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# T. Charles Clancy, PhD

## Personal Summary

Dr. Charles Clancy is a successful academic executive, research innovator, and entrepreneur who currently directs Virginia Tech's Hume Center. He joined Virginia Tech to help launch the center in 2010 after starting his career at the National Security Agency. Clancy is an internationally-recognized expert at the intersection of artificial intelligence, wireless communications, and cybersecurity, regularly testifying to the US Congress on associated issues. He has led ground-breaking programs in cognitive radio, deep learning for wireless, cryptographic authentication, and communication security, and is currently working on 5G and IoT. He has served in leadership roles within the IEEE Communication Society (COMSOC) and Signal Processing Society (SPS), and the Internet Engineering Task Force (IETF). He is co-author to five books, over 20 patents, and over 200 academic publications.

## Education

### University of Maryland, College Park, MD

*Ph.D.*, Computer Science 2006  
Advisor: William A. Arbaugh

### University of Illinois, Urbana-Champaign, IL

*M.S.*, Electrical Engineering 2002  
Advisor: Richard E. Blahut

### Rose-Hulman Institute of Technology, Terre Haute, IN

*B.S.*, Computer Engineering, *magna cum laude* 2001  
Minor: Computer Science

## Experience

### Virginia Tech, Arlington, VA

*Executive Director*, Hume Center for National Security and Technology 2010–present  
*Associate Director 2010 • Director 2011 • Executive Director 2017*

Founder of the Hume Center, an interdisciplinary university research institute engaging 85+ faculty/staff and 400+ students in \$12M to \$15M per year in extramural sponsored programs. Leading major university initiatives in securing defense funding in artificial intelligence, space/satellites, cybersecurity, and quantum computing, working with key stakeholders in federal agencies and on Capitol Hill. Launched eight spin-out companies that have raised \$130M in venture capital. Lead the university's research strategy for its *Integrated Security Destination Area* and the *Commonwealth Cyber Initiative*.

*Bradley Professor of Cybersecurity*, Electrical and Computer Engineering 2011–present  
*Associate Professor 2011 • Professor 2017 • Bradley Professor 2018*

Internationally recognized expert at the intersection of artificial intelligence, cybersecurity, and wireless, with a strong record of academic scholarship that impacts international standards and policies. Work closely with the US telecom industry and federal regulators on 5G. Regularly testify on Capitol Hill as a telecommunications expert.

### National Security Agency, Fort Meade, MD

*Engineering Leader*, Emerging Mobile Technologies Research 2000–2010  
*Intern 2000 • Researcher 2004 • Senior Researcher 2006 • Engineering Leader 2008*

Built a research team of 20 government, military, and contractors to execute a \$75M portfolio of cognitive communications research, sponsoring programs at universities, national labs, and companies. Funded major advances in open-source software-defined and cognitive radio that led to successful government programs transitioned to the field. Worked effectively with stakeholders across the interagency and on Capitol Hill to fund and transition programs.

<b>Awards</b>	<i>Bradley Cybersecurity Professorship</i> , Virginia Tech College of Engineering	2018
	<i>Best Student Paper Award</i> , IEEE Conference on Computer and Information Tech	2018
	<i>Innovation Award (HawkEye 360)</i> , Washington Business Journal	2017
	<i>Fierce Innovation Awards (Federated Wireless)</i> , FierceWireless	2016
	<i>40 Under 40 Honoree</i> , Leadership Arlington	2015
	<i>Deans Award for Research Excellence</i> , Virginia Tech College of Engineering	2014
	<i>L-3 Communications Faculty Fellowship</i> , Virginia Tech College of Engineering	2013
	<i>GAP-50 Finalist (Entrepreneurship Award)</i> , Commonwealth of Virginia	2012
	<i>Secretary of Defense Medal for the Global War on Terrorism</i> , Department of Defense	2011
	<i>Best Student Paper Runner Up</i> , IEEE Workshop on Signal Processing Systems	2011
	<i>Senior Member Status</i> , Institute of Electrical and Electronics Engineers	2010
	<i>Letter of Commendation</i> , United States Forces Iraq J6	2010
	<i>Outstanding Paper Award</i> , SDR Forum Technical Conference	2007
	<i>Joint Meritorious Unit Award</i> , National Security Agency	2007
	<i>Outstanding Paper Award</i> , SDR Forum Technical Conference	2006
	<i>Deckert-Foster SIGINT Engineering Award</i> , National Security Agency	2006
	<i>Best Paper Award</i> , Virginia Tech Wireless Symposium	2006
	<i>Joint Meritorious Unit Award</i> , National Security Agency	2004
	<i>Graduate Fellowship</i> , University of Maryland, Department of Computer Science	2003
	<i>Valedictorian</i> , Ben Davis High School	1998
<b>Professional Societies</b>	<b>Institute for Electrical and Electronics Engineers (IEEE)</b>	
	<b>Membership Levels</b>	
	<i>Senior Member</i> , IEEE	2010–present
	<i>Member</i> , IEEE	2006–2010
	<i>Student Member</i> , IEEE	2003–2006
	<b>Society Membership</b>	
	<i>Member</i> , IEEE Signal Processing Society	2012–present
	<i>Member</i> , IEEE Communications Society	2010–present
	<b>Technical Committee Membership</b>	
	<i>Voting Member</i> , Technical Committee on Cognitive Networks (TCCN)	2013–present
	<i>Elected Member</i> , Information Forensics and Security (IFS-TC)	2013–2017
	<i>Member</i> , Comms and Information Security (CISTC)	2011–present
	<b>Technical Committee Assignments</b>	
	<i>Vice Chair</i> , TCCN Cognitive Network Security Special Interest Group	2013–present
	<i>Education Committee Chair</i> , IFS-TC	2015–2017
	<i>Awards Committee Member</i> , IFS-TC	2015–2017
	<i>Communications Security Area Chair</i> , IFS-TC	2014–2017
	<i>North America Regional Representative</i> , IFS-TC	2014–2015
	<i>Member</i> , Technical Directions, IFS-TC	2014–2015
	<b>Armed Forces Communications and Electronics Association (AFCEA)</b>	
<i>Member</i> , AFCEA	2012–present	
<i>Elected Member</i> , AFCEA Intelligence Committee	2015–present	
<b>Journal Editorships</b>	<i>Editor</i> , IEEE Transactions on Cognitive Communications and Networks	2014–2017
	<i>Associate Editor</i> , IEEE Transactions on Information Forensics and Security	2012–2015
<b>Conference Leadership</b>	<b>Conference Leadership</b>	
	<i>General Chair</i> , IEEE Communication and Network Security (CNS)	2019
	<i>General Co-Chair</i> , AFCEA Intelligence Symposium	2019
	<i>Co-Organizer</i> , AFCEA/INSA National Security Summit	2017, 2018
	<i>Co-Organizer</i> , AFCEA Intelligence Symposium	2016
	<i>Workshop Co-Chair</i> , IEEE Personal, Indoor and Mobile Radio Comms (PIMRC)	2014
	<i>TPC Co-Chair</i> , IEEE Dynamic Spectrum Access Networks (DySPAN)	2014

<i>Patron Co-Chair, IEEE Communication and Network Security (CNS)</i>	2013
<i>Co-Chair, ACM Cognitive Radio Architectures for Broadband (CRAB) Workshop</i>	2013
<i>Co-Chair, IEEE Security in Communications Networks Workshop</i>	2012
<i>TPC Co-Chair, IEEE ICC Cognitive Radio Networks Symposium</i>	2012
<i>Co-Chair, Open Source Workshop, Wireless Innovation Forum</i>	2011
<i>Co-Chair, SDR Forum Open Source Workshop</i>	2011
<i>Tutorial Chair, Virginia Tech Wireless Symposium and Summer School</i>	2011
<i>Chair, GNU Radio Future Directions Workshop</i>	2009, 2010
<i>General Chair, WLAN/WMAN Symposium, Department of Defense</i>	2006, 2008

#### **Technical Program Committee Member**

<i>IEEE Military Communications Conference (MILCOM)</i>	2014–present
<i>IEEE Wireless Wireless for Space and Extreme Environments (WiSEE)</i>	2018
<i>IEEE Dynamic Spectrum Access Networks (DySPAN)</i>	2017, 2018
<i>IEEE Intl Workshop on Information Forensics and Security (WIFS)</i>	2015, 2016, 2017
<i>IEEE Vehicular Technologies Conference (VTC)</i>	2017
<i>IEEE Intl Conference on Acoustics, Speech and Signal Proc (ICASSP)</i>	2014, 2015, 2016
<i>Workshop on Security in Cloud Computing, ACM AsiaCCS</i>	2015
<i>IEEE Intl Conference on Computing, Networking and Comms (ICNC)</i>	2015
<i>IEEE Cognitive Radio and Electromagnetic Spectrum Security (CRESS)</i>	2014
<i>IEEE Global Conference on Signal and Infor Processing (GlobalSIP)</i>	2013, 2014
<i>IEEE Global Communications Conference (GLOBECOM)</i>	2012, 2014
<i>Conference on Decision and Game Theory for Security (GameSec)</i>	2011
<i>ICST Security in Emerging Wireless Comms and Networking Systems</i>	2009

#### **Standards Bodies**

<i>Steering Group Member, WinnF Spectrum Sharing Committee (SSC)</i>	2014–present
<i>Chair, WinnF SSC Security Working Group</i>	2014–2017
<i>Vice Chair, DoD IEEE 802.16 Secure Profile Working Group</i>	2009–2010
<i>Chair, Security Task Force, DoD IEEE 802.16 Secure Profile Working Group</i>	2009–2010
<i>Member, WinnF Educational Working Group</i>	2007–2010
<i>Co-Chair, IETF Handover Keying Working Group</i>	2006–2009
<i>Member, IETF Security Directorate</i>	2006–2009
<i>Security Advisor, IETF CAPWAP Working Group</i>	2006–2008
<i>Security Advisor, IETF Extensible Authentication Protocol Working Group</i>	2005–2007
<i>Member, IEEE 802.22 Spectrum Sensing Task Force</i>	2005–2006

#### **Professional Service**

<i>Co-Director, NSF Security and Software Engineering Research Center</i>	2011–present
<i>Advisory Board Member, DoD CoE in Cyber Security, Norfolk State University</i>	2018–present
<i>Member, Defense Policy Working Group, Hillary for America</i>	2015–2016
<i>Star Mentor, Mach37 Cybersecurity Incubator</i>	2014–2017
<i>Member, STEM Committee, Fairfax County Public Schools</i>	2013–2016
<i>Member, JCOTS Cyber Security Panel, Virginia General Assembly</i>	2012–2016
<i>Member, JIEDDO Enduring Capabilities Working Group</i>	2012
<i>Review Panel Member, National Science Foundation</i>	2010, 2015
<i>Steering Committee, NSF EARS Workshop</i>	2010
<i>Amateur Radio Operator, American Radio Relay League</i>	2001–present

#### **University Service**

##### **Committees and Advisor Roles**

<i>Member, Promotion &amp; Tenure Committee, Electrical and Computer Engr</i>	2018–2019
<i>Member, Advancement and Promotions Committee, Hume Center</i>	2016–present
<i>Member, Stakeholders Committee, Integrated Security Destination Area</i>	2016–present
<i>Chair, Research Subcommittee, Integrated Security Destination Area</i>	2016–present
<i>Co-Chair, Development Subcommittee, Integrated Security Destination Area</i>	2016–present
<i>Member, Faculty Design Team, Integrated Security Destination Area</i>	2016
<i>Member, Steering Group, Integrated Security Destination Area</i>	2015–2016

<i>Member, Networks Area Committee, Electrical and Computer Engineering</i>	2012–present
<i>Member, Comms Area Committee, Electrical and Computer Engineering</i>	2011–present
<i>Member, Network Inf and Services Advisory Committee, VP for IT</i>	2011–2018
<i>Member, Scholarship Selection Committee, Hume Center</i>	2010–present
<i>Faculty Advisor, Student Cybersecurity Club</i>	2011–2014
<i>Area Recruiting Representative, Communications Area, ECE</i>	2012–2013
<i>Review Panel Member, ICTAS Joint Faculty Collaborative Program</i>	2011

#### **Faculty Search Committees**

<i>Chair, Professor, Secure HW/SW Systems, Computer Engineering</i>	2018–2019
<i>Member, Director, Office of Export Control and Secure Research Compliance</i>	2018
<i>Member, Associate Vice President, Sponsored Programs</i>	2018
<i>Chair, Program Manager, Commonwealth Cyber Initiative, Hume Center</i>	2018
<i>Chair, Director, Information Systems Lab, Hume Center</i>	2018
<i>Member, Dean, College of Engineering</i>	2016–2017
<i>Chair, Director, Information Systems Lab, Hume Center</i>	2016
<i>Member, Asst Prof, Cyber-Physical Security, Computer Engineering</i>	2015–2016
<i>Chair, Assoc Director for Info Systems, Hume Center</i>	2015
<i>Member, Vice President, National Capital Region</i>	2013
<i>Member, Associate Vice President, National Capital Region</i>	2013
<i>Chair, Asst Prof, Software Security, Computer Engineering</i>	2012–2013
<i>Chair, Portfolio Director, Hume Center</i>	2012
<i>Member, Asst Prof, Software Security, Computer Engineering</i>	2011–2012
<i>Member, Asst Prof, Cyber Security, Computer Science</i>	2010–2011

## **Entrepreneurship and Consulting**

<i>Co-Founder, HawkEye 360 Inc</i>	2015–present
<i>CTO, HawkEye 360 Inc (during sabbatical)</i>	2018
<i>Co-Founder, Federated Wireless Inc</i>	2012–present
<i>Co-Founder, Optio Labs Inc</i>	2012–2017
<i>President and Founder, Stochastic Research LLC</i>	2009–present
<i>Founding Advisor, DeepSig</i>	2017–present
<i>Advisory Board Member, Allied Minds PLC</i>	2018–present
<i>Advisory Board Member, Votem Inc</i>	2015–2016
<i>Consultant, Barr Group Inc</i>	2013–2014
<i>Consultant, Center for Innovative Technologies</i>	2011
<i>Consultant, Chemring North America</i>	2014
<i>Consultant, CTIA – The Wireless Association</i>	2013–present
<i>Consultant, Eogogics Inc</i>	2011–2013
<i>Consultant, FastIraq Inc</i>	2010–2011
<i>Consultant, IDA Center for Computer Sciences</i>	2010–2013
<i>Consultant, Litmore LLC</i>	2012
<i>Consultant, Lyric Semiconductor</i>	2010–2011
<i>Consultant, Millennium Space Systems</i>	2014–2015
<i>Consultant, Office of the Secretary of Defense</i>	2013–2016
<i>Consultant, Netgear</i>	2011–2012
<i>Consultant, WAA Associates LLC</i>	2003–2005

## **Teaching**

### **Curriculum Development**

<i>Cyber Security Graduate Certificate, Virginia Tech, College of Engineering</i>	2018
<i>CyberLeaders Capstone, Virginia Tech</i>	2017
<i>Cyber Security Undergraduate Minor, Virginia Tech, College of Engineering</i>	2012
<i>Information and Network Security, University of Maryland, MS Telecomms</i>	2008

### **University Courses**

<i>CyberLeaders Capstone (SPIA 4984), Virginia Tech</i>	2017, 2018
<i>Telecommunication Networks (ECE 4614), Virginia Tech</i>	2011, 2013, 2016

<i>Network Security (ECE/CS 5584), Virginia Tech</i>	2015
<i>Network Architecture and Protocols II (ECE/CS 5566), Virginia Tech</i>	2012
<i>Special Study: Control Theory and the Dynamics of Cybersecurity, Virginia Tech</i>	2014
<i>Network Architecture and Protocols I (ECE/CS 5565), Virginia Tech</i>	2013
<i>Information Theory (ECE 5634), Virginia Tech</i>	2011
<i>Communications Networks (ENEE 426), University of Maryland</i>	2008, 2009
<i>Information and Network Security (ENTS 689i), University of Maryland</i>	2008
<i>Teaching Assistant, Cryptology (CMSC 456), University of Maryland</i>	2003
<i>Teaching Assistant, Communication Networks (ECE 438), University of Illinois</i>	2001

#### **Short Courses, Seminars, and Tutorials**

<i>Introduction to Telecom and Crypto (8 hours), CTIA</i>	2018
<i>Numerical Methods and Analysis (40 hours), Navy SPAWAR Atlantic</i>	2015
<i>Cybersecurity Technologies and Tactics (8 hours), Fujitsu Ltd</i>	2014
<i>Cellular Core Networks (40 hours), US Special Operations Command (SOCOM)</i>	2012
<i>Wireless Comms and Security (40 hours), Office of the Secretary of Defense</i>	2012
<i>Android Security (6 hours), L-3 Communications</i>	2012
<i>Cyberwarfare Strategy (6 hours), Joint Inter-American Defense College</i>	2011, 2012
<i>Security for Tactical Wireless (4 hours), VT Wireless Summer School</i>	2011
<i>Wireless 4G Communications (8 hours), ProObject Speaker Series</i>	2010
<i>Intro to WLAN Security (8 hours), DOD Cryptanalytic Program</i>	2005, 2006, 2008, 2009
<i>Wireless Networks (24 hours), DOD Resident Signal Engineers Program</i>	2007
<i>Software-Defined and Cognitive Radio (4 hours), IEEE MILCOM</i>	2007
<i>UNIX Systems Admin using Solaris (16 hours), Indiana University</i>	2001, 2002, 2003
<i>Computer and Network Security (16 hours), Indiana University</i>	2001

## **Sponsored Research**

### **\$53M in Total Grant/Contract Awards**

1. J. Graham, T. Clancy, W. Saad, A. Brantly, "Adaptive Gray-Zone Intent Platform for Probing and Analysis," Defense Advanced Research Projects Agency (DARPA/STO), with STR and Charles River Analytics, **\$895K**, 2019–2022
2. M. Vondal, T. Clancy, "Sensitive Program," Defense Advanced Research Projects Agency (DARPA/I2O), with DeepSig and 26 Labs, **\$2,591K**, 2018–2022
3. T. Clancy, J. Graham, K. Karra, "Deep Learning Techniques for Social Media Analysis," Defense Advanced Research Projects Agency (DARPA/I2O), with USC-ISI, **\$1,001K**, 2018–2022
4. N. McCarthy, T. Clancy, "RF Data for Commercial Geospatial Analytics," Defense Advanced Research Projects Agency (DARPA/STO), with Decartes Labs, **\$400K**, 2018–2020
5. T. Clancy, C. Headley, "Cyber Adversarial Awareness and Modeling based on Electromagnetic Sensing," Office of Naval Research (ONR), **\$100K**, 2018–2019
6. T. Clancy, J. Graham, K. Karra, N. Ramakrishnan, "Anticipatory SIGINT and Activity Prediction," Intelligence Advanced Research Projects Agency (IARPA), with STR and USC-ISI, **\$367K**, 2018–2019
7. T. O'Shea, T. Clancy, "Machine Learning for Cyber Awareness and Defense," Virginia Research Investment Fund, **\$1,181K**, 2018–2020
8. J. Black, T. Clancy, A. Michaels, R. McGwier, J. Ernst, M. Fowler, C. Headley, "Disaggregated, Resilient, and Secure Satellite Systems," sensitive sponsor, **\$10,000K**, 2018–2023
9. J. Black, T. Clancy, R. McGwier, C. Headley, "OpenCPI Middleware for the AstroSDR Payload," sensitive sponsor, **\$750K**, 2018–2019



10. C. Williams, T. Clancy, T. O'Shea, "Anomaly Analysis in Additive Manufacturing Design," sensitive sponsor, **\$1,485K**, 2018-2019
11. T. Clancy, P. Schaumont, "Security and Software Engineering Research Center @ Virginia Tech – Phase II," National Science Foundation (NSF), **\$300K**, 2017-2020
12. J. Black, T. Clancy, A. Wicks, M. Fowler, "Integrated Cognition for Electromagnetic Squad Defense," Defense Advanced Research Projects Agency (DARPA/TTO), with CACI, **\$1,552K**, 2017-2019
13. T. Clancy, S. Rahman, "Mapping Industrial Control Systems," Office of the Secretary of Defense, **\$150K**, 2016-2017
14. T. Clancy, "Analyzing End-to-End Encryption with Deep Learning," NSF Security and Software Engineering Research Center, **\$50K**, 2016-2017
15. T. Clancy, T. O'Shea, "Deep Learning-Based RF Emitter Characterization," Lockheed Martin Corporation, **\$300K**, 2016-2018
16. T. Chantem, E. Tilevich, T. Clancy, "Compiler Tools for Critical Program Information Protection," Office of the Secretary of Defense, **\$1,150K**, 2016-2020
17. A. Abdelhadi, T. Clancy, "Security Analysis of Wireless Connections for Remote Sensors," Airbus, **\$40K**, 2015-2017
18. A. Abdelhadi, T. Clancy, "Attack Detection Methods for Threats Coming from the IoT," Airbus, **\$40K**, 2015-2017
19. T. Clancy, J. Black, N. Ramakrishnan, M. Marathe, "SIGINT-based Anticipation of Future Events," Intelligence Advanced Research Projects Activity (IARPA), with USC-ISI, Next Century, and Draper Labs, **\$1,082K**, 2016-2017
20. A. Michaels, T. Clancy, J. Ernst, R. McGwier, "Tackling WiFi Interference and Co-Channel Excision," sensitive sponsor, **\$1,396K**, 2015-2016
21. T. Clancy, T. O'Shea, J. Black, "Distributed Coordination among Tactical Electronic Warfare Platforms," Defense Advanced Research Projects Agency (DARPA/TTO), with CACI, **\$1,968K**, 2015-2017
22. T. Clancy, T. O'Shea, "Bayesian Algorithms for Pattern of Life Estimation and Forecasting in RF Environments," sensitive sponsor, **\$2,445K**, 2015-2020
23. T. Clancy, "Closed-Loop Cognitive Electronic Warfare Operations with Cyber Feedback," Office of Naval Research (ONR), **\$694K**, 2015-2016
24. J. Tront, T. Clancy, "Virginia Tech GenCyber Summer Camp," National Security Agency (NSA), **\$100K**, 2015
25. T. Clancy, R. McGwier, "Mission Feasibility Study and Prototyping for Software Radio Waveforms," sensitive sponsor, **\$1,392K**, 2014-2016
26. T. Clancy, M. Fowler, "Heterogeneous Parallel Mobile Computing for Cognitive Electronic Warfare," Office of Naval Research (ONR), **\$894K**, 2014-2016
27. T. Clancy, "Exploitation of Android Ad Libraries," L-3 Communications, **\$44K**, 2014-2015
28. T. Clancy, "Machine Learning for Target Models in Cognitive Electronic Warfare," L-3 Communications, **\$42K**, 2014-2015
29. T. Clancy, R. McGwier, "Resilient Tactical SATCOM Using Cognitive Radio: Phase 2," Air Force Research Labs (AFRL), with Shared Spectrum Company, **\$293K**, 2014-2015
30. J. Tront, T. Clancy, K. Cooper, "Virginia Tech CyberCorps: Federal Scholarship for Service," National Science Foundation (NSF), **\$3,909K**, 2013-2018

31. R. McGwier, T. Clancy, "Experimental Software Defined Radio," Harris Corporation, **\$110K**, 2014
32. T. Clancy, A. Abdelhadi, R. McGwier, "Spectral Coexistence using MIMO Radar Platforms," Defense Advanced Research Projects Agency (DARPA/STO), **\$349K**, 2013-2014
33. R. McGwier, T. Clancy, "Tactical Platforms for Advanced Electronic Warfare," Air Force Research Labs (AFRL), **\$498K**, 2013-2014
34. T. Clancy, R. McGwier, "Satellite Communications using DSA under Spectral Uncertainty," Air Force Office of Scientific Research (AFOSR), with Shared Spectrum Company, **\$56K**, 2013-2014
35. R. Tandon, T. Clancy, "Physical Layer Security: Information Theoretic Approach to Jamming," L-3 Communications, **\$237K**, 2013-2014
36. S. Shukla, T. Clancy, "Application-Specific Firewall Synthesis Tool for High-Assurance Systems," L-3 Communications, **\$162K**, 2013-2014
37. S. Sodagari, T. Clancy, "Using Asynchronous Weak-Commitment Search for Distributed Constraint Satisfaction for Autonomous Network Management," Office of Naval Research (ONR), **\$75K**, 2013-2015.
38. P. Athanas, T. Clancy, "Novel Applications of FPGA Logic," Air Force Research Labs (AFRL), with USC Information Sciences Institute, **\$994K**, 2013-2014
39. P. Athanas, R. Buehrer, R. McGwier, J. Reed, T. Clancy, "Software Defined Radio Technology Development," sensitive sponsor, **\$955K**, 2012-2015
40. T. Clancy, "Advanced Threat Development for Cognitive Electronic Warfare Platforms," Defense Advanced Research Projects Agency (DARPA/I2O), with MIT Lincoln Labs, **\$300K**, 2012-2013
41. T. Clancy, "Distributed/Cognitive EW for Agile/Adaptive Systems," Air Force Research Labs (AFRL), with MacAulay Brown, **\$142K**, 2012-2013
42. R. McGwier, T. Clancy, P. Athanas, J. Reed, R. Buehrer, A. Beex, "Advanced Wideband Systems and Technologies," sensitive sponsor, **\$8,690K**, 2012-2015
43. T. Clancy, R. McGwier, J. Reed, "Sharing and Shaping 4G Cellular Resources," Allied Minds Federal Innovations, **\$425K**, 2012-2013
44. J. White, C. Dietrich, J. Reed, T. Clancy, R. McGwier, "Software Defined Radio Deployment Optimization," sensitive sponsor, **\$205K**, 2012-2013
45. S. Sodagari, T. Clancy, R. McGwier, "Resilient Tactical SATCOM Using Cognitive Radio: Phase 1," Air Force Research Labs (AFRL), with Shared Spectrum Company, **\$40K**, 2012
46. T. Clancy, "Security and Robustness of TD-LTE for Public-Safety Communications," NSF Security and Software Engineering Research Center (S2ERC), **\$20K**, 2012
47. T. Clancy, D. Yao, M. Hsiao, J. Park, J. Tront, "S2ERC @ Virginia Tech Cyber Security Industry/University Cooperative Research Center," National Science Foundation (NSF), **\$325K**, 2011-2016
48. T. Clancy, R. McGwier, S. Sodagari, "Spectral Coexistence through Cognitive Radar," Office of Naval Research (ONR), with Shared Spectrum Company, **\$1,482K**, 2011-2014
49. T. Clancy, "Cognitive Electronic Warfare," Naval Research Laboratory (NRL), **\$297K**, 2011-2014
50. T. Clancy, "Android Smartphone System Security," L-3 Communications, **\$318K**, 2011-2012

51. T. Clancy, "High Performance IPv6 Security Gateway," Department of Homeland Security (DHS), with Centripetal Networks Inc, **\$35K**, 2011-2012
52. T. Clancy, "Android Operating System Security," Naval Postgraduate School (NPS), **\$109K**, 2011-2012
53. R. McGwier, T. Clancy, B. Agee, "Low-Cost Communications Satellite Design," Los Alamos National Labs (LANL), **\$292K**, 2011-2012
54. T. Clancy, R. Buehrer, "Cellular Network Security Research," Aerospace Corporation, **\$129K**, 2011-2012
55. T. Clancy, "Mobility and Spectrum Security Strategy and Policy," Office of the Assistant Secretary of Defense and Chief Information Officer (DOD CIO), with JHU Applied Physics Laboratory, **\$250K**, 2011-2012
56. T. Clancy, "Secure Spectrum Access Policy Research," Defense Advanced Research Programs Agency (DARPA/STO), with Shared Spectrum Company, **\$50K**, 2011-2012
57. T. Clancy, "Mobile Wireless Communications Research," JHU Applied Physics Laboratory (APL), **\$35K**, 2011
58. T. Clancy, "Cognitive Electronic Warfare," Virginia Tech Institute for Critical Technologies and Applied Sciences (ICTAS), **\$40K**, 2011
59. T. Clancy, "Dynamic Spectrum Access Security Study," Office of the Assistant Secretary of Defense for Networks and Information Integration (ASD-NII), with Shared Spectrum Company, **\$150K**, 2010-2011

## Research Agreements

### IDIQ Contract Vehicles

1. Army Research Labs, *C5ISR Integrated Operations for High Performance Computing*, subcontractor to Parsons, 2018–2026
2. US CYBERCOM, *Omnibus R&D*, subcontractor to SAIC, 2016–2021
3. Defense Intelligence Agency, *DORE*, subcontractor to CACI, 2015–2020
4. Defense Technical Information Center, *Cybersecurity Technical Area Task (CS-TAT)*, subcontractor to Macaulay Brown, 2015–2021
5. Defense Intelligence Agency, *E-SITE*, subcontractor to CACI and Occam, 2014–2019
6. US Army TACOM, *Omnibus III*, subcontractor to Leidos, 2014–2018
7. Air Force Research Labs, *ANSWER Program*, subcontractor to Macaulay Brown, 2014–2019
8. Air Force Research Labs, *SMIRF Program*, subcontractor to Macaulay Brown, 2014–2019
9. US Army CERDEC, *TAOSS Program*, subcontractor to Systemtek, 2013–2018
10. Air Force Research Labs, *Agile Cyber Technologies*, subcontractor to L-3 Communications, 2012–2018
11. Air Force Research Labs, *IDARE Program*, subcontractor to Macaulay Brown, 2012–2017

### Cooperative Research and Partnership Agreements

1. US Army CERDEC, *Cyber Operations*, CRADA, 2011–2021
2. CACI, *UAS Cybersecurity Research*, Partnership Agreement, 2015–2019



	3. Center for Innovative Technologies, <i>Mach37 Accelerator Testbed Support</i> , Partnership Agreement, 2013–2016	
	4. Defense Intelligence Agency, <i>Science and Technology Research</i> , CRADA, 2013–2016	
	5. National Intelligence University, <i>Cyber Education</i> , Partnership Agreement, 2012–2015	
	6. L-3 Communications, <i>National Security Research</i> , Partnership Agreement, 2011–2015	
<b>Current Students</b>	<b>PhD Students</b>	
	Dane Brown	2014–present
	Tugba Erpek	2013–present
	Michael Fowler (co-advised with R. Williams)	2012–present
	Ian Garrett	2019–present
	Seth Hitefield (co-advised with A. Butt)	2012–present
	Jason McGinthy (co-advised with A. Michaels)	2016–present
	<b>Masters Students (with thesis)</b>	
	Robert Smith	2015–present
	<b>Masters Students (non-thesis)</b>	
Adam Gorski	2019–present	
Ben Johnson	2018–present	
<b>Students Graduated</b>	<b>PhD Students</b>	
	1. Amr Abed, “Securing Cloud Containers through Intrusion Detection and Remediation,” PhD ECE, Virginia Tech, 2017	
	2. Mohamed Ghorbanzadeh, “Resource Allocation and End-to-End Quality of Service for Cellular Communications Systems in Congested and Contested Environments,” PhD ECE, Virginia Tech, 2015	
	3. Nathan Goergen (co-advised with R. Liu), “Extrinsic Channel-Like Fingerprinting for Transmitter Authentication in Wireless Systems,” PhD ECE, University of Maryland, 2011	
	4. Awais Khawar, “Spectrum Sharing between Radar and Communication Systems,” PhD ECE, Virginia Tech, 2015	
	5. Akshay Kumar (co-advised with R. Tandon), “Efficient Resource Allocation Schemes in Wireless Networks with Diverse Quality-of-Service Requirements,” PhD ECE, Virginia Tech, 2016	
	6. Matt La Pan, “Security Issues for Modern Communications Systems: Fundamental Electronic Warfare Tactics for 4G Systems and Beyond,” PhD ECE, Virginia Tech, 2014	
	7. Jasmin Mahal, “Analysis of Jamming Vulnerabilities and Antijam-Capabilities of Modern Wireless Communication Systems,” PhD ECE, Virginia Tech, 2018	
	8. Tim O’Shea, “Learning from Data in Radio Algorithm Design,” PhD ECE, Virginia Tech, 2017	
	9. Avik Sengupta (co-advised with R. Tandon), “Fundamentals of Cache Aided Wireless Networks,” PhD ECE, Virginia Tech, 2016	
	10. Chowdhury Shahriar, “Resilient Waveform Design for OFDM-MIMO Communication Systems,” PhD ECE, Virginia Tech, 2015	
11. Haya Shajaiah, “Resource Allocation with Carrier Aggregation for Spectrum Sharing in Cellular Networks,” PhD ECE, Virginia Tech, 2016		

12. Wile Sehery, "OneSwitch Data Center Architecture," PhD ECE, Virginia Tech, 2018

#### **Masters Students (with thesis)**

1. Yang Chen, "Robust Prediction of Large Spatio-Temporal Datasets," MS CS, Virginia Tech, 2013
2. Kiran Karra, "Wireless Distributed Computing on the Android Platform," MS ECE, Virginia Tech, 2012
3. Awais Khawar, "Spectrum Sensing Security in Cognitive Radio Networks," MS ECE, University of Maryland, 2010
4. Neelima Krishnan, "Android Hypovisors: Securing Mobile Devices through High-Performance, Light-Weight, Subsystem Isolation with Integrity Checking and Auditing Capabilities," MS CS, Virginia Tech, 2014
5. Rebecca Kurrle, "Resource Allocation for Smart Phones in 4G LTE-Advanced Carrier Aggregation," MS ECE, Virginia Tech, 2012
6. Marc Lerch, "Using Decoys as a Resiliency Mechanism in Spectrally Harsh DSA Environments," MS ECE, Virginia Tech, 2014
7. Zhongmin Ma, "Android Application Install-time Permission Validation and Run-time Malicious Pattern Detection," MS ECE, Virginia Tech, 2013
8. Andrew Pham, "An Implementation of Utility-Based Traffic Shaping on Android Devices," MS ECE, Virginia Tech, 2014
9. Kevin Ryland, "Software-Defined Radio Implementation of Two Physical Layer Security Techniques," MS ECE, Virginia Tech, 2017
10. David Sowers, "Architecture for Department of Defense Mobile Derived Credentials," MS ECE, Virginia Tech, 2014
11. Jeremy Tate, "Security Weaknesses of the Android Advertising Ecosystem," MS ECE, Virginia Tech, 2014

#### **Masters Students (non-thesis)**

1. Joel Anderson, "OP-TEE Structured Data Extension," MEng, ECE, Virginia Tech, 2018
2. Timothy Buttner, "RF Network on Chip (RF-NoC) based Polyphase Filter Bank Implementation," MEng ECE, Virginia Tech, 2015
3. Aaron Dougherty, "Wideband Signal Classification using Convolutional Neural Networks," MEng ECE, Virginia Tech, 2018
4. Kristina Freeman, "Applying Cognitive Radio Techniques in 5G Wireless," MEng ECE, Virginia Tech, 2012
5. Robert Horst, "Security in the LTE S1-MME Link," MEng ECE, Virginia Tech, 2014
6. Tyler Howell, "Influence of Concurrent Processing in a Microcontroller on AES Correlation Power Analysis Side Channel Attack," MEng ECE, Virginia Tech, 2015
7. James Massey, "Implementation of a Software-Based GPS Receiver," MEng ECE, Virginia Tech, 2014
8. John Narayan, "Mitigating Effects of Bit Errors on Block Cipher Encrypted Wireless Data Links," MEng ECE, Virginia Tech, 2013
9. Peter Nguyen, "Implementation of an Open Source LTE eNodeB," MEng ECE, Virginia Tech, 2016
10. Kruti Pandya, "Survey of Different Dirty Paper Coding Methods," MEng ECE, Virginia Tech, 2013

11. Tejas Patel, "MaxWell Lab – Over-the-Air Testbed for IEEE 802.16e," MS Telecommunications, University of Maryland, 2008
12. Yadu Raghu, "Analysis of Beamforming and MIMO for 5G Communication Systems," MEng ECE, Virginia Tech, 2018
13. Casandra Robinson, "Security in Autonomy: A Review of Security Considerations in Autonomous Systems," MEng ECE, Virginia Tech, 2017
14. Ruth Stoehr-Filipiak, "Algorithm and Performance Comparison of Convolutional Turbo Codes and Low-Density Parity Check Codes," MEng ECE, Virginia Tech, 2016
15. Korey Weeks, "Statistical Randomness of Pseudo-Random Number Generators," MEng ECE, Virginia Tech, 2018

#### Reserach Group Alumni in Tenure-Track Positions

1. "Ahmed Abdelhadi," University of Houston
2. "Ravi Tandon," University of Arizona
3. "Shabnam Sodagari," California State University Long Beach

### Publication Summary

#### Statistics on Publications

6	Books
62	Journal Papers
148	Conference Papers
7000+	Total Citations
42	H-Index
127	i10-Index

### Books

#### Books

1. H. Shajaiah, A. Abdelhadi, T. Clancy, *Internet of Things Performance and Security*, McGraw Hill, in preparation
2. A. Kumar, A. Abdelhadi, T. Clancy, *Design and Implementation of Practical Schedulers for M2M Uplink Networks Using MATLAB*, Springer, 184 pages, 2018
3. H. Shajaiah, A. Abdelhadi, T. Clancy, *Resource Allocation with Carrier Aggregation in Cellular Networks: Optimality and Spectrum Sharing*, Springer, 201 pages, 2018
4. A. Khawar, A. Abdelhadi, T. Clancy, *Spectrum Sharing between Radars and Communication Systems*, Springer, 102 pages, 2017
5. M. Ghorbanzadeh, A. Abdelhadi, T. Clancy, *Cellular Communications Systems in Congested Environments: Resource Allocation and End-to-End Quality of Service*, Springer, 247 pages, 2017
6. A. Khawar, A. Abdelhadi, T. Clancy, *MIMO Radar Waveform Design for Spectrum Sharing with Cellular Systems: A MATLAB Based Approach*, Springer, 59 pages, 2016

#### Book Chapters

1. T. Erpek, T. O'Shea, Y. Sagduyu, Y. Shi, T. Clancy, "Deep Learning for Wireless Communications," in *Developent and Analyiss of Deep Learning Architectures*, ed W. Pedrycz and S-M Chen, Springer, in press, 2019
2. A. Abdelhadi, T. Clancy, "Application-Aware Spectrum Sharing," in *Handbook of Cognitive Radio*, ed Wei Zhang, Springer, in press, 2019

### Journal Papers

#### Under Submission

1. A. Sengupta, S. Amuru, R. Tandon, R. Buehrer, T. Clancy, "Learning-Aided Collaborative Caching in Small Cell Networks," *IEEE Transactions on Cognitive Communications and Networking*, under submission
2. A. Abed, T. Clancy, "Intrusion Detection as a Service for Container-Based Clouds," *IEEE Transactions on Service Computing*, under submission
3. T. Erpek, T. O'Shea, T. Clancy, "Deep Learning-Based MIMO Communications for Spatial Multiplexing," *IEEE Transactions on Cognitive Communications and Networking*, under submission

#### **Published or Accepted for Publication**

1. A. Kumar, A. Abdelhadi, T. Clancy, "A Delay Optimal Multiclass Packet Scheduler for Generic M2M Uplink," *IEEE Systems Journal*, to appear
2. M. Azab, A. Abed, T. Clancy, "Resilient Intrusion Detection System for Cloud Containers," *International Journal of Communication Networks and Distributed Systems*, to appear
3. T. O'Shea, T. Clancy, K. Karra, "Radio Modulation Recognition Using Neural Networks Based Feature Learning," *Springer Neural Computing and Applications Journal*, to appear
4. H. Shajaiah, A. Abdelhadi, T. Clancy, "An Optimal Strategy for Determining True Bidding Values in Secure Spectrum Auctions," *IEEE Systems Journal*, available online
5. T. Clancy, "So you want to be a L337 H4x0r (Elite Hacker)? Careers in Cyber Operations," *ACM Crossroads (XRDS)*, vol. 24, (4), pp. 12–13, July 2018
6. M. Lichtman, M. Vondal, T. Clancy, J. Reed, "Antifragile Communications," *IEEE Systems Journal*, vol. 12, (1), pp. 659–670, March 2018
7. H. Shajaiah, A. Abdelhadi, T. Clancy, "Robust Resource Allocation with Joint Carrier Aggregation in Multi-Carrier Cellular Networks," *IEEE Transactions on Cognitive Communications and Networking*, vol. 4, (1), pp. 53–65, March 2018
8. T. O'Shea, T. Roy, T. Clancy, "Over the Air Deep Learning Based Radio Signal Classification," *IEEE Journal of Selected Topics in Signal Processing*, vol. 12, (1), pp. 168–179, February 2018
9. W. Seher, T. Clancy, "Flow Optimization in Data Centers with Clos Networks in Support of Cloud Applications," *IEEE Transactions on Network and Service Management*, vol. 14, (4), December 2017
10. M. Ghorbanzadeh, A. Abdelhadi, T. Clancy, "Application-Aware Resource Allocation of Hybrid Traffic in Cellular Networks," *IEEE Transactions on Cognitive Communications and Networking*, vol. 3, (2), pp. 226–241, June 2017
11. A. Kumar, R. Tandon, T. Clancy, "On the Latency and Energy Efficiency of Distributed Storage Systems," *IEEE Transactions on Cloud Computing*, vol. 5, (2), pp. 221–233, April 2017
12. J. Mahal, A. Khawar, A. Abdelhadi, T. Clancy, "Spectral Coexistence of MIMO Radar and MIMO Cellular System," *IEEE Transactions on Aerospace and Electronic Systems*, vol. 53, (2), pp. 655–668, April 2017
13. M. Lichtman, T. Clancy, J. Reed, "FSK-Based Reactive Jamming Piggybacking," *IEEE Communication Letters*, vol. 21, (1), pp. 68–71, January 2017

14. J. Mahal, T. Clancy, "The BER Analysis of OFDMA and SC-FDMA under Pilot-Assisted Channel Estimation and Pilot Jamming in Rayleigh Slow-Fading Channels," *Wiley Wireless Communications and Mobile Computing*, vol. 16, (15), pp. 2315–2328, October 2016
15. C. Shahriar, T. Clancy, R. McGwier, "Equalization Attacks against OFDM: Analysis and Countermeasures," *Wiley Wireless Communications and Mobile Computing*, vol. 16, (13), pp. 1809–1825, September 2016
16. M. Ghorbanzadeh, E. Visotsky, W. Yang, P. Moorut, T. Clancy, "Radar Interference into LTE Base Stations in the 3.5 GHz Band," *Elsevier Physical Communications*, vol. 20, pp. 33–47, September 2016
17. R. Tandon, S. Amuru, T. Clancy, R. Buehrer, "Towards Optimal Secure Distributed Storage Systems with Exact Repair," *IEEE Transactions on Information Theory*, vol. 62, (6), pp. 3477–3492, June 2016
18. A. Khawar, A. Abdelhadi, T. Clancy, "Coexistence Analysis between Radar and Cellular System in LoS Channel," *IEEE Antennas and Wireless Propagation Letters*, vol. 15, pp. 972–975, March 2016
19. M. La Pan, T. Clancy, R. McGwier, "Physical Layer OFDM Acquisition and Timing Synchronization Security," *Wiley Wireless Communications and Mobile Computing*, vol. 16, (2), pp. 177–191, February 2016
20. H. Shajaiah, A. Abdelhadi, T. Clancy, "Towards an Application-Aware Resource Scheduling with Carrier Aggregation in Cellular Systems," *IEEE Communication Letters*, vol. 20, (1), pp. 129–132, January 2016
21. M. Lichtman, J. Poston, S. Amuru, C. Shahriar, T. Clancy, R. Buehrer, J. Reed, "A Communications Jamming Taxonomy," *IEEE Security and Privacy*, vol. 14, (1), pp. 47–54, January 2016
22. H. Shajaiah, A. Abdelhadi, T. Clancy, "An Efficient Multi-Carrier Resource Allocation with User Discrimination Framework for 5G Wireless Systems," *Springer International Journal of Wireless Information Networks*, vol. 22, (4), pp. 345–356, December 2015
23. A. Abdelhadi, A. Khawar, T. Clancy, "Optimal Downlink Power Allocation in Cellular Networks," *Elsevier Physical Communication*, vol. 17, pp. 1–14, December 2015
24. A. Khawar, A. Abdelhadi, T. Clancy, "QPSK Waveform for MIMO Radar with Spectrum Sharing Constraints," *Elsevier Physical Communication*, vol. 17, pp. 37–57, December 2015
25. J. Narayan, S. Shukla, T. Clancy, "A Survey of Automatic Protocol Reverse Engineering Tools," *ACM Computing Surveys*, vol. 48, (3), December 2015
26. A. Kumar, A. Sengupta, R. Tandon, T. Clancy, "Dynamic Resource Allocation for Cooperative Spectrum Sharing in LTE Networks," *IEEE Transactions on Vehicular Technology*, vol. 64, (11), pp. 5232–5245, November 2015
27. A. Khawar, A. Abdelhadi, T. Clancy, "Target Detection Performance of Spectrum Sharing MIMO Radars," *IEEE Sensors Journal*, vol. 15, (9), pp. 4928–4940, September 2015
28. A. Abdelhadi, H. Shajaiah, T. Clancy, "A Multi-Tier Wireless Spectrum Sharing System Leveraging Secure Spectrum Auctions," *IEEE Transactions on Cognitive Communications and Networks*, vol. 1, (2), pp. 217–229, June 2015
29. C. Shahriar, M. La Pan, M. Lichtman, T. Clancy, R. McGwier, R. Tandon, S. Soda-gari, J. Reed, "PHY-Layer Resiliency in OFDM Communications: A Tutorial," *IEEE Communications Surveys & Tutorials*, vol. 17, (1), pp. 292–314, March 2015



30. S. Sodagari, T. Clancy, "On Singularity Attacks in MIMO Channels," *Wiley Transactions on Emerging Telecommunication Technologies*, vol. 26, (3), pp. 482–490, March 2015
31. A. Sengupta, R. Tandon, T. Clancy, "Fundamental Limits on Caching with Secure Delivery," *IEEE Transactions on Information Forensics and Security*, vol. 10, (2), February 2015
32. S. Amuru, R. Tandon, R. Buehrer, T. Clancy, "Retroactive Anti-Jamming for MISO Broadcast Channels," *IEEE Transactions on Information Theory*, vol. 60, (6), pp. 3593–3619, June 2014
33. J. Mitola, J. Guerci, J. Reed, Y. Yao, T. Clancy, Y. Chen, Y. Guo, H. Li, H. Man, R. McGwier, "Accelerating 5G QoE via Public-Private Spectrum Sharing," *IEEE Communications Magazine*, vol. 52, (5), pp. 77–85, May 2014
34. J. Park, J. Reed, A. Beex, T. Clancy, V. Kumar, B. Bahrak, "Security and Enforcement in Spectrum Sharing," *Proceedings of the IEEE*, vol. 102, (3), pp. 270–281, March 2014
35. G. Zaki, W. Plishker, S. Bhattacharyya, T. Clancy, J. Kuykendall, "Integration of Dataflow-based Heterogeneous Multiprocessor Scheduling Techniques in GNU Radio," *Journal of Signal Processing Systems*, Springer, vol. 70, (2), pp. 177–191, February 2013
36. J. Goodman, K. Rudd, T. Clancy, "Blind Multiuser Localization in Cognitive Radio Networks," *IEEE Communications Letters*, vol. 16, (7), pp. 1018–1021, July 2012
37. Y. Wu, B. Wang, R. Liu, T. Clancy, "Anti-Jamming Games in Multi-Channel Cognitive Radio Networks," *IEEE Journal on Selected Areas in Communications*, vol. 30, (1), pp. 4–15, January 2012
38. N. Goergen, W. Lin, R. Liu, T. Clancy, "Extrinsic Channel-Like Fingerprint Embedding for Authenticating MIMO Systems," *IEEE Transactions on Wireless Communications*, vol. 10, (12), pp. 4270–4281, December 2011
39. N. Goergen, W. Lin, R. Liu, T. Clancy, "Extrinsic Channel-Like Fingerprinting Overlays Using Subspace Embedding," *IEEE Transactions on Information Forensics and Security*, vol. 6, (4), pp. 1355–1369, December 2011
40. N. Goergen, R. Liu, T. Clancy, "Best Effort Cooperative Relaying," *IEEE Transactions on Wireless Communications*, vol. 10, (6), pp. 1833–1843, June 2011
41. T. Clancy, A. Khawar, T. Newman, "Robust Signal Classification using Unsupervised Learning," *IEEE Transactions on Wireless Communications*, vol. 10, (4), pp. 1289–1299, April 2011
42. B. Wang, Y. Wu, R. Liu, T. Clancy, "An Anti-Jamming Stochastic Game for Cognitive Radio Networks," *IEEE Journal on Selected Areas in Communications*, vol. 29, (4), pp. 877–889, April 2011
43. B. Wang, R. Liu, T. Clancy, "Evolutionary Cooperative Spectrum Sensing Game: How to Collaborate?," *IEEE Transactions on Communications*, vol. 58, (3), pp. 890–900, March 2010
44. Y. Wu, B. Wang, R. Liu, T. Clancy, "A Scalable Collusion-Resistant Multi-Winner Cognitive Spectrum Auction Game," *IEEE Transactions on Communications*, vol. 57, (12), pp. 3805–3816, December 2009
45. T. Clancy, "On the Use of Interference Temperature for Dynamic Spectrum Access," *Annals of Telecommunications*, Springer, vol. 64, (7), pp. 573–585, August 2009
46. B. Wang, Z. Ji, M. Abdulrehem, R. Liu, T. Clancy, "Primary-Prioritized Markov Approach for Dynamic Spectrum Allocation," *IEEE Transactions on Wireless Communications*, vol. 8, (4), pp. 1854–1865, April 2009

47. Y. Wu, B. Wang, R. Liu, T. Clancy, "Repeated Open Spectrum Sharing Game with Cheat-Proof Strategies," *IEEE Transactions on Wireless Communications*, vol. 8, (4), pp. 1922–1933, April 2009
48. B. Wang, Y. Wu, Z. Ji, R. Liu, T. Clancy, "Game Theoretical Mechanism Design for Cognitive Radio Networks with Selfish Users," *IEEE Signal Processing Magazine*, vol. 25, (6), pp. 74–84, November 2008
49. T. Clancy, "Secure Handover in Enterprise WLANs: CAPWAP, HOKEY, and 802.11r," *IEEE Wireless Communications*, vol. 15, (5), pp. 80–85, October 2008
50. T. Clancy, "Formalizing the Interference Temperature Model," *Wiley Journal on Wireless Communications and Mobile Computing*, vol. 7, (9), pp. 1077–1086, November 2007
51. T. Clancy, J. Hecker, T. O'Shea, E. Stuntebeck, "Applications of Machine Learning to Cognitive Radio Networks," *IEEE Wireless Communications*, vol. 14, (4), pp. 47–52, August 2007
52. A. Mishra, M. Shin, N. Petroni, T. Clancy, W. Arbaugh, "Proactive Key Distribution using Neighbor Graphs," *IEEE Wireless Communications*, vol. 11, (1), pp. 26–36, February 2004

## Conference Papers

### Under Submission

1. H. Shajaiah, M. Ghorbanzadeh, A. Abdelhadi, T. Clancy, "Application-Aware Resource Allocation based on Channel Information for Cellular Networks," *IEEE Wireless Communications and Networking Conference (WCNC)*, under submission
2. T. Erpek, Y. Sagduyu, T. O'Shea, T. Clancy, "Deep Learning for MIMO Communications via Expert System Pre-Training," *IEEE International Conference on Communications (ICC)*, under submission
3. A. Khawar, A. Abdelhadi, T. Clancy, "MIMO Radar and Cellular System Spatial Coexistence using Channel Modeling," *IEEE WCNC Workshop on Smart Spectrum*, under submission
4. A. Khawar, A. Abdelhadi, T. Clancy, "Interference Mitigation between Seaborne Radar and Cellular System using 3D Channel Modeling," *IEEE WCNC Workshop on Advanced 5G Radio Access Network Features and Performance*, under submission

### Published or Accepted for Publication

1. A. Kumar, A. Abdelhadi, T. Clancy, "Novel anomaly detection and classification schemes for Machine-to-Machine uplink," *IEEE BigData*, December 2018
2. J. Mahal, T. Clancy, "Jammer Blind Estimation of a Third-Party OFDM Channel," *IEEE Global Communications Conference (GLOBECOM)*, December 2018
3. J. Mahal, T. Clancy, "Analysis of Pilot-Spoofing Attack in MISO-OFDM System over Correlated Fading Channel," *IEEE Military Communications Conference (MILCOM)*, October 2018
4. S. Hitefield, M. Fowler, T. Clancy, "Exploiting Buffer Overflow Vulnerabilities in Software Defined Radios," *IEEE Conference on Computer and Information Technology (CIT)*, July 2018
5. M. Fowler, P. Tokekar, T. Clancy, R. Williams, "Constrained-Action POMDPs for Multi-Agent Intelligent Knowledge Distribution," *IEEE International Conference on Robotics and Automation*, May 2018

6. T. Erpek, T. O'Shea, T. Clancy, "Learning a Physical Layer Scheme for the Multi-Antenna Interference Channel," IEEE International Conference on Communications (ICC), May 2018
7. H. Shajaiah, A. Abdelhadi, T. Clancy, "Secure Power Scheduling Auction for Smart Grids Using Homomorphic Encryption," IEEE International Conference on Big Data (BigData), December 2017
8. T. O'Shea, T. Erpek, T. Clancy, "Physical Layer Deep Learning of Encodings for the MIMO Fading Channel," Allerton Conference on Communication, Control, and Computing, October 2017
9. J. Mitola, M. Vondal, K. Karra, J. Graham, T. Clancy, "Closed-Loop Cognitive Electronic Warfare Operations with Cyber Feedback," IEEE Military Communications Conference (MILCOM), October 2017
10. T. O'Shea, T. Roy, T. Clancy, "Learning Robust General Radio Signal Detection using Computer Vision Methods," IEEE Conference on Signals, Systems and Computers (Asilomar), October 2017
11. T. O'Shea, K. Karra, T. Clancy, "Learning Approximate Neural Estimators for Wireless Channel State Estimation," IEEE International Workshop on Machine Learning for Signal Processing (MLSP), September 2017
12. K. Ryland, T. Clancy, M. Lichtman, "Implementation of Two Physical Layer Security Techniques in OTA Systems," GNU Radio Conference, September 2017
13. T. O'Shea, K. Karra, T. Clancy, "Learning to Communicate: Channel Auto-encoders, Domain Specific Regularizers, and Attention," IEEE International Symposium on Signal Processing and Information Technology (ISSPIT), December 2016
14. A. Kumar, A. Abdelhadi, T. Clancy, "A Delay Efficient MAC and Packet Scheduler for Heterogeneous M2M Uplink," IEEE Global Communications Conference (GLOBECOM), December 2016
15. A. Sengupta, R. Tandon, T. Clancy, "Layered Caching for Heterogeneous Storage," IEEE Conference on Signals, Systems and Computers (Asilomar), November 2016
16. T. O'Shea, L. Pemula, D. Bhatra, T. Clancy, "Radio Transformer Networks: Attention Models for Learning to Synchronize in Wireless Systems," IEEE Conference on Signals, Systems and Computers (Asilomar), November 2016
17. H. Shajaiah, J. Mahal, T. Clancy, "Resource Management with Anti-Jamming Capability for Cognitive Space Communication Systems," IEEE Military Communications Conference (MILCOM), November 2016
18. J. Narayan, T. Clancy, "A Hidden Markov Model Approach for Automatic Closed Protocol Hop Synchronization," IEEE Military Communications Conference (MILCOM), November 2016
19. A. Kumar, A. Abdelhadi, T. Clancy, "A Delay Efficient Multiclass Packet Scheduler for Heterogeneous M2M Uplink," IEEE Military Communications Conference (MILCOM), November 2016
20. A. Kumar, A. Abdelhadi, T. Clancy, "A Delay-Optimal Packet Scheduler for M2M Uplink," IEEE Military Communications Conference (MILCOM), November 2016
21. M. Lichtman, J. Reed, T. Clancy, "Reactive Jammer Piggybacking: Achieving Antifragile Electronic Warfare," IEEE Military Communications Conference (MILCOM), November 2016
22. S. Hitefield, T. Clancy, "Flowgraph Acceleration with GPUs: Analyzing the Benefits of Custom Buffers in GNU Radio," Proceedings of the GNU Radio Conference (GRcon), September 2016

23. T. O'Shea, J. Corgan, T. Clancy, "Convolutional Radio Modulation Recognition Networks," International Conference on Engineering Applications of Neural Networks, September 2016
24. T. O'Shea, J. Corgan, T. Clancy, "Unsupervised Representation Learning of Structured Radio Communication Signals," IEEE International Workshop on Sensing Processing and Learning for Intelligent Machines (SPLINE), July 2016
25. T. Erpek, A. Abdelhadi, T. Clancy, "An Application-Aware Resource Block and Power Allocation for LTE," IEEE Systems Conference, April 2016
26. A. Kumar, A. Abdelhadi, T. Clancy, "An Online Delay Efficient Packet Scheduler for M2M Traffic in Industrial Automation," IEEE Systems Conference, April 2016
27. Y. Wang, A. Abdelhadi, T. Clancy, "Optimal Power Allocation for LTE Users with Different Modulations," IEEE Systems Conference, April 2016
28. H. Shajaiah, A. Abdelhadi, T. Clancy, "An Application-Aware Spectrum Sharing Approach for Commercial Use of 3.5 GHz Spectrum," IEEE Systems Conference, April 2016
29. A. Abdelhadi, F. Rechia, A. Narayanan, T. Teixeira, R. Lent, D. Benhaddou, H. Lee, T. Clancy, "Position Estimation of Robotic Mobile Nodes in Wireless Testbed using GENI," IEEE Systems Conference, April 2016
30. A. Abdelhadi, T. Clancy, "Network MIMO with Partial Cooperation between Radar and Cellular Systems," IEEE International Conference on Computing, Networking and Communications (ICNC), February 2016
31. A. Abdelhadi, T. Clancy, "Optimal Context-Aware Resource Allocation in Cellular Networks," IEEE International Conference on Computing, Networking and Communications (ICNC), February 2016
32. A. Abdelhadi, T. Clancy, "An Optimal Resource Allocation with Frequency Reuse in Cellular Networks," IEEE International Conference on Computing, Networking and Communications (ICNC), February 2016
33. A. Abed, T. Clancy, D. Levy, "Applying Bag of System Calls for Anomaly Detection in Linux Containers," IEEE Global Communications Conference (GLOBECOM), December 2015
34. M. Bari, A. Khawar, M. Doroslovacki, T. Clancy, "Recognizing FM, BPSK and 16-QAM using Supervised and Unsupervised Learning Techniques," IEEE Conference on Signals, Systems and Computers (Asilomar), November 2015
35. J. Mahal, C. Shahriar, T. Clancy, "Jamming and Nulling Attacks on Cyclic Prefix of SC-FDMA and Two Novel Countermeasures," IEEE Military Communications Conference (MILCOM), October 2015
36. M. Fowler, A. O'Donnell, D. DePoy, T. Clancy, "A Cognitive Subsystem for the Optimization of Radar Doctrine for Radar/Comms Coexistence," IEEE Military Communications Conference (MILCOM), October 2015
37. A. Abed, T. Clancy, D. Levy, "Intrusion Detection System for Applications using Linux Containers," International Workshop on Security and Trust Management, Lecture Notes in Computer Science, vol. 9331, pp. 123–135, September 2015
38. A. Sengupta, R. Tandon, T. Clancy, "Improved Approximation of Storage-Rate Trade-off for Caching via New Outer Bounds," IEEE International Symposium on Information Theory (ISIT), June 2015
39. H. Shajaiah, A. Abdelhadi, T. Clancy, "Spectrum Sharing Approach between Radar and Communication Systems and its Impact on Radar's Detectable Target Parameters," IEEE Vehicular Technology Conference (VTC), May 2015

40. W. Seher, T. Clancy, "Load Balancing in Data Center Networks with Folded-Clos Architectures," IEEE NetSoft Workshop on Management Issues in SDN and NFV, April 2015
41. H. Shajaiah, A. Abdelhadi, T. Clancy, "A Price Selective Centralized Algorithm for Resource Allocation with Carrier Aggregation in LTE Cellular Networks," IEEE Wireless Communications and Networking Conference (WCNC), March 2015
42. C. Shahriar, A. Abdelhadi, T. Clancy, "Overlapped-MIMO Radar Waveform Design for Coexistence with Communication Systems," IEEE Wireless Communications and Networking Conference (WCNC), March 2015
43. M. Ghorbanzadeh, E. Visotsky, P. Moorut, W. Yang, T. Clancy, "Radar In-band and Out-of-Band Interference into LTE Macro and Small Cell Uplinks in the 3.5 GHz Band," IEEE Wireless Communications and Networking Conference (WCNC), March 2015
44. M. Ghorbanzadeh, A. Abdelhadi, T. Clancy, "A Utility Proportional Fairness Radio Resource Block Allocation in Cellular Networks," IEEE International Conference on Computing, Networking and Communications (ICNC), February 2015
45. A. Abdelhadi, T. Clancy, "An Optimal Resource Allocation with Joint Carrier Aggregation in 4G-LTE," IEEE International Conference on Computing, Networking and Communications (ICNC), February 2015
46. M. Ghorbanzadeh, E. Visotsky, P. Moorut, W. Yang, T. Clancy, "Radar in-Band Interference Effects on Macrocell LTE Uplink Deployments in the U.S. 3.5 GHz Band," IEEE International Conference on Computing, Networking and Communications (ICNC), February 2015
47. M. Ghorbanzadeh, A. Abdelhadi, A. Amanna, J. Dwyer, T. Clancy, "Implementing an Optimal Rate Allocation Tuned to the User Quality of Experience," IEEE International Conference on Computing, Networking and Communications (ICNC), February 2015
48. A. Kumar, R. Tandon, T. Clancy, "On the Latency of Heterogeneous MDS Queue," IEEE Global Communications Conference (GLOBECOM), December 2014
49. M. La Pan, T. Clancy, R. McGwier, "A Machine Learning Approach for Dynamic Spectrum Access Radio Identification," IEEE Global Communications Conference (GLOBECOM), December 2014
50. J. Tate, T. Clancy, "Secure and Tamper Proof Code Management," ACM CCS Workshop on Cyber Security Analytics and Automation (SafeConfig), November 2014
51. M. Ghorbanzadeh, A. Abdelhadi, T. Clancy, "A Utility Proportional Fairness Resource Allocation in Spectrally Radar-Coexistent Cellular Networks," IEEE Military Communications Conference (MILCOM), October 2014
52. C. Shahriar, C. Cole, T. Clancy, "Performance Impact of Imperfect CSI on Spatial Hiding Anti-Jam Communications," IEEE Military Communications Conference (MILCOM), October 2014
53. C. Cole, C. Shahriar, T. Clancy, "An Anti-jam Communications Technique via Spatial Hiding Precoding," IEEE Military Communications Conference (MILCOM), October 2014
54. A. Khawar, A. Abdelhadi, T. Clancy, "On The Impact of Time-Varying Interference-Channel on the Spatial Approach of Spectrum Sharing between S-band Radar and Communication System," IEEE Military Communications Conference (MILCOM), October 2014
55. M. La Pan, T. Clancy, R. McGwier, "An Assessment of OFDM Carrier Frequency Offset Synchronization Security for 4G Systems," IEEE Military Communications Conference (MILCOM), October 2014



56. M. Lichtman, J. Peck, V. Arellano, J. Reed, T. Clancy, "An Electronic Warfare Perspective of LTE," IEEE Military Communications Conference (MILCOM), October 2014
57. S. Hitefield, M. Fowler, C. Jennette, T. Clancy, "Link Hijacking through Wireless Exploitation of a Vulnerable Software Defined Waveform," IEEE Military Communications Conference (MILCOM), October 2014
58. H. Shajaiah, A. Abdelhadi, T. Clancy, "Multi-Application Resource Allocation with Users Discrimination in Cellular Networks," IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC), September 2014
59. A. Sengupta, R. Tandon, T. Clancy, "Decentralized Caching with Secure Delivery," IEEE International Symposium on Information Theory (ISIT), July 2014
60. A. Sengupta, R. Tandon, T. Clancy, "Fundamental Limits of Caching with Secure Delivery," IEEE ICC Workshop on Wireless Physical Layer Security, June 2014
61. J. Mahal, T. Clancy, "The Closed-form BER Expressions of PSK Modulation for OFDM and SC-FDMA under Jamming and Imperfect Channel Estimation," IEEE International Conference on Communications (ICC), June 2014
62. R. Tandon, S. Amuru, T. Clancy, R. Buehrer, "Optimal Secure (3; 2; 2) and (4; 3; 3) Distributed Storage Systems with Exact Repair," IEEE International Conference on Communications (ICC), June 2014
63. Y. Chen, M. Ghorbanzadeh, K. Ma, T. Clancy, R. McGwier, "A Hidden Markov Model Detection of Malicious Android Applications at Runtime," IEEE Wireless & Optical Communications Conference (WOCC), May 2014
64. A. Sengupta, R. Tandon, T. Clancy, "Secure Caching with Non-Uniform Demands," IEEE Global Wireless Summit (GWS), May 2014
65. A. Khawar, A. Abdelhadi, T. Clancy, "A Mathematical Analysis of Cellular Interference on the Performance of S-band Military Radar Systems," IEEE Wireless Telecommunications Symposium (WTS), April 2014
66. A. Khawar, A. Abdelhadi, T. Clancy, "Spectrum Sharing between S-band Radar and LTE Cellular System: A Spatial Approach," IEEE DySPAN Workshop on Shared Spectrum Access for Radar and Communications (SSPARC) Technologies, April 2014
67. A. Khawar, A. Abdelhadi, T. Clancy, "MIMO Radar Waveform Design for Coexistence with Cellular Systems," IEEE DySPAN Workshop on Shared Spectrum Access for Radar and Communications (SSPARC) Technologies, April 2014
68. H. Shajaiah, A. Khawar, A. Abdelhadi, T. Clancy, "Resource Allocation with Carrier Aggregation in LTE Advanced Cellular System Sharing Spectrum with S-band Radar," IEEE DySPAN Workshop on Shared Spectrum Access for Radar and Communications (SSPARC) Technologies, April 2014
69. A. Abdelhadi, T. Clancy, "A Utility Proportional Fairness Approach for Resource Allocation in 4G-LTE," IEEE International Conference on Computing, Networking, and Communications (ICNC), February 2014
70. V. Kumar, J. Park, T. Clancy, K. Bian, "PHY-Layer Authentication Using Hierarchical Modulation and Duobinary Signaling," IEEE International Conference on Computing, Networking, and Communications (ICNC), February 2014
71. H. Shajaiah, A. Abdelhadi, T. Clancy, "Spectrum Sharing between Public Safety and Commercial Users in 4G-LTE," IEEE International Conference on Computing, Networking, and Communications (ICNC), February 2014
72. A. Khawar, A. Abdelhadi, T. Clancy, "Beampattern Analysis for MIMO Radar and Telecommunication System Coexistence," IEEE International Conference on Computing, Networking, and Communications (ICNC), February 2014

73. S. Amuru, R. Tandon, R. Buehrer, T. Clancy, "Jamming Countermeasures for Multi-User MISO Broadcast Channels: A DoF Perspective," IEEE Global Communications Conference (GLOBECOM), December 2013
74. H. Shajaiah, A. Abdelhadi, T. Clancy, "Utility Proportional Fairness Resource Allocation with Carrier Aggregation in 4G-LTE," IEEE Military Communications Conference (MILCOM), November 2013
75. S. Amuru, R. Tandon, R. Buehrer, T. Clancy, "Interference Alignment for MISO Broadcast Channels under Jamming attacks," IEEE Conference on Signals, Systems, and Computers (Asilomar), November 2013
76. A. Abdelhadi, T. Clancy, "A Resource Allocation Algorithm for Multi-Application Users in 4G-LTE," ACM MOBICOM Workshop on Cognitive Radio Architectures for Broadband (CRAB), October 2013
77. V. Kumar, J. Park, T. Clancy, K. Bian, "PHY-Layer Authentication by Introducing Controlled Inter Symbol Interference," IEEE Conference on Communications and Network Security (CNS), October 2013
78. A. Abdelhadi, T. Clancy, "A Robust Optimal Rate Allocation Algorithm and Pricing Policy for Hybrid Traffic in 4G-LTE," IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC), September 2013
79. M. Ghorbanzadeh, Y. Chen, T. Clancy, R. McGwier, "Fine-Grained End-to-End Network Model via Vector Quantization and Hidden Markov Processes," IEEE International Conference on Communications (ICC), June 2013
80. C. Shahriar, S. Sodagari, R. McGwier, T. Clancy, "Performance Impact of Asynchronous Off-tone Jamming Attacks Against OFDM," IEEE International Conference on Communications (ICC), June 2013
81. M. La Pan, T. Clancy, R. McGwier, "Phase Warping and Differential Scrambling Attacks against OFDM Frequency Synchronization," IEEE International Conference on Acoustics Speed and Signal Processing (ICASSP), May 2013
82. C. Shahriar, R. McGwier, T. Clancy, "Performance Impact of Pilot Tone Randomization to Mitigate OFDM Jamming Attacks," IEEE Consumer Communications and Networking Conference (CCNC), January 2013
83. M. Ghorbanzadeh, Y. Chen, K. Ma, T. Clancy, R. McGwier, "A Neural Network Approach to Category Validation of Android Applications," IEEE International Conference on Computing, Networking and Communications (ICNC), January 2013
84. Y. Chen, F. Chen, J. Dai, T. Clancy, "Student-T Based Robust Spatio-Temporal Prediction," IEEE International Conference on Data Mining (ICDM), December 2012
85. S. Sodagari, A. Khawar, T. Clancy, R. McGwier, "A Projection-Based Approach for Radar and Telecommunication Systems Coexistence," IEEE Global Conference on Communications (GLOBECOM), December 2012
86. S. Cannon, Y. Shlyak, F. Perich, M. McHenry, M. Lerch, R. McGwier, T. Clancy, "Detecting and Mitigating Primary User Emulation Attacks against DSA," IEEE Military Communications Conference (MILCOM), October 2012
87. M. La Pan, T. Clancy, R. McGwier, "Jamming Attacks against OFDM Timing Synchronization and Signal Acquisition," IEEE Military Communications Conference (MILCOM), October 2012
88. T. Tsou, T. Cooper, R. McGwier, T. Clancy, J. Reed, "Development of an Open-Source GSM Femtocell and Integrated Core Infrastructure," IEEE Military Communications Conference (MILCOM), October 2012
89. S. Sodagari, T. Clancy, "Efficient Jamming Attacks on MIMO Channels," IEEE International Conference on Communications (ICC), June 2012

90. C. Shahriar, S. Sodagari, T. Clancy, "Performance of Pilot Jamming on MIMO Channels with Imperfect Synchronization," IEEE International Conference on Communications (ICC), June 2012
91. S. Sodagari, T. Clancy, "An Anti-Jamming Strategy for Channel Access in Cognitive Radio Networks," Conference on Decision and Game Theory for Security (GameSec), November 2011
92. G. Zaki, W. Plishker, S. Bhattacharyya, T. Clancy, J. Kuykendall, "Vectorization and Mapping of Software Defined Radio Applications on Heterogeneous Multi-Processor Platforms," IEEE Workshop on Signal Processing Systems (SiPS), October, 2011
93. T. Clancy, "Efficient OFDM Denial: Pilot Jamming and Pilot Nulling," IEEE International Conference on Communications (ICC), June 2011
94. W. Plishker, G. Zaki, S. Bhattacharyya, T. Clancy, J. Kuykendall, "Applying Graphics Processor Acceleration in a Software Defined Radio Prototyping Environment," IEEE International Symposium on Rapid System Prototyping (RSP), May 2011
95. N. Goergen, W. Lin, R. Liu, T. Clancy, "Channel-Like Fingerprinting Overlays for Authenticating OFDM Signals Using Channel Side Information," APSIPA Annual Summit and Conference, December 2010
96. N. Goergen, W. Lin, R. Liu, T. Clancy, "Authenticating MIMO Transmissions Using Channel-Like Fingerprinting," IEEE Global Communications Conference (GLOBECOM), December 2010
97. T. Newman, T. Clancy, M. McHenry, J. Reed, "Case Study: Security Analysis of a Dynamic Spectrum Access Radio System," IEEE Global Communications Conference (GLOBECOM), December 2010
98. N. Goergen, T. Clancy, T. Newman, "Physical Layer Authentication Watermarks Through Synthetic Channel Emulation," IEEE Dynamic Spectrum Access Networks Conference (DySPAN), April 2010
99. N. Goergen, R. Liu, T. Clancy, "Best Effort Cooperative Communication using Non-Dedicated Relays," IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), March 2010
100. T. Clancy, T. OShea, "TRANSEC Mitigation Options for Wireless Metropolitan Area Networks," IEEE Military Communications Conference (MILCOM), December 2009
101. A. Khawar, T. Clancy, "Signal Classifiers using Self-Organizing Maps: Performance and Robustness," SDR Forum Technical Conference (SDR), November 2009
102. T. Clancy, A. Burnette, A. Agrawala, "MAXWell Lab: Building a WiMAX Forum Applications Laboratory," IEEE Mobile WiMAX Symposium, July 2009
103. T. Clancy, A. Khawar, "Security Threats to Signal Classifiers Using Self-Organizing Maps," International Conference on Cognitive Radio Oriented Wireless Networks and Communications (CrownCom), June 2009
104. T. Newman, T. Clancy, "Security Threats to Cognitive Radio Signal Classifiers," Virginia Tech Wireless Personal Communications Symposium, June 2009
105. T. Clancy, K. Hoeper, "Making the Case for EAP Channel Bindings," IEEE Sarnoff Symposium, March 2009
106. B. Wang, R. Liu, T. Clancy, "Evolutionary Game Framework for Behavior Dynamics in Cognitive Radio Networks," IEEE Global Communications Conference (GLOBECOM), December 2008
107. Y. Wu, B. Wang, R. Liu, T. Clancy, "Collusion-Resistant Multi-Winner Spectrum Auction for Cognitive Radio Networks," IEEE Global Communications Conference (GLOBECOM), December 2008

108. T. Clancy, R. McGwier, T. OShea, "On the Capacity of the Third-Party MIMO Receiver Channel," IEEE Military Communications Conference (MILCOM), November 2008
109. B. Walker, T. Clancy, J. Glenn, "Using Localized Random Walks to Model Delay-Tolerant Protocols," IEEE Military Communications Conference (MILCOM), November 2008
110. W. Lin, R. Liu, T. Clancy, "Modulation Forensics for Space Time Coding in Wireless Communications," SDR Forum Technical Conference (SDR), October 2008
111. Y. Wu, B. Wang, R. Liu, T. Clancy, "A Multi-Winner Cognitive Spectrum Auction Framework with Collusion-Resistant Mechanisms," IEEE Dynamic Spectrum Access Networks Conference (DySPAN), October 2008
112. M. Seligman, B. Walker, T. Clancy, "Delay-Tolerant Network Experiments of the MeshTest Wireless Testbed," ACM MobiCOM Challenged Networks Workshop (CHANTS), pp. 49–56, September 2008
113. A. Mills, B. Smith, T. Clancy, E. Soljanin, S. Vishwanath, "On Secure Communication over Wireless Erasure Networks," IEEE International Symposium on Information Theory (ISIT), pp. 161–165, July 2008
114. N. McCarthy, E. Blossom, N. Goergen, T. OShea, T. Clancy, "High-Performance SDR: GNU Radio and the IBM Cell Broadband Engine," Virginia Tech Wireless Personal Communications Symposium, June 2008
115. T. Clancy, N. Goergen, "Security in Cognitive Radio Networks: Threats and Mitigation," International Conference on Cognitive Radio Oriented Wireless Networks and Communications (CrownCom), May 2008
116. A. Soysal, S. Ulukus, T. Clancy, "Channel Estimation and Adaptive M-QAM in Cognitive Radio Links," IEEE International Conference on Communications (ICC), pp. 4043–4047, May 2008
117. B. Walker, T. Clancy, "A Quantitative Evaluation of the MeshTest Wireless Testbed," IEEE Conference on Testbeds and Research Infrastructures (TridentCom), March 2008
118. T. OShea, T. Clancy, H. Ebeid, "Practical Signal Detection and Classification in GNU Radio," SDR Forum Technical Conference (SDR), November 2007
119. T. Clancy, Z. Ji, B. Wang, R. Liu, "Planning Approach to Dynamic Spectrum Access in Cognitive Radio Networks," IEEE Global Communications Conference (GLOBECOM), November 2007
120. B. Walker, J. Glenn, T. Clancy, "Analysis of Simple Counting Protocols for Delay-Tolerant Networks," ACM MobiCOM Challenged Networks Workshop (CHANTS), pp. 19–26, September 2007
121. T. Clancy, "Dynamic Spectrum Access: The Capacity versus Complexity Tradeoff," Virginia Tech Symposium on Wireless Personal Communications, June 2007
122. T. Clancy, B. Walker, "MeshTest: Laboratory-Based Testbed for Large Wireless Topologies," IEEE Conference on Testbeds and Research Infrastructure (TridentCom), May 2007
123. T. Clancy, "Achievable Capacity under the Interference Temperature Model," IEEE Conference on Computer Communications (INFOCOM), pp. 794–802, May 2007
124. E. Stuntebeck, T. OShea, J. Hecker, T. Clancy, "Architecture for an Open-Source Cognitive Radio," SDR Forum Technical Conference (SDR), November 2006
125. T. Clancy, B. Walker, "Spectrum Shaping for Interference Management in Cognitive Radio Networks," SDR Forum Technical Conference (SDR), November 2006

126. T. Clancy, B. Walker, "Predictive Dynamic Spectrum Access," SDR Forum Technical Conference (SDR), November 2006
127. T. Clancy, W. Arbaugh, "Measuring Interference Temperature," Virginia Tech Symposium on Wireless Personal Communications, June 2006
128. T. Clancy, N. Kiyavash, D. Lin, "Secure Smartcard-Based Fingerprint Authentication," ACM SIGMM Workshop on Biometrics Methods and Applications (WBMA), pp 45–52, November 2003
129. N. Boston, T. Clancy, Y. Liow, J. Webster, "Genus Two Hyperelliptic Curve Coprocessor," Workshop on Cryptographic Hardware and Embedded Systems (CHES), Springer, LNCS vol. 2523, pp 400–414, August 2002
130. J. Predina, K. Gibbs, B. Dames, Z. Kissel, B. Brosmer, T. Clancy, K. Galamback, R. Smith, C. Zawistoski, "Use of Apodization to Improve the Quality of Radiometric Measurements from Interferometric Sounders," Twelfth International TOVS Study Conference, March 2002

#### **Invited Conference and Workshop Papers**

1. C. Carlson, V. Nguyen, S. Hitefield, T. OShea, T. Clancy, "Measuring Smart Jammer Strategy Efficacy Over the Air," IEEE CNS Workshop on Cognitive Radio and Electromagnetic Spectrum Security (CRESS), October 2014
2. S. Hitefield, V. Nguyen, C. Carlson, T. OShea, T. Clancy, "Demonstrated LLC-Layer Attack and Defense Strategies for Wireless Communication Systems," IEEE CNS Workshop on Cognitive Radio and Electromagnetic Spectrum Security (CRESS), October 2014
3. A. Sengupta, S. Amuru, R. Tandon, R. Buehrer, T. Clancy, "Learning Distributed Caching Strategies in Small Cell Networks," IEEE International Symposium on Wireless Communication Systems (ISWCS), August 2014
4. R. Tandon, S. Amuru, T. Clancy, R. Buehrer, "Distributed Storage Systems with Secure and Exact Repair - New Results," IEEE Information Theory and Applications (ITA), February 2014
5. M. Lichtman, J. Reed, M. Norton, T. Clancy, "Vulnerability of LTE to Hostile Interference," IEEE Global Conference on Signal and Information Processing (GlobalSIP), November 2013
6. T. Clancy, M. Norton, M. Lichtman, "Security Challenges with LTE-Advanced Systems and Military Spectrum," IEEE Military Communications Conference (MILCOM), November 2013
7. M. La Pan, M. Lichtman, T. Clancy, R. McGwier, "Protecting Physical Layer Synchronization: Mitigating Attacks against OFDM Acquisition," IEEE Global Wireless Summit (GWS), June 2013
8. T. Clancy, "Confluence of Electronic Warfare and Computer Network Attack," Emerging Technologies Conference, Lawrence Livermore National Labs, November 2011
9. C. Shahriar, S. Sodagari, T. Clancy, "Physical-Layer Security Challenges of DSA-Enabled TD-LTE," Conference on Cognitive Radio and Advanced Spectrum Management (CogArt), October 2011
10. S. Sodagari, T. Clancy, "Preemption, Fairness, and Security Dynamics in Heterogeneous DSA Environments," IEEE International Symposium on Personal, Indoor, and Mobile Radio Communications (PIMRC), September 2011



11. G. Zaki, W. Plishker, S. Bhattacharyya, E. Blossom, T. OShea, N. McCarthy, T. Clancy, "Integration of Dataflow Optimization Techniques into a Software Radio Design Framework," IEEE Conference on Signals, Systems, and Computers (Asilomar), November 2009
12. T. Clancy, M. Beecher, I. Vo, B. Walker, "A Demonstration of the MeshTest Wireless Testbed," IEEE Conference on Testbeds and Research Infrastructure (TridentCom), April 2009
13. T. Clancy, "Adaptation Overhead in Time-Varying Cognitive Radio Channels," IEEE CCNC Workshop on Cognitive Radio Networks (CRN), pp. 1009–1013, January 2008
14. T. Clancy, "FPGA-based Hyperelliptic Curve Cryptosystems," AMS Central Section Meeting, Special Session on Cryptography and Computational Number Theory, April 2003

## Technical Reports

### Technical Reports, Preprints, and Theses

1. A. Khawar, A. Abdelhadi, T. Clancy, "Shared Spectrum Access for MIMO Radar and MIMO Communications," Virginia Tech Hume Center Technical Report HC-R140013, September 2014
2. A. Khawar, A. Abdelhadi, T. Clancy, "On the Coherence Time of the Wireless Channel under Various Sea States," Virginia Tech Hume Center Technical Report HC-R140009, September 2014
3. A. Khawar, A. Abdelhadi, T. Clancy, "Performance of Spectrum Sharing MIMO Radars in LoS Channel Models," Virginia Tech Hume Center Technical Report HC-R140012, August 2014
4. A. Khawar, A. Abdelhadi, T. Clancy, "3D Channel Modeling between Radar and Communication Systems for Spectrum Sharing," Virginia Tech Hume Center Technical Report HC-R140011, August 2014
5. A. Khawar, A. Abdelhadi, T. Clancy, "Limits on Search/Track/Detect Volume Illuminated by Spectrum Sharing MIMO Radars," Virginia Tech Hume Center Technical Report HC-R140010, August 2014
6. A. Khawar, J. Mahal, A. Abdelhadi, T. Clancy, "A Realistic Channel Model for Radar/Cellular Coexistence in the 3.5 GHz Band," Virginia Tech Hume Center Technical Report HC-R140007, July 2014
7. J. Mahal, A. Abdelhadi, T. Clancy, "Impact of Location and Mobility on Radar/Cellular Coexistence in 3.5 GHz Band," Virginia Tech Hume Center Technical Report HC-R140006, July 2014
8. T. Clancy, W. Clark, "Fundamental Bounds on Learning in Cognitive Electronic Warfare Systems," Virginia Tech Hume Center Technical Report HC-R140005, March 2014
9. A. Khawar, A. Abdelhadi, T. Clancy, "Spectral Coexistence using MIMO Radar Platforms," Virginia Tech Hume Center Technical Report HC-R140002, March 2014
10. T. Clancy, "Security in Long Term Evolution and the Evolved Packet Core," Technical Report SR-2013-02, CTIA, October 2013
11. J. White, T. Clancy, "Security of BYOD Mobility Models," Technical Report SR-2013-01, CTIA, September 2013
12. N. Krishnan, S. Hitefield, T. Clancy, R. McGwier, J. Tront, "Multipersona Hypovisors: Securing Mobile Devices through High-Performance Light-Weight Subsystem Isolation," Virginia Tech CS Tech Report, TR-13-02, June 2013

13. T. Clancy, J. Mitola, A. Amanna, R. McGwier, J. Reed, "Comments on Amendment of the Commissions Rules with Regard to Commercial Operations in the 3550-3650 MHz Band," Federal Communications Commission, GN Docket No. 12-354, February 2013
14. T. Clancy, "Security Recommendations for Military Use of Dynamic Spectrum Access Technology," Hume Center Tech Report VT-HCNST-10-002, Virginia Tech, July 2011
15. T. Clancy, T. OShea, "Recommendations for Military Use of Wireless MAN Technology," Technical Report, Department of Defense, August 2009
16. T. Clancy, "Dynamic Spectrum Access in Cognitive Radio Networks," Ph.D. Dissertation, University of Maryland, April 2006
17. R. Blahut, T. Clancy, X. Hua, J. Kim, N. Kiyavash, M. Ma, K. Markandan, S. Mathur, M. Nigam, D. Pozdol, S. Song, S. Sriram, A. Suk, B. Wang, T. Wong, A. Vovchak, "Secure Middleware for Infrastructure Systems," Technical Report, Coordinated Science Laboratory, University of Illinois, January 2004
18. T. Clancy, "Analysis of FPGA-based Hyperelliptic Curve Cryptosystems," Masters Thesis, University of Illinois, December 2002

## Standards

### Published RFCs

1. S. Hartman (Ed), T. Clancy, K. Hoepfer, "Channel Binding Support for EAP Methods," RFC 6677, Proposed Standard, July 2012
2. T. Clancy, H. Tschofenig, "EAP Generalized PSK (GPSK)," RFC 5433, Proposed Standard, February 2009
3. S. Kelly, T. Clancy, "CAPWAP Threat Analysis for 802.11 Deployments," RFC 5418, Informational, December 2008
4. P. Calhoun, M. Montemurro, D. Stanley, B. O'Hara, R. Suri, N. Winget, S. Kelly, M. Williams, S. Hares, E. Rescola, P. Narasimhen, D. Harkins, S. Ponnuswamy, T. Clancy, "CAPWAP Protocol Specification," RFC 5415, Proposed Standard, December 2008
5. T. Clancy, M. Nakhjiri, V. Narayanan, L. Dondeti, "Handover Key Management and Re-Authentication Problem Statement," RFC 5169, Informational, March 2008
6. T. Clancy, W. Arbaugh, "EAP Password Authenticated Exchange," RFC 4746, Informational, November 2006

### Internet Drafts

1. T. Clancy, A. Lior (Ed), G. Zorn, K. Hoepfer, "EAP Method Support for Transporting AAA Payloads," draft-clancy-emu-aaapay, Standards Track, November 2010
2. T. Clancy, "HOKEY Re-authentication Protocol Plan," draft-clancy-hokey-plan, April 2007
3. T. Clancy, N. Petroni, W. Arbaugh, "Technique for Method-Specific Fast EAP Rekeying," draft-clancy-eap-rekeying, February 2004

## Intellectual Property

### Awarded Patents

1. T. Clancy, C. White, "Systems and methods for enforcing access control policies on privileged accesses for mobile devices," (US 9,787,681 awarded October 2017), filed January 2013

2. C. White, B. Dougherty, D. Hamrick, G. Sharpe, R. Hanlin, K. Zienkiewicz, C. Thompson, T. Clancy, "Systems and Methods for Enforcing Security in Mobile Computing," (US 9,773,107 awarded September 2017), filed January 2013
3. C. White, T. Clancy, B. Dougherty, "Systems and Methods for Enforcing Security in Mobile Computing," (US 9,712,530 awarded July 2017), filed January 2012
4. J. White, T. Clancy, "Systems and Methods to Enforce Security Policies on the Loading, Linking, and Execution of Native Code by Mobile Applications Running inside of Virtual Machines," (US 9,609,020 awarded March 2017), filed April 2013
5. J. White, B. Dougherty, T. Clancy, D. Hamrick, G. Sharpe, R. Hanlin, K. Zienkiewicz, C. Thompson, "Systems and Methods to Synchronize Data to a Mobile Device Based on a Device Usage Context," (US 9,578,445 awarded February 2017), filed March 2014
6. A. Amanna, T. Clancy, "Method of Network Sharing between Public Safety and Commercial Users," (US 9,544,778 awarded January 2017), filed March 2014
7. A. Amanna, J. Mitola, R. Tandon, T. Clancy, J. Reed, R. McGwier, A. Sengupta, A. Kumar, "System and Method for Heterogeneous Spectrum Sharing Between Commercial Cellular Operators and Legacy Incumbent Users in Wireless Networks," (US 9,516,508 awarded December 2016), filed March 2013
8. A. Amanna, J. Mitola, T. Clancy, J. Reed, R. McGwier, S. Hitefield, A. Pham, S. Bernales, M. Fowler, "System and Method of Distributed Data Management in Wireless Networks," US 9,391,749 awarded July 2016, filed March 2013
9. B. Dougherty, T. Clancy, J. White, D. Hamrick, G. Sharpe, R. Hanlin, K. Zienkiewicz, C. Thompson, "Systems and Methods for Restricting Access to Network Resources via In-Location Access Point Protocol," US 9,363,670 awarded June 2016, filed August 2012
10. I. Lee, S. Yun, W. Arbaugh, T. Clancy, M. Shin, "Authentication Method for Wireless Distributed System," (US 7,756,510 awarded July 2010; EP 1,722,589 awarded November 2006; CN 101,189,826 awarded November 2011), filed May 2006

#### **Filed Patents**

1. B. Dougherty, C. White, T. Clancy, D. Hamrick, G. Sharpe, R. Hanlin, K. Zienkiewicz, C. Thompson, "Systems and Methods to Secure Short-Range Proximity Signals," (US utility filing 14/210,240), filed March 2014
2. B. Dougherty, C. White, T. Clancy, D. Hamrick, G. Sharpe, R. Hanlin, K. Zienkiewicz, C. Thompson, "Systems and Methods for Enforcing Security in Mobile Computing," (International PCT/US13/20575), filed January 2013
3. T. Clancy, J. White, "Systems and Methods for Enhancing Mobile Device Security with a Processor Trusted Zone," (US utility filing 13/922,673), filed June 2012

#### **Filed Provisional Patents**

1. T. Clancy, R. McGwier, T. O'Shea, N. McCarthy, "Hierarchical Space System Objective-Driven Satellite System Task and Resource Scheduling System," (US provisional filing 62/575,128), filed October 2017
2. K. Karra, T. O'Shea, T. Clancy, "Learning Approximate Neural Estimators for Wireless Channel State Information," (US provisional filing 62/523,861), filed June 2017

3. A. Abdelhadi, T. Clancy, R. McGwier, J. Mitola, "System and Method for Optimal Resource Allocation Using Joint Carrier Aggregation," (US provisional filing 61/859,536), filed July 2013
4. H. Shajaiah, A. Abdelhadi, T. Clancy, "Utility Proportional Fairness Resource Allocation with Carrier Aggregation in 4G-LTE," (US provisional filing 61/828,624), filed May 2013
5. B. Dougherty, C. White, T. Clancy, D. Hamrick, G. Sharpe, R. Hanlin, K. Zienkiewicz, C. Thompson, "System and Method for Securing the Boot Process of a Device using Credentials Stored on an Authentication Token," (US provisional filing 61/779,931), filed March 2013
6. T. Clancy, R. Kurrle, A. Abdelhadi, "Method for Distributed Resource Allocation in LTE Networks Based on User Demand," (US provisional filing 61/787,317), filed March 2013
7. T. Clancy, J. Mitola, R. McGwier, A. Abdelhadi, "Method for Radio Resource Shadow Pricing," (US provisional filing 61/787,367), filed March 2013
8. J. Reed, H. Volos, R. Buehrer, K. Rele, M. Sohul, T. Clancy, R. McGwier, "Cognitive Radio Implementations for LTE," (US provisional filing 61/683,491), filed August 2012
9. S. Sodagari, A. Khawar, T. Clancy, R. McGwier, "A Projection Based Methodology for Radar and Telecommunication Systems Coexistence," (US provisional filing 61/646,453), filed May 2012
10. T. Clancy, N. Krishnan, S. Hitefield, "High Assurance Light-Weight Virtualization for Mobile Devices," (US provisional filing 61/614,005), filed March 2012
11. T. Clancy, J. White, B. Dougherty, "Method to Enforce Data Provenance in Mobile Computing," (US provisional filing 61/583,605), filed January 2012
12. J. White, T. Clancy, B. Dougherty, "Method to Enforce Security Policies using a Distributed Object-Oriented IPC Firewall," (US provisional filing 61/584,284), filed January 2012
13. T. Clancy, J. White, B. Dougherty, "Method to Protect against Malware Threats in Mobile Computing," (US provisional filing 61/583,610), filed January 2012

#### **Invention Disclosures (Not Filed as Patents)**

1. H. Shajaiah, A. Abdelhadi, T. Clancy, "Spectrum Sharing Between Public Safety and Commercial Groups of Users In 4G-LTE," Virginia Tech Intellectual Properties Disclosure 14-007, 2014
2. H. Shajaiah, A. Abdelhadi, T. Clancy, J. Mitola, "Multiple Stage Resource Allocation from Multiple Network Operators with Carrier Aggregation in 4G-LTE," Virginia Tech Intellectual Properties Disclosure 14-006, 2014
3. J. White, T. Clancy, "Method to Use a Mobile Device Management System to Prevent Information Exfiltration by Messaging Services," Virginia Tech Intellectual Properties Disclosure 12-007, 2012
4. T. Clancy, J. Reed, R. McGwier, "Method for the Use of Georeference Databases and Spectrum Sensing for Heterogeneous Spectrum Sharing in Mobile Broadband Networks," Virginia Tech Intellectual Properties Disclosure 12-125, 2012
5. T. Clancy, J. Reed, R. McGwier, "Method for Operating a Market for Sublicensed Access to Electromagnetic Spectrum," Virginia Tech Intellectual Properties Disclosure 12-124, 2012

## Media and Talks

6. A. Abdelhadi, T. Clancy, R. McGwier, J. Mitola, "Method for Optimal Resource Allocation with Carrier Aggregation for Cellular Networks," Virginia Tech Intellectual Properties Disclosure 12-163, 2012

### News Coverage and Commentary

1. "National Security Commentator: UK Terrorism Attack, Cybersecurity, Presidential Wiretapping Stories," Fox 5 News at 6:30pm (WTTG), March 22, 2017

### Radio and Podcasts

1. "5G Supply Chain and Chinese Equipment Bans," The CyberWire, December 6, 2018
2. "Virginia Cyber Range," The CyberWire, November 18, 2018
3. "Automotive Cell Phone Jammers," The CyberWire, November 8, 2018
4. "Cognitive Electronic Warfare," The CyberWire, October 18, 2018
5. "Software Defined Networking," The CyberWire, September 29, 2018
6. "University Partnerships in Cyber," The CyberWire, September 26, 2018
7. "Commonwealth Cyber Initiative," The CyberWire, September 7, 2018
8. "Radiofrequency Spectrum and Digital Communications," The CyberWire, July 27, 2018
9. "Supply Chain Security," The CyberWire, June 29, 2018
10. "Antifragile Communications," The CyberWire, June 14, 2018
11. "Location Services in Mobile Networks," The CyberWire, May 24, 2018
12. "5G Mobile Network Rollout," The CyberWire, April 27, 2018
13. "LTE Network Vulnerabilities," The CyberWire, April 13, 2018
14. "Analog Cybersecurity and Cyber-Physical Systems," The CyberWire, March 28, 2018
15. "NSA Makes Virginia Tech Center of Excellence in Cyber Operations," NPR Radio IQ (WVTF), May 26, 2017
16. "5G Mobile Technologies," The CyberWire, April 28, 2017
17. "Vault-7 vs. Shadowbrokers Impact," The CyberWire, April 18, 2017
18. "Telephony Control-Plane Security," The CyberWire, April 4, 2017
19. "End to End Encryption," The CyberWire, March 13, 2017
20. "Election Infrastructure as Critical Infrastructure," The CyberWire, February 24, 2017
21. "Security for the Internet of Things," NPR Radio IQ (WVTF), February 10, 2016
22. "Mobile Device Encryption Standards," The CyberWire, December 22, 2016
23. "Cybersecurity: 5G Cellular," Pulse of the Planet (NPR Syndicated), December 19, 2016
24. "Cybersecurity: Cloud to the Rescue," Pulse of the Planet (NPR Syndicated), December 16, 2016
25. "Cybersecurity: Cyber Warfare," Pulse of the Planet (NPR Syndicated), December 15, 2016

26. "Cybersecurity: IDing the Fridge," Pulse of the Planet (NPR Syndicated), December 14, 2016
27. "Cybersecurity: Cybercrime, hacktivism, espionage, and warfare," Pulse of the Planet (NPR Syndicated), December 9, 2016
28. "Cybersecurity: Hacking the Grid," Pulse of the Planet (NPR Syndicated), December 8, 2016
29. "Cybersecurity: Hacker to Defender," Pulse of the Planet (NPR Syndicated), December 7, 2016
30. "Dual Use Cybersecurity Solutions," The CyberWire, December 7, 2016
31. "Virginia Cyber Range," The CyberWire, November 18, 2016
32. "Quantum Information Processing and Encryption," The CyberWire, October 24, 2016
33. "Cybersecurity and Presidential Politics," The CyberWire, October 7, 2016
34. "Software Defined Networking," The CyberWire, September 29, 2016
35. "MedSec/Muddy Waters," The CyberWire, September 20, 2016
36. "5G Wireless," The CyberWire, August 9, 2016
37. "Smart Cities," The CyberWire, July 25, 2016
38. "Data Privacy," The CyberWire, July 11, 2016
39. "Transportation Cybersecurity," The CyberWire, June 22, 2016
40. "Cyber Threat Information Sharing," The CyberWire, June 15, 2016

#### **Print Media**

1. "It's time cellphone signal jammers were installed in people's steering wheels," LA Times, November 2018
2. "Shooting for the Moon, VCU Joins State Higher Education Push in Cybersecurity," Richmond Times Dispatch, September 2018
3. "Virginia Tech Paves Way for Research Partnerships and Start-ups," Alexandria News, September 2018
4. "Sands Touts Tech's Accomplishments in State of the University Address," Roanoke Times, September 2018
5. "Commonwealth Cyber Initiative Takes Next Steps with Meeting of Executive Committee," Augusta Free Press, September 2018
6. "The Cybersecurity 202: Cellphone spying has lawmakers worried. But they don't know how to stop it.," Washington Post, June 2018
7. "As Congress Examines Telecommunications Industry Challenges, Threats To Competition And National Security Remain Key Focus Areas," JD Supra, May 2018
8. "Blackburn, Walden, Lance examine U.S. telecom cybersecurity," The Ripon Advance, May 2018
9. "Cyber Moon Shot," Washingtonian Magazine, May 2018
10. "Governor McAuliffe: Virginia Tech Innovative AI Defense Against Cyber-attacks is "Cutting-edge"," Washington DC CityBizList, December 13, 2017



11. "Experts at Virginia Tech, RU discuss cybersecurity breaches," Roanoke Times, November 19, 2017
12. "Workforce development, partnerships cited as key to securing wireless cybersecurity," Cabling Installation and Maintenance, July 16, 2017
13. "Workforce development and partnerships key to securing wireless technology," Augusta Free press, July 15, 2017
14. "Security Alert: Hill Digs Into Innovating with IoT while Protecting Consumers," Cablefax, July 15, 2017
15. "Lawmakers Voice Fears over Security of Internet Devices," The Hill, June 14, 2017
16. "Rep. Pallone: GOP Playing Politics With National Security," Multichannel, June 13, 2017
17. "Higher Ed Stepping in to Fill Cybersecurity Gaps," Education Drive, May 31, 2017
18. "Policy implications of WikiLeaks dump differ from Snowden leaks," Washington Examiner, March 13, 2017
19. "Herndon start-up HawkEye360 wants to send fleets of tiny satellites into orbit," Washington Post, November 23, 2016
20. "Local inventors win cybersecurity patent," Fauquier Now, September 29, 2016
21. "SAIC donates \$750,000 to Virginia Techs Hume Center for National Security and Technology," Intelligence Community News, November 4, 2014
22. "Inside the New Arms Race to Control Bandwidth on the Battlefield," Wired, March 2014
23. "L-3, Virginia Tech open joint National Security Solutions Center," Washington Technology, October 5, 2012
24. "L-3, Va. Tech Partner for Arlington Cyber Center; Les Rose Comments," Executive Biz, October 2, 2012
25. "L-3, Virginia Tech open cybersecurity center," Washington Post, September 30, 2012

### **Press Coverage**

1. "HawkEye 360 Selects Deep Space Industries to Manufacture Pathfinder Small Satellites," Business Wire, May 2016
2. "HawkEye 360 Expands Management Team to Accelerate Commercial Development of Space-Based Radio Frequency Mapping and Analytics Technology," Business Wire, April 2016
3. "CACI Becomes Anchor Partner in Cyber-Physical System Security Program With Virginia Tech Hume Center," Business Wire, February 2016
4. "Allied Minds Announces the Formation of HawkEye 360," Business Wire, September 2015
5. "Optio Labs Names Mobile Industry Veteran Gregg Smith as Chief Executive Officer," Business Wire, December 2014
6. "Federated Wireless Applauds FCC for Adopting Three-Tier Spectrum Sharing Network and Recommends That the Exclusion Zones Be Eliminated to Broaden Access Further," Business Wire, July 2014

7. “Mobile Security Software Developer Optio Labs Raises \$10 Million in Series A Round,” Business Wire, March 2014
8. “Optio Labs Appoints Mobile and Cyber Security Industry Veteran Matt Hartley as General Manager to Drive Commercial Expansion,” Business Wire, August 2013

### **Congressional Testimony**

1. “Witness, Bolstering Data Privacy and Mobile Security: An Assessment of IMSI Catcher Threats,” US House of Representatives, Committee on Science, Space, and Technology, Subcommittee on Oversight, Washington, DC, June 2018
2. “Witness, Telecommunications, Global Competitiveness, and National Security,” US House of Representatives, Energy and Commerce Committee, Communications and Technology Subcommittee, Washington, DC, May 2018
3. “Witness, Promoting Security in Wireless Technology,” US House of Representatives, Energy and Commerce Committee, Communications and Technology Subcommittee, Washington, DC, June 2017

### **Invited Talks**

1. “Speaker, 5G Security and Defense Applications,” Defense Science Board, Arlington, VA, December 2018
2. “Speaker, IoT Security Moonshot,” Smart Cities Working Group, Mobile World Congress, Los Angeles, CA, September 2018
3. “Speaker, Playing Mind Games in the Electromagnetic Battlespace,” J8 Workshop on Cognitive Electronic Warfare, Pentagon, Arlington, VA, June 2018
4. “Speaker, Mobile Phone and Mobile Network Security,” Federal Communications Commission, Washington, DC, May 2018
5. “Speaker, CyberX and IoT Security,” Virginia Tech Wireless Symposium, Arlington, VA, April 2018
6. “Keynote, Blockchain, Beyond the Buzzwords,” Blacksburg Blockchain Symposium, Blacksburg, VA, April 2018
7. “Speaker, Virginia Tech and Cybersecurity Innovation,” Blu Ventures Cyber Summit, Tysons Corner, VA, February 2018
8. “Speaker, Cybersecurity Careers,” National Veterans Training Workshop, Arlington, VA, September 2017
9. “Organizer, Artificial Intelligence and Machine Learning Panel,” AFCEA/INSA Intelligence and National Security Summit, Washington, DC, September 2017
10. “Moderator, Leveraging Broader Federal Funding for I/UCRCs,” NSF Industry/University Cooperative Research Center Conference, Arlington, VA, July 2017
11. “Panelist, Partnering with Academia: Growing Relationships between the IC and Academia,” IC STEM Recruitment Summit, Bethesda, MD, June 2017
12. “Moderator, Cyber Threat Sharing,” Commonwealth Conference on National Defense and Intelligence, Charlottesville, VA, June 2017
13. “Panelist, Emerging Technology: Internet of Things,” LMI Research Institute Government-University Forum, Vienna, VA, May 2017
14. “Panelist, Cybersecurity Challenges and What Congress Can Do About It,” Virginia Tech Roundtable on Capitol Hill, Washington, DC, March 2017

15. "Speaker/Panelist, Cybersecurity for Commercial Aviation," United Technologies Research Center, East Hartford, CT, March 2017
16. "Speaker, 5G, IoT, and Edge Computing," Bround Bag Seminar, G2 Inc, Annapolis Junction, MD, February 2017
17. "Panelist, Machine Learning: Research and Applications," IEEE Global Signal and Information Processing (GlobalSIP), Washington, DC, December 2016
18. "Moderator, Force Multipliers to Future Cybersecurity," NVTC Capital Cybersecurity Conference, Vienna, VA, November 2016
19. "Moderator, Commercialization of State of the Art Cyber Research Panel," Virginia Tech Enterprise Forum: The Evolution and Expansion of Cybersecurity, Arlington VA, October 2016
20. "Moderator, IoT as a Game Changer Panel," Virginia Governor's Cyber-Physical Systems Summit, Newport News, VA, September 2016
21. "Keynote, Deep Neural Signal Processing," GNU Radio Annual Conference (GRcon), Boulder, CO, September 2016
22. "Speaker, Challenges and Opportunities with Power Infrastructure Cybersecurity," IEEE Power and Energy Society MD Section, Baltimore, MD, September 2016
23. "Speaker, Challenges and Opportunities with Power Infrastructure Cybersecurity," IEEE Power and Energy Society VA/DC Section, Arlington, VA, June 2016
24. "Moderator, Cyber Careers Panel," Business Higher Education Forum CyberLeaders Kickoff, Arlington, VA, June 2016
25. "Keynote, Cybersecurity for the IoT," ForeScout Best Practice Seminar, Washington, DC, May 2016
26. "Moderator, Harnessing the Next Technological Revolution Panel," AFCEA Intelligence Symposium, Springfield, VA, April 2016
27. "Panelist, Academic Panel," Northrop Grumman Executive Symposium, Falls Church, VA, March 2016
28. "Speaker, Electronic Warfare in Modern Military Operations," Information Warfare Guest Lecture, Georgetown University, Washington, DC, February 2016
29. "Panelist, Assured Communications," IEEE Military Communications Conference, Tampa, FL, October 2015
30. "Speaker, Cybersecurity Risks to Connected Vehicles and Smart Infrastructure," ITS America Webinar, October 2015
31. "Speaker, Cognition and Autonomy in Electronic Warfare Platforms," Electromagnetic Spectrum Operations Summit, Alexandria, VA, May 2015
32. "Speaker, Cognitive Electronic Warfare: An Information Theory and Machine Learning Perspective," Association of Old Crows Luncheon, Arlington, VA, March 2015
33. "Speaker, Information Security and Privacy in the Mobile World," Virginia Tech Presidential Installation Academic Showcase, Blacksburg, VA, October 2014
34. "Speaker, Applications of Cognition to MIMO Radar for Spectrum Sharing," Cognitive RF Workshop, Army Research Labs, Adelphi, MD, June 2014
35. "Speaker, Risk-Based Cybersecurity Regulation and the NIST Framework," CIO Summit, Richmond, VA, June 2014
36. "Speaker, Broadband Access and the Digital Divide," Virginia Wireless Association Seminar, Alexandria, VA, May 2014

37. "Speaker, Future Directions in Cyber Warfare and Electronic Warfare," Naval Postgraduate School Foundation Roundtable, Washington, DC, April 2014
38. "Speaker, Future Directions in Cyber Warfare and Electronic Warfare," Virginia Military Institute Seminar, Lexington, VA, April 2014
39. "Speaker, Convergence of Electronic Warfare and Cyber Warfare: First Principals," Cyber/EW CAG, L-3 Communications, Arlington, VA, March 2014
40. "Speaker, The Science of Electronic Warfare: Bounds on Target Knowledge," Sensors Directorate Seminar, Air Force Research Labs, Dayton, OH, February 2014
41. "Speaker, Control Theory and the Dynamics of Cybersecurity," EECS With-It Seminar, Vanderbilt University, Nashville, TN, January 2014
42. "Speaker, Spectrum Sharing to Support Commercial use of Military Spectrum," Classified US Military Communications Conference, McLean, VA, November 2013
43. "Keynote, Broadband Access and the Digital Divide," Exploring Loudoun Countys Digital Divide, Ashburn, VA, November 2013
44. "Speaker, Cybersecurity Research, Education, and Outreach at Virginia Tech," Dulles Chamber Innovate Conference, Dulles, VA, October 2013
45. "Speaker, Security Challenges with LTE-Advanced Systems and Military Spectrum," IEEE Communications Society (COMSOC) Baltimore Section, Linthicum, MD, October 2013
46. "Speaker, Vulnerability Assessment of Emerging Mobile Core Networks," Cellular Telephone Industry Association (CTIA), Cybersecurity Working Group Meeting, Washington, DC, October 2013
47. "Speaker, Security and Management of Android Devices," Google Federal Technology Workshop, Washington, DC, June 2013
48. "Speaker, How Secure is Your Smartphone," Wireless @ Virginia Tech Advisory Board Meeting, Blacksburg, VA, May 2013
49. "Speaker, Cyber-Physical Security: Hacking the Internet of Things," Virginia Tech Black Swan Seminar, Blacksburg, VA, April 2013
50. "Speaker, Secure Mobility: From RF to Apps," Electrical and Computer Engineering Seminar, Virginia Tech, Blacksburg, VA, April 2013
51. "Speaker, Research Directions in Security," Research Day, Virginia Tech Center for Embedded Systems and Critical Applications, Arlington, VA, March 2013
52. "Speaker, Cyber Warfare: Intersection of Technology and Analytics," DIA Five Eyes Analytic Training Workshop, Harrisonburg, VA, February 2013
53. "Speaker, Jamming and Next-Generation Commercial Waveforms," DOD CIO LTE Jamming Technical Exchange Meeting, McLean, VA, February 2013
54. "Speaker, Security and Management of Android Devices," Google Mobile Security Forum, Washington, DC, November 2012
55. "Panelist, Cybersecurity Education," Cyber Innovation Symposium, Intelligence and National Security Alliance (INSA), Washington, DC, September 2012
56. "Panelist, Cyber Education and Research at Virginia Tech," NSA Information Assurance Symposium, Nashville, TN, August 2012
57. "Speaker, Cybersecurity for Mobile Broadband Networks," Cellular Telephone Industry Association (CTIA), Cybersecurity Working Group, Arlington, VA, July 2012
58. "Speaker, Cybersecurity Innovation and Research," Virginia Tech Intelligence and Defense Executive Alumni Event, Arlington, VA, June 2012

59. "Speaker, Wireless and Mobile Security Trends," Center for High Assurance Computer Systems Seminar, Naval Research Laboratory, Washington, DC, June 2012
60. "Speaker, Security and Robustness of TD-LTE for Public Safety Applications," Security and Software Engineering Research Center (S2ERC) Showcase, Arlington, VA, May 2012
61. "Speaker, Cognitive Radar for Spectrum Coexistence," Communications Research Gathering, Office of Naval Research, Washington, DC, May 2012
62. "Speaker, Mobile Security Research and Trends," Northrop Grumman Mobile Community of Interest, McLean, VA, May 2012
63. "Speaker, Cybersecurity Research and Education at Virginia Tech," Cybersecurity Workshop and Panel, Office of Congressman Jim Moran, Arlington, VA, April 2012
64. "Speaker, Electronic Warfare and Cyber Warfare," Association of Old Crows, Naval Research Labs, Washington, DC, April 2012
65. "Speaker, Tactical ISR Challenges with 5G Cellular Communications," US Marine Radio Battalion Users Conference, Monterey, CA, April 2012
66. "Panelist, Cybersecurity Research and Development at Virginia Tech," Northern Virginia Technology Council, Vienna, VA, March 2012
67. "Moderator, Securing the Mobile Frontier," Executive Discussion on Cybersecurity and Mobility, Washington, DC, February 2012
68. "Speaker, Electronic Warfare in a Cyber Battlefield," IDGA Network Enabled Operations Summit, Alexandria, VA, January 2012
69. "Speaker, Making Sense of Intelligence through Visualization," ManTech WoW Technical Conference, Stafford, VA, September 2011
70. "Speaker, Security's Promising Directions and Biggest Challenges," Security and Software Engineering Research Center Workshop, Ball State University, Muncie, IN, May 2011
71. "Speaker, International Technology and Policy Impact of Cyber Warfare," Virginia Tech Cybersecurity Summit and Competition, Blacksburg, VA, April 2011
72. "Panelist, Cybersecurity Panel," Special Session on National Security: Cybersecurity & Wireless Communications, Howard University, Washington, DC, September 2010
73. "Speaker, An Insider's View of Working for the US Federal Government," Intelligence Community Center of Academic Excellence Seminar, Virginia Tech, Blacksburg, VA, September 2010
74. "Speaker, TRANSEC and COMSEC Recommendations for a Military WiMAX Profile," DoD 802.16 Secure Profile Industry Day, McLean, VA, July 2009
75. "Speaker, Using Game Theory to Analyze Spectral Fairness and Robustness to Adversarial Agents in DSA Networks," DSO Workshop on Dynamic Spectrum Access, Arlington, VA, June 2009
76. "Speaker, Security Threats to Intelligent Networks," Department Seminar, Universidad de Murcia, Spain, May 2009
77. "Speaker, New protocol standards for wireless mobility: CAPWAP and HOKEY," Security for Seamless Mobility Forum, IEEE Globecom 2008, New Orleans, December 2008
78. "Speaker, Game Theory and Dynamic Spectrum Access," Emerging Spectrum Technology Workshop, DISA Defense Spectrum Organization, March 2008

79. "Speaker, Security Threats to Intelligent Wireless Networks," Security and Privacy for 4G Workshop, IEEE Globecom 2007, Washington, DC, November 2007
80. "Panelist, Securing Next-Generation Mobile Networks: How Far Are We?," Security and Privacy for 4G Workshop, IEEE Globecom 2007, Washington, DC, November 2007
81. "Speaker, Challenges in Signal Detection and Identification," SASDCRT Symposium, Naval Postgraduate School, Monterey, CA, September 2007
82. "Speaker, Software-Defined and Cognitive Radio," University of Maryland Telecommunications Seminar, College Park, MD, February 2007
83. "Speaker, Whither WiMAX," Red Blue (ReBl) Symposium, Johns Hopkins Applied Physics Lab, Laurel, MD, October 2006
84. "Speaker, Open-Source Cognitive Radio," SASDCRT Symposium, Naval Postgraduate School, Monterey, CA, September 2006
85. "Speaker, Unlicensed Devices in Licensed Bands," Communications Seminar, University of Illinois Urbana-Champaign, Urbana, IL, May 2006
86. "Speaker, CAPWAP System Security," CAPWAP Working Group, Internet Engineering Task Force, Vancouver, BC, November 2005
87. "Speaker, Interference Temperature Multiple Access," Virginia Tech Wireless Seminar, Blacksburg, VA, November 2005
88. "Speaker, EAP Password Authenticated Exchange," EAP Working Group, Internet Engineering Task Force, San Diego, CA, August 2004
89. "Speaker, Password Authentication in the Wireless World," Rose-Hulman Institute of Technology, Terre Haute, IN, March 2004
90. "Speaker, Provably Secure Middleware for Distributed Application Development," Boeing Phantomworks, Seattle, WA, November 2003
91. "Speaker, FPGA-Based Hyperelliptic Curve Cryptosystems," AMS Central Section Meeting, Indiana University, Bloomington, April 2003
92. "Speaker, On the Feasibility and Security of Biometric Cryptosystems," Rose-Hulman Institute of Technology, Terre Haute, IN, March 2003