March 2013.

Honors & Awards

- Cisco IoT Security Grand Challenge Winner, 2014.
- Best Paper Awards: IRI 2018 (student), CCNC 2014 (student), PIMRC 2007 (student).
- NSF CAREER Award, 2012.
- Outstanding Graduate Research Award, Center for Information Assurance and Cybersecurity CAE-R, University of Washington, 2009.
- Yang Research Award, Department of Electrical Engineering, University of Washington, 2009.

Service

- *Academic Service*
 - Associate Director, Information Networking Institute, 2013-current.
 - Instructor, Information Assurance Capacity Building Program, 2011.
 - Chair (and multiple other positions), Graduate Student Association, University of Washington, Department of Electrical Engineering, 2004-2008.
- *Conference/Journal Service*
 - Workshop Co-Chair - MobiCASE Workshop on Mobile Security 2010, 2011.
 - Conference Committee Membership - SecureComm 2010-2013, VTC 2010-2014, WSNS 2011, WCNC 2012-2016, SECON 2012-2016, SecurIT 2012, ACSAC 2013-2015, GlobeCom 2013-2017, CCS 2013-2014, NDSS 2014, SSS 2017, CANS 2017, ASIACCS 2014-2017, IPSN 2018, WiSec 2014-2018, Infocom 2015-2018 (TPC); SECON 2012 (Student travel chair); WiSec 2012 (Publicity chair); WoWMoM 2012, SECON 2014 (demo co-chair); Mobicom 2014 (registration chair); CNS 2014 (local chair); CCS 2014-2015 (tutorial chair); ICNP 2015 (finance chair); SafeThings 2017 (general co-chair)
 - Associate Editor, IEEE Transactions on Mobile Computing 2017-present
 - External Reviewer for numerous conferences and journals