

# 5G

## IEEE Workshop on 5G Technologies for Tactical and First Responder Networks

Johns Hopkins Applied Physics Laboratory, Laurel, Maryland

October 7, 2019, 8:00 AM–6:00 PM



# WELCOME

On behalf of IEEE, the world's largest professional organization advancing technology for humanity, and the Johns Hopkins Applied Physics Laboratory (APL), welcome to the 2nd Annual Workshop on 5G Technologies for Tactical and First Responder Networks.

This one-day workshop is designed to bring together government, industry, and academic communities to discuss the opportunities and challenges that emerging 5G technologies pose for a broad spectrum of government, tactical, and first responder missions. The workshop will also serve as a catalyst to help define government use cases, drive standards, and investigate network deployments suitable for tactical and first responder networks using 5G and beyond technologies.

Today's presentations will focus on the technical and mission impacts of 5G on government applications, including defense, national security, and emergency preparedness. Take advantage of the breaks incorporated throughout the day to network with other attendees and to visit with the exhibitors who have helped to support this event.

At the conclusion of the day's proceedings, please join your hosts for a reception to continue discussions over hors d'oeuvres and drinks.

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# SCHEDULE

7:30 a.m.	<b>Registration</b>		
8:30 a.m.	<b>Welcome Remarks</b> John Forte, Johns Hopkins Applied Physics Laboratory		
8:45 a.m.	Keynote 1: Paradigm Shift: First Responders Impact on 5G CDR John K. Merrill, U.S. Coast Guard (Ret.) Department of Homeland Security S&T		
	<b>Government And Regulator Sub-Track</b>		
9:15 a.m.	FCC's Actions to Ensure U.S. Leadership in 5G Julius Knapp, Federal Communications Commission		
9:35 a.m.	Enabling Service Continuity for First Responder Communications Dr. David Griffith, National Institute for Standards and Technology		
9:55 a.m.	NSF Support for Next Generation Wireless Networks and Dynamic Spectrum Sharing Dr. Alexander Sprintson, National Science Foundation		
10:15 a.m.	Exhibits and Demos		
10:30 a.m.	Keynote 2: Learning at the Edge Prof. Vince Poor, Princeton University		
	<b>Research Labs Sub-Track</b>		
11:00 a.m.	5G in Crisis and Emergency Operations Dr. Tony DeSimone, Johns Hopkins Applied Physics Laboratory		
11:20 a.m.	5G Security: Building Blocks for Secure and Resilient Networks Dr. Charles Clancy, MITRE		
11:40 a.m.	Leveraging 5G Networks for Tactical Army Communications: The Good, The Bad, and The Ugly Jack Burbank, Sabre Systems		
12:00 p.m.	Networking Lunch		
	<b>Operator Sub-Track</b>		
1:00 p.m.	AT&T 5G Optimization and Reliability Dr. Kathy Meier-Hellstern, AT&T		
1:20 p.m.	5G Empowering the Smart Network Dr. Sanyogita Shamsunder, Verizon		
1:40 p.m.	Role of Satellite Communications for Public Safety in the 5G Era Dr. Lin-Nan Lee, Hughes Networks		
		<b>Test, Tools, And Measurement Sub-Track</b>	
2:00 p.m.		5G Explores Options to Address Reliability and Latency James Kimery, National Instruments	
2:20 p.m.		Test Assets for 5G Tactical and Public Safety Networks Dr. Raymond Shen, Keysight	
2:40 p.m.		5G for Airborne Mobile Telemetry Dr. Tony Triolo, Perspecta Labs	
3:00 p.m.		Exhibits and Demos	
		<b>Vendor Sub-Track</b>	
3:20 p.m.		5G eMBB is Here! More 5G is Coming! Dr. Ed Tiedeman, Qualcomm	
3:40 p.m.		IEEE 802.11: Wi-Fi 6 and Beyond Dorothy Stanley, HPE, IEEE 802.11 Chair	
4:00 p.m.		Non-Terrestrial Networks for 5G New Radio Dr. Rapeepat Ratasuk, Nokia	
4:20 p.m.		Heterogeneous Integration and How it Enables 5G Modules Frank Ferrante, Intel	
4:40 p.m.		Keynote 3: DoD and 5G Dr. Lisa Porter, Deputy Undersecretary of Defense (R&E)	
		<b>Open Source Sub-Track</b>	
5:10 p.m.		Towards the Construction of Reliable 5G Infrastructure Dr. Hiroaki Kamoda, METI	
5:30 p.m.		SDN-Enabled Mobile Edge Cloud Enabling Tactical and First Responder Networks Dr. Oguz Sunay, Open Networking Foundation	
5:50 p.m.		An Overview of the Open Air Interface Community and Applications in Public-Safety Networks Prof. Raymond Knopp, Open Air Interface	
6:10 p.m.		City Scale Testbed for Emergency Orchestration with ONAP/ORAN Dr. Ivan Seskar, WINLAB	
6:30 p.m.		Wrap-up and Closing Remarks	
6:30 p.m.		Reception	

# SPEAKERS



**MR. JACK L. BURBANK** is a senior wireless network engineer at Sabre Systems, where he helps design, develop, and evaluate next-generation wireless capabilities for the U.S. Army. He is an expert in the areas of wireless networking, modeling and simulation, wireless system development, and wireless network security. He has also published over 50 technical papers on topics of wireless networking (both terrestrial-based and space-based), and contributed to multiple books related to wireless networking. Mr. Burbank has authored books on the subjects of wireless networking and modeling and simulation. He is active within IEEE, acting as technical reviewer, organizer, chair, and associate technical editor for numerous IEEE conferences and periodicals. Mr. Burbank is editor of the Wiley-IEEE Press book series on IEEE standards. He earned bachelor's and master's degrees in electrical engineering from North Carolina State University.



**DR. CHARLES CLANCY** is vice president for Intelligence Programs at The MITRE Corporation. In this role, he leads the organization's technical strategy, priorities, and program delivery in support of the intelligence community. He is an internationally recognized expert on topics at the intersection of wireless, cybersecurity, and artificial intelligence. He has co-authored six books and more than 250 patents and peer-reviewed academic publications. He has also been heavily involved in wireless security protocol standardization and held leadership positions within the Internet Engineering Task Force, Wireless Innovation Forum, and Institute for Electronics and Electrical Engineers. In 2015, he was elected to the prestigious AFCEA Intelligence Committee. He holds a bachelor's degree in computer engineering from Rose-Hulman Institute of Technology, a master's degree in electrical engineering from the University of Illinois at Urbana-Champaign, and a Ph.D. in computer science from the University of Maryland College Park.



**DR. ANTONIO DESIMONE** is the chief scientist for communications systems at the Johns Hopkins' Applied Physics Laboratory (APL). He is the principal technical leader for APL's efforts in National Security Communications. Prior to joining APL, he led product teams in Lucent's Optical Networking Unit and Lucent Digital Video, a pioneer in high-definition television encoding. He started his career at AT&T Bell Laboratories, where he did work in network design, performance analysis, network and computer security, wireless, digital video, and storage networking. He holds 10 patents in data networking, web caching, and other internet applications and has authored numerous technical publications. He holds a bachelor's degree from Rensselaer Polytechnic Institute, and a master's degree and Ph.D. from Brown University, all in physics.



**MR. FRANK FERRANTE** is the director of the Military, Aerospace and Government division within Intel Corporation's Network & Custom Logic Group (NCLG). He was an employee of Altera for 7 years before the company was acquired by Intel in 2015. He holds a bachelor's degree in electrical engineering from Manhattan College and has spent most of his career working on E/W and radar systems.



**MR. JOHN FORTE** is the mission area executive for APL's Homeland Protection Mission Area. His programs focus on securing the nation and its interests against asymmetric, terrorist-type attacks of catastrophic consequence through applied technology and systems engineering. He serves on the Board of Advisors to Johns Hopkins University's Information Security Institute. He also serves as the co-director for the Johns Hopkins Institute for Assured Autonomy, a national center of excellence ensuring the safe, secure, reliable, and predictable integration of autonomous systems into society by covering the full spectrum of research across the three pillars of technology, ecosystem, and policy and governance. He earned a bachelor's degree in electrical engineering from the University of Tulsa, and a master's degree in electrical engineering from George Washington University.



**DR. DAVID GRIFFITH** is an electrical engineer in the Wireless Networks Division of the Communications Technology Laboratory at the National Institute of Standards and Technology (NIST). At NIST, he has worked on techniques for improving the resiliency of optical networks including: optical burst-switched networks, communications systems for smart grid, and characterizing signaling overhead in the IEEE 802.21 Media Independent Handover (MIH) protocol. He is currently working on public safety communications (including device-to-device communications), and on resource allocation in 5G wireless networks. Prior to working at NIST, he spent several years at various companies working on modeling satellite communications systems. Dr. Griffith earned his doctorate in electrical engineering at the University of Delaware.



**MR. JAMES KIMERY** is director of marketing for RF, communications, and software defined radio (SDR) initiatives at National Instruments (NI), responsible for the company's communication system design and SDR strategies. He also manages NI's advanced research RF/Communications Lead User program. Prior to joining NI, he was the director of marketing for Silicon Laboratories' wireless division, which later became a subsidiary of ST-Ericsson. Under his leadership, the division produced several industry innovations, including the first integrated CMOS RF synthesizer and transceiver for cellular communications, the first digitally controlled crystal oscillator, and the first integrated single-chip phone (AeroFONE). The IEEE voted AeroFONE one of the top 40 innovative ICs ever developed. He has authored nearly 30 technical papers and articles covering a variety of wireless and test and measurement topics. He earned a bachelor's degree in electrical engineering from Texas A&M University, and a master's degree in business administration from The University of Texas at Austin.



# SPEAKERS



**DR. HIROAKI KAMODA** is the director for policy planning of the Cybersecurity Division at the Ministry of Economy, Trade and Industry (METI), Japan. METI formulated the Cyber/Physical Security Framework (CPSF), an overview of security measures that industries are required to take. He is currently striving to disseminate the CPSF among major industries and to promote discussions on specific security measures that respective industries need. He was the general manager of the cybersecurity section in NTT DATA Japan and led many cybersecurity consulting projects and secure system integration projects. He has researched the formal methods as a visiting researcher of Fraunhofer FOKUS, Germany, and Imperial College London. He was also the guest professor of Shizuoka University and the cybersecurity advisor of Aichi Prefectural Police. He received a Ph.D. in engineering from Osaka University.



**MR. JULIUS KNAPP** has been with the FCC for 44 years and has served as the chief of the FCC's Office of Engineering and Technology (OET) since 2006. OET is the Commission's primary resource for engineering expertise and provides technical support to the chairman, commissioners, and FCC bureaus and offices. He has received numerous awards, including the FCC's Silver and Gold Medal Awards for distinguished service at the Commission as well as the Presidential Distinguished Rank Award for exceptional achievement in the career Senior Executive Service. He was also granted the Federal Communications Bar Association Excellence in Government Service Award, the WCAI Government Leadership Award, the National Spectrum Management Association Fellow Award, the Association of Federal Communications Consulting Engineers E. Noel Luddy Award, the Satellite Industry Association Satellite Leadership in Government Award, and the Dynamic Spectrum Alliance Lifetime Achievement Award. Mr. Knapp is a Life Member of the IEEE. He earned a bachelor's degree in electrical engineering from the City College of New York.



**PROF. RAYMOND KNOPP** is a professor in the Communication Systems Department at EURECOM. He is also currently a part-time visiting professor at the Beijing University of Posts and Telecommunications under the Discipline Innovative Engineering Plan. His current research and teaching interests are in the area of digital communications, software radio architectures, and implementation aspects of signal processing systems and real-time wireless networking protocols. Prof. Knopp has a proven track record in managing both fundamental and experimental research projects at an international level and is currently president of the OpenAirInterface.org academia-industry radio platform initiative, which aims to bridge the gap between cutting-edge theoretical advances in wireless communications and practical designs through a 3GPP-compatible open source code collaboration model. He earned bachelor's and master's degrees in electrical engineering from McGill University, Montreal, Canada.



**DR. LIN-NAN LEE** is the vice president of advance development at Hughes (an EchoStar company). His research activity spans many fundamental communications disciplines, such as channel coding, modulation, multiple access, and signal processing and data compression. He is currently involved in the 3GPP standardization process for the 5G wireless standard. Dr. Lee's main focuses have been to incorporate satellite communications as part of the 5G wireless network of networks, and a grant-free Non-Orthogonal Multiples Access technique optimized for massive Machine Type Communications. Prior to Hughes, he worked for Communications Satellite Corporation (COMSAT), serving in various research and development positions in the COMSAT Laboratory, and as chief scientist of the COMSAT System Division. Dr. Lee earned his bachelor's degree from National Taiwan University, and a master's degree and Ph.D. from the University of Notre Dame.



**DR. KATHLEEN (KATHY) MEIER-HELLSTERN** is the assistant vice president of Optimization, Reliability & Customer Analytics (ORCA) for AT&T's Advanced Technology & Services Organization. She is a versatile technology, telecommunications, and data science executive utilizing a unique combination of optimization, artificial intelligence, in-depth technology, and business expertise to create best-in-class analytics tools and software for emerging services. Dr. Meier-Hellstern is currently charged with delivering enhanced analytic tools and software for AT&T's 5G and Next Generation networks. In recognition of her outstanding leadership and execution, she was named an AT&T Fellow in 2017 for significant contributions to performance and reliability of the company's networks and services. Recognized as a thought leader and industry expert, Meier-Hellstern is the author of four book chapters, 24 issued or in-progress patents, and 30 publications. She is an active member of the Institute of Electrical & Electronics Engineering (IEEE). She earned a bachelor's degree in mathematics from Millersville State College, and a master's degree and Ph.D. in operations research from University of Delaware.



**COMMANDER JOHN K. MERRILL**, U.S. Coast Guard (Retired), currently serves as the executive director of the Department of Homeland Security (DHS) First Responders and Detection (FRD) division as well as the Next Generation First Responder (NGFR) Apex Program director. Leading FRD, CDR Merrill oversees four key operating components: Countering Weapons of Mass Destruction Office, Federal Emergency Management Agency, Federal Law Enforcement Training Center, and First Responders. Under his leadership, NGFR is developing and integrating cutting-edge technologies to make responders better protected, connected, and fully aware – allowing for a more effective and efficient response to disasters of all sizes. CDR Merrill has successfully established a model for the NGFR program that expands industry involvement and collaboration with the nation's first responders. Prior to joining NGFR in 2014, CDR Merrill was formerly the senior policy and technical advisor for DHS on GPS interference, detection, mitigation, and radio frequency spectrum management. He is a 28-year veteran of the U.S. Coast Guard and has worked in program and policy management, radio navigation, maritime law enforcement, search and rescue, vessel traffic services, and telecommunications. CDR Merrill, a native of Maine, holds Masters of Science degrees in both management of secure information systems and systems engineering from George Mason University, as well as Bachelor of Science degrees in both electrical engineering and electronics engineering from Capitol Technology University.

# SPEAKERS



**PROF. H. VINCENT POOR** is the Michael Henry Strater University Professor of Electrical Engineering at Princeton University. His research interests include information theory and signal processing, and their applications in wireless networks, energy systems, and related fields. He is a member of the National Academy of Engineering and the National Academy of Sciences, and is a foreign member of the Royal Society and other national and international academies. He received IEEE Alexander Graham Bell Medal in 2017. He holds a Ph.D. in electrical engineering and computer science from Princeton, and has also received honorary doctorates for a number of universities in Asia, Europe, and North America.



**DR. LISA PORTER** is the deputy under secretary of defense for research and engineering (DUSD(R&E)), and with the USD(R&E), is responsible for the research, development, and prototyping activities across the DoD enterprise. In addition, the USD and DUSD oversee the activities of the Defense Advanced Research Projects Agency (DARPA), the Missile Defense Agency, the Strategic Capabilities Office, Defense Innovation Unit, the DoD Laboratory and Engineering Center enterprise, and the Under Secretariat staff focused on developing advanced technology and capability for the U.S. military. She previously served as executive vice president of In-Q-Tel (IQT) and director of IQT Labs. Prior to joining IQT, she was the president of Teledyne Scientific & Imaging. She was the first director of the Intelligence Advanced Research Projects Activity (IARPA) in the Office of the Director of National Intelligence (ODNI), and also previously served as the associate administrator for the Aeronautics Research Mission Directorate at the National Aeronautics and Space Administration (NASA). She also served as a program manager and senior scientist at DARPA. She received the Office of the Secretary of Defense Medal for Exceptional Public Service in 2005, the NASA Outstanding Leadership Medal in 2008, the National Intelligence Distinguished Service Medal in 2012, and the Presidential Meritorious Rank Award in 2013. She holds a bachelor's degree in nuclear engineering from the Massachusetts Institute of Technology and a doctorate in applied physics from Stanford University.



**DR. RAPEEPAT RATASUK** is a principal research specialist with Nokia Bell Labs. He has extensive experience in cellular system design and analysis, including algorithm development, performance analysis and validation, physical-layer modeling, and simulations. His current research areas are in the areas of 5G wireless networks, mmWave, and machine-type communications. He has more than 70 issued patents and published more than 70 journal and conference papers. He is a co-author of the book titled "Essentials of LTE and LTE-A." He received a Ph.D. in electrical engineering from Northwestern University.



**MR. IVAN SESKAR** is an associate director at Rutgers University's Wireless Information Network Laboratory (WINLAB), where he is responsible for experimental systems and prototyping projects. He is currently the program director for the COSMOS project responsible for the New York City NSF PAWR deployment. He is also the principal investigator for the NSF GENI Wireless project, which resulted in campus deployments of LTE/WiMAX base stations at several U.S. universities, and for the NSF CloudLab deployment at Rutgers. He has served as the co-PI and project manager for all three phases of the NSF-supported ORBIT mid-scale testbed project at WINLAB, successfully leading technology development and operations since the testbed was released as a community resource in 2005 and receiving the 2008 NSF Alexander Schwarzkopf Prize for Technological Innovation (a team award). He is a co-chair of the IEEE 5G Testbed Working Group, a Senior Member of the IEEE, a member of ACM, and the co-founder and CTO of Upside Wireless Inc.



**DR. SANYOGITA SHAMSUNDER** is the vice president of 5G Labs and Innovation at Verizon. Previously, she was director of Advanced Wireless and Mobile Technology Planning, and has led the 5G network planning and device technologies teams at Verizon. She has directed and managed teams in all areas of the wireless business, including silicon, network technology development, marketing, planning, and strategy. She received an MBA from The Wharton School, and a Ph.D. in electrical engineering and math from The University of Virginia.



**DR. RAYMOND SHEN** directs Spectrum Monitoring and Field Test Solutions at Keysight Technologies. In this role, he leads Keysight's spectrum monitoring group, managing a vast portfolio of solutions that include handheld, outdoor, and modular platforms. He has more than 20 years of experience in spectrum monitoring and signal demodulation, with expertise in cellular signals. He has a bachelor's degree in electrical engineering from the California Institute of Technology (CalTech) and a master's degree and Ph.D. in electrical engineering from Stanford University.



**DR. ALEX SPRINTSON** serves as a program director in the Directorate of Computer & Information Science and Engineering (CISE) at the National Science Foundation. He manages networking research within the Networking Technologies and Systems (NeTS) and Secure and Trustworthy Cyberspace (SaTC) programs. Dr. Sprintson is also a faculty member in the Department of Electrical and Computer Engineering at Texas A&M University, College Station, where he conducts research on wireless networks, distributed storage, and software-defined networking. He received the Wolf Award for Distinguished Ph.D. students, the Viterbi Postdoctoral Fellowship, the TAMU College of Engineering Outstanding Contribution award, and the NSF CAREER award. From 2013 and 2019 he served as an associate editor of the IEEE Transactions on Wireless Communications. He has been a member of the Technical Program Committee for the IEEE Infocom 2006-2020.

# SPEAKERS



**MS. DOROTHY STANLEY** is an HPE Fellow and head of standards strategy at Aruba Networks, a Hewlett Packard Enterprise company. She currently serves as chair of the IEEE 802.11 Working Group. She is also chair of the IEEE 802.11REVmd Task Group (responsible for maintenance and revision of the 802.11 standard), and has chaired the IEEE 802.11REVmc, 802.11REVmb, and IEEE 802.11v Wireless Network Management task groups. She has served in numerous leadership roles in Wi-Fi Alliance and is co-chair of the IETF-IEEE 802 coordination committee. Before joining Aruba Networks, she was a consulting member of the technical staff at Agere Systems for Wave-lan products and a distinguished member of the technical staff at Lucent Technologies and AT&T Bell Laboratories. Her responsibilities included system architecture, software development, and capacity and performance analysis for digital switching systems and fixed wireless systems. Among Ms. Stanley's awards are five patents, a WFA Members Achievement Award, WFA Special Recognition Awards for contributions and service to WFA, and IEEE Standards Association awards for contributions to numerous IEEE 802.11 standards.



**DR. OGUZ SUNAY** is the chief architect at Open Networking Foundation, where he leads efforts on a 5G mobile edge cloud platform that is suitable for both operator and private enterprise deployment scenarios, and is built on the pillars of open source, SDN, NFV, and cloud. He was previously the chief technology officer at Netsia, where he was the innovator of a Programmable Radio Access Network Architecture (ProgRAN) for 5G that enabled the world's first dynamically programmable RAN slicing solution. He also held prior positions at Nokia Research Center and Bell Laboratories, as well as in academia. He holds more than 40 U.S. and European patents on various aspects of 3G, 4G, and 5G.



**DR. EDWARD G. TIEDEMANN JR.** is a Qualcomm Fellow and a senior vice president of Engineering of Qualcomm Technologies, Inc. He leads Qualcomm's worldwide standardization and industry organization activities. Dr. Tiedemann was instrumental in the design and development of the TIA/EIA/IS-95 CDMA system, also called cdmaOne™. He led Qualcomm and much of the industry's efforts in the design and development of the third-generation cdma2000® system. Dr. Tiedemann holds over 200 U.S. patents and has participated in many papers, conference lectures, and industry panels. He is chairman of the Board of the Open Connectivity Foundation, and sits on the board of several other industry organizations. He holds a bachelor's from Virginia Polytechnic Institute and State University (Virginia Tech), a master's from Purdue University, and a doctorate from MIT, where he worked in the areas of queueing theory and communications networks.

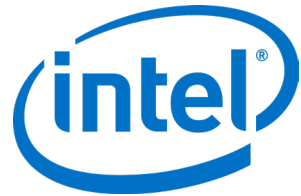
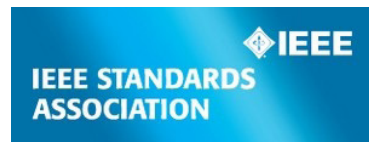


**DR. ANTHONY A. (TONY) TRIOLO** serves as chief scientist and senior manager at Perspecta Labs and is a member of the Executive Committee of the National Spectrum Consortium (NSC). As chief scientist, he is responsible for programs related to custom uses of commercial cellular equipment and other high-performance signal processing programs. He is currently principal investigator for the NSC Cellular Range Telemetry effort, where Perspecta Labs is developing appliques that allow COTS LTE equipment to be used to provide aeronautical telemetry service to aircraft travelling at speeds up to Mach 2. He is responsible for the Device to Device for Public Safety effort, where his team is developing an open source standards-based implementation of 3GPP Proximity Services to enable first responders to communicate with each other when cellular infrastructure is down. Over the past 20 years, he has provided leadership in many wireless technology areas, such as propagation measurement and modeling, spectrum management systems, dynamic spectrum access systems, and distributed and multi-antenna signal processing. He is also leading several other efforts to adapt cellular equipment for operation in contested tactical environments.





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