

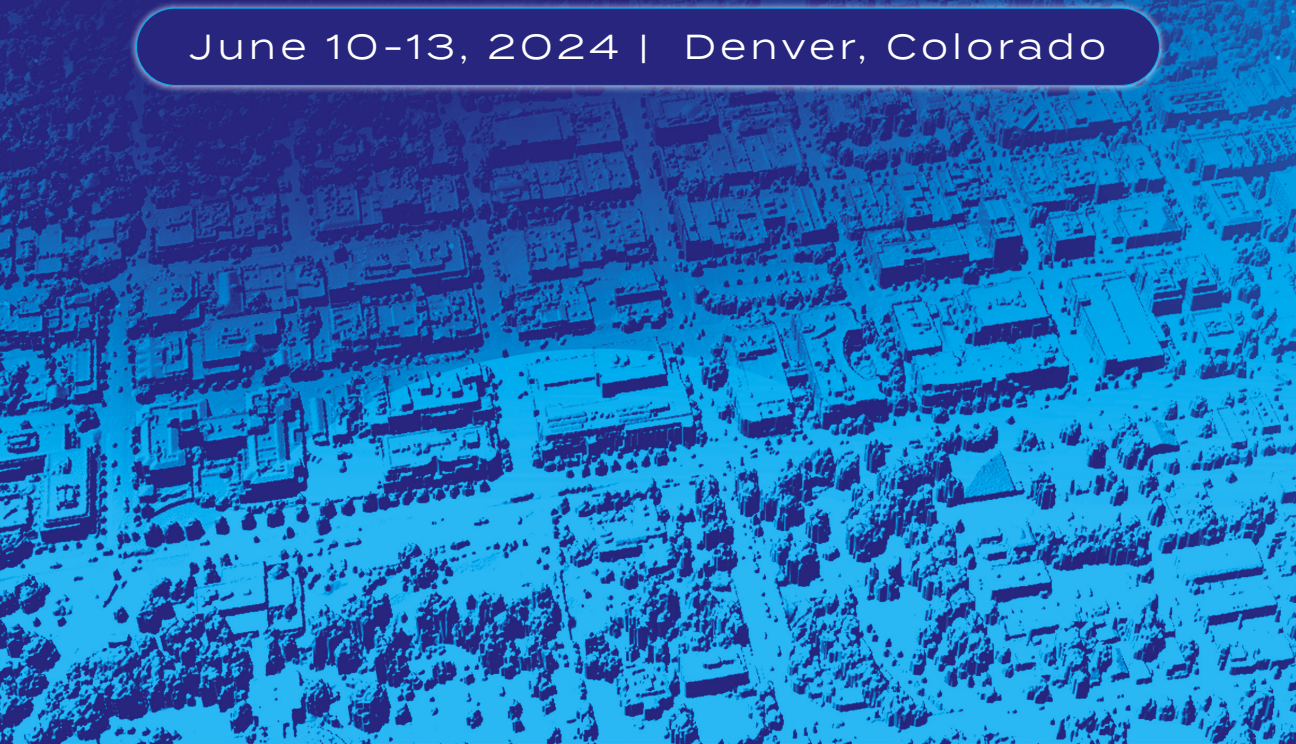


International Symposium on
Advanced Radio Technologies™

2024

In Pursuit of Consensus on Clutter

June 10-13, 2024 | Denver, Colorado





International Symposium on
Advanced Radio Technologies™



ITS

Institute for Telecommunication Sciences

Boulder, Colorado

ITS: THE NATION'S SPECTRUM AND COMMUNICATIONS LAB

Realizing the full potential of telecommunications to drive a new era of innovation, development, and productivity.

The mission of ITS is to ADVANCE innovation in communications technologies, INFORM spectrum and communications policy for the benefit of all stakeholders, and INVESTIGATE our Nation's most pressing telecommunications challenges through research that employees are proud to deliver.

The Institute for Telecommunication Sciences (ITS) is the research and engineering laboratory of the [National Telecommunications and Information Administration \(NTIA\)](#), an agency of the U.S. [Department of Commerce \(DOC\)](#). ITS manages the telecommunications technology research programs of NTIA and the Table Mountain Radio Quiet Zone, working closely with other NTIA Line Offices to support the National Spectrum Strategy. ITS also addresses other federal agencies' telecommunications and spectrum research needs via Interagency Agreements and engages directly with industry and academia via Cooperative Research and Development Agreements.

ITS basic research in radio science provides the technical foundation for NTIA's policy development and spectrum management activities and enhances scientific knowledge and understanding in cutting-edge areas of telecommunications technology. The Institute's research capacity and expertise is used to analyze new and emerging technologies, and to contribute to standards creation.

Research results are broadly disseminated through peer-reviewed [publications](#), including software on [GitHub](#), as well as through technical contributions and recommendations to standards bodies. ITS staff represent U.S. interests in many national and international telecommunication conferences and standards organizations. Through leadership roles in various working groups, ITS helps to drive innovation and contributes to the development of communications and broadband policies that enable a robust telecommunication infrastructure, ensure system integrity, support e-commerce, and protect an open global Internet.

VISIT [ITS.NTIA.GOV](https://its.ntia.gov) TO LEARN MORE



The International Symposium on Advanced Radio Technologies (ISART)™ is a U.S. government-sponsored conference hosted by the Institute for Telecommunication Sciences (ITS), the science and engineering laboratory of the National Telecommunications and Information Administration (NTIA). ISART is a science and engineering discussion-based conference that brings together government, industry, and academic leaders (both domestic and international) for the purpose of forecasting the development and application of advanced radio technologies.

For over two decades, ISART has contributed scientific and technical input towards encouraging sound, forward-looking spectrum management and regulatory policies that rely on careful engineering and ground-breaking research. The focus of ISART is to engage in a wide-ranging technical discussion. ISART does not represent NTIA policy positions.

IN PURSUIT OF CONSENSUS ON CLUTTER

ISART 2024 seeks consensus on how to address the pressing challenge of developing, agreeing on, and applying radio frequency propagation models that take into account the impact of foliage and buildings—clutter—for planning of both spectrum policy and spectrum-dependent systems of all kinds. The development of such models has historically been fraught with competing methodologies, assumptions, and toolsets. Yet today's environment of ubiquitous spectrum sharing, increasing system diversity and complexity, and rapidly expanding exploitation of mid-band frequencies means that the demand for more modeling fidelity and greater modeling accuracy is both urgent and compelling.

ISART 2024 will focus on how the broader community of researchers and system owners can collectively marshal and invest its finite resources to develop, validate, and apply new, more broadly used clutter models. These tools are needed to ensure that the ambitious goals set forth in both the U.S. National Spectrum Strategy (NSS) and the 2023 World Radio Conference (WRC-23) can be achieved.





ISART 2024 TECHNICAL CO-CHAIRS

Dr. Charles Dietlein, NTIA Institute for Telecommunication Sciences

William Kozma, Jr., NTIA Institute for Telecommunication Sciences and Head of U.S. Delegation to ITU-R Study Group 3

ISART 2024 GENERAL CHAIR

Jeremy Glenn, J.D., NTIA Institute for Telecommunication Sciences

ISART 2024 TECHNICAL PROGRAM COMMITTEE

Michael G. Cotton, Electronics Engineer, Institute for Telecommunication Sciences

Dr. Nick Laneman, Director, SpectrumX; Co-Director, Wireless Institute, University of Notre Dame

Kasey Pugh, Defense Information Systems Agency (DISA), Program Executive Office Spectrum (PEO-S)

Neeti Tandon, Distinguished Member of Technical Staff & Technical Fellow, AT&T



International Symposium on
Advanced Radio Technologies™

HYBRID AGENDA

JUNE 10, 2024
1300-1730

JUNE 11, 2024
0900-1730

JUNE 12, 2024
0900-1700

JUNE 13, 2024
0900-1700

THE CURTIS HOTEL

1405 Curtis Street
Denver, Colorado 80202

MONDAY, JUNE 10, 2024

1300 – 1730 **Tutorial: Building and Evaluating a Statistical Propagation Model**

The purpose of this tutorial is to guide attendees to build their own statistical propagation model based on clutter metrics derived from lidar data. Attendees will build, experiment, and evaluate their propagation models against real clutter measurement datasets. Each attendee will be provided with a cloud-based Python programming environment accessible through the web browsers on their laptops (no software installation necessary). Example code and step-by-step instructions will guide attendees to (a) measure clutter statistics from LiDAR data, (b) formulate a clutter loss model, and (c) assess their model's generalizability against measurements in new clutter environments. No programming experience necessary, but tutorial attendees must have a computer with a browser and a GitHub account.

***William Kozma, Jr.**, NTIA Institute for Telecommunication Sciences and Head of U.S. Delegation to ITU-R Study Group 3*

***Max Hollingsworth**, University of Colorado Boulder and NTIA Institute for Telecommunication Sciences*

***Anthony Romaniello**, NTIA Institute for Telecommunication Sciences*

TUESDAY, JUNE 11, 2024

0900 – 0930 **Introduction & Opening Remarks**

***Jeremy Glenn**, NTIA Institute for Telecommunication Sciences*

0930 – 1000 **Keynote Address**

***Shiva Goel**, Senior Spectrum Advisor, NTIA*

1000 – 1100 **Fireside Chat: Clutter is a Universal Concern**

***Charles Cooper**, Associate Administrator, Director Office of Spectrum Management, and Acting Director Institute of Telecommunication Sciences, NTIA (Moderator)*

***Clare Allen**, Senior Spectrum Engineer, Ofcom and ITU-R Study Group 3 Chair*

***Stéphane Gagnon**, Vice-President of Research at the Communications Research Centre, Innovation, Science and Economic Development Canada*



1100 – 1145 **Technical Talk: Abuse of Propagation Models & Future of Clutter Modeling**

William Kozma, Jr., NTIA Institute for Telecommunication Sciences and Head of U.S. Delegation to ITU-R Study Group 3

1145 – 1315 **Lunch**

1315 – 1400 **Technical Talk: Radar Clutter | Virtual**

William Melvin, Deputy Director for Research, Georgia Tech Research Institute (GTRI)

1400 – 1530 **Panel: Model Use Cases and Requirements**

Propagation models are used for a wide variety of purposes, from predicting communications link performance, to broadcast coverage, to interference analyses, and more. Each use case drives different propagation model requirements, and the use cases span diverse geometries, including airborne-terrestrial, terrestrial-terrestrial, satellite-terrestrial, etc. Given this broad scope, this panel will describe selected use cases of current and future interest, and discuss propagation model requirements (specifically including clutter) that are derived from their applications. Panelists/speakers will address: What are the different use cases for propagation/clutter models? What is known about the problem? What is needed from the output of the model? What propagation metrics need to be predicted? What role does clutter play in the analysis?

Kalle Kontson, Johns Hopkins University Applied Physics Laboratory (Moderator)

Andrew Clegg, Spectrum Engineering Lead, Google

Prasanna Satarasinghe, Army Spectrum Management Office (ASMO), U.S. Department of Defense, Chief Information Officer

Neeti Tandon, Distinguished Member of Technical Staff & Technical Fellow, AT&T

Oscar Valle-Colon, Federal Aviation Administration (FAA)

1530 – 1600 **Break**



TUESDAY, JUNE 11, 2024, CONTINUED

1600 – 1730 **Panel: Modeling**

The final output of the development of a clutter model is shaped by the multiple decisions that go into it. Some decisions are straightforward, some are more nuanced, and all are influenced by the scenario the modeling is targeted to support. In all cases, documentation about these decisions is often absent from the final publication of the clutter model itself. The result is models with implicit assumptions that can affect everything from their range of applicability to the underlying uncertainty within the model. This panel discusses how to formalize the model development process for greater transparency and usability, from decision-making steps through model evaluation. All models require some simplifying assumptions: how do we identify and capture the impact of those simplifications? What constitutes sufficient documentation of a model? How can we reduce barriers to improving and expanding existing models? How can we objectively evaluate model performance?

William Kozma, Jr., *NTIA Institute for Telecommunication Sciences and Head of U.S. Delegation to ITU-R Study Group 3 (Moderator)*

Tingjun Chen, *Assistant Professor, Electrical and Computer Engineering and Computer Science, Duke University*

Ted Kaplan, *Chief Operating Officer and Chief Systems Engineer, RFK Engineering*

Roy Sun, *Principal Architect, CableLabs*

WEDNESDAY, JUNE 12, 2024

0900 – 0915 **Opening Remarks**

William Kozma, Jr., *NTIA Institute for Telecommunication Sciences and Head of U.S. Delegation to ITU-R Study Group 3*



0915 – 1000 Fireside Chat: The Reality of Building Consensus

Jeremy Glenn, NTIA Institute for Telecommunication Sciences
(Moderator)

Ira Keltz, Deputy Chief/Chief of Staff, Office of Engineering and
Technology, Federal Communications Committee (FCC)

Derek Khlopin, Deputy Associate Administrator Office of
Spectrum Management, NTIA

1000 – 1015 Break

1015 – 1045 Technical Talk

Sunny Wescott, Chief Meteorologist, CISA ISD, U.S.
Department of Homeland Security

1045 – 1215 Panel: Measurements and Data

The development of clutter models requires high quality, diverse, and verifiable measurement data. This panel will look at how we can establish a scalable measurement framework within which organizations can capture and exchange clutter measurement data across an assorted range of systems. What commonly accepted standards are needed? How can trust be established between diverse datasets? What are the implications of aggregating disparate datasets?

Adrian Florea, Director of Data Science Communications
Research Centre Canada (Moderator)

Burak Berksoy, Director of RF Engineering, Netscout

Julius Fodje, Expert Member of Technical Staff, AT&T

Max Hollingsworth, University of Colorado Boulder and NTIA
Institute for Telecommunication Sciences

Frank Lind, Geospace Technology Lead and Deputy Research
Director for SpectrumX, Massachusetts Institute of Technology
Haystack Observatory

1215 – 1345 Lunch

1345 – 1415 Technical Talk: Network Planning and Deconfliction

Chris Wieczorek, Director of Spectrum Policy, T-Mobile USA,
Inc.



WEDNESDAY, JUNE 12, 2024, CONTINUED

1415 – 1445 **Technical Talk: NSF Greenbank NRQZ Analysis of Base Station Requests**

***Sheldon Wasik**, Zone Regulatory Services Coordinator,
National Radio Astronomy Observatory*

1445 – 1530 **Break**

1530 – 1700 **Panel: Using Clutter Models**

Incorporation of clutter models in system-level scenario analysis requires careful attention to both the details of the model itself and the system- and scenario-specific considerations that may require additional tuning or corrections. For example, it may be necessary to incorporate corrections for antenna patterns, clutter depth or angle, or extrapolation of other model parameters to apply the most appropriate clutter model to a scenario that has differences in geometry or other factors from those driving the measurements and assumptions used to develop the original model. This panel discusses how systems, sharing architectures, and studies use clutter model outputs, and how models can be adapted to scenarios that may not share the exact assumptions that were used in their development.

***Tony Rennie**, Founder and CEO, Foundry Inc. (Moderator)*

***Martin Doczkat**, Chief of the Electromagnetic Compatibility Division, Office of Engineering and Technology, FCC*

***Kasey Pugh**, Defense Information Systems Agency (DISA), Program Executive Office Spectrum (PEO-S)*

***Todd Summers**, Director of Research and Development, SoftWright LLC*

***William Young**, Subject Matter Expert in Spectrum Dependent Technologies, MITRE Inc.*



THURSDAY, JUNE 13, 2024

0900 – 0915 **Opening Remarks**

Charles Dietlein, *NTIA Institute for Telecommunication Sciences*

0915 – 0945 **Technical Talk: Frictionless Reproducibility | Pre-Recorded**

David Donoho, *Professor of Statistics, Stanford University*

0945 – 1015 **Technical Talk: Challenges, Data/Software Sharing**

Jacobus (Kobus) Van der Merwe, *Jay Lepreau Professor, School of Computing and Director Flux Research Group, University of Utah*

1015 – 1030 **Break**

1030 – 1200 **Panel: Openness, Collaboration, and Growing the Community**

The U.S. Government has ambitious plans to utilize mid-band spectrum in support of both governmental and commercial interests. In order to accomplish such goals, the roster of spectrum engineers must grow. Part of growing the workforce is educational, but part is also lowering the bar to entry to attract attention in an increasingly crowded list of technical fields. This panel will look at how embracing open source and open data can grow the number of people wanting to pursue a career in RF measurement or propagation modeling. How can increased transparency of data and tooling open the doors to more productive collaboration among government, industry, and academia?

Nick Laneman, *Director of SpectrumX; Co-Director of Wireless Institute, University of Notre Dame (Moderator)*

Richard Bernhardt, *Vice President Spectrum and Industry WISPA and Treasurer and CFO, WinnForum*

Alan Rosner, *Director Spectrum National Security Systems NTIA*

Jacobus (Kobus) Van der Merwe, *Jay Lepreau Professor, School of Computing and Director Flux Research Group, University of Utah*



THURSDAY, JUNE 13, 2024, CONTINUED

1200 – 1330 **Lunch**

1330 – 1400 **Tutorial Outcomes: Building and Evaluating a Statistical Propagation Model**

William Kozma, Jr., NTIA Institute for Telecommunication Sciences and Head of U.S. Delegation to ITU-R Study Group 3

1400 – 1530 **Panel: Wrap-up and Roadmap**

What are next steps? The panel moderators summarize the most important take-aways from the discussions and consider whether community consensus is possible on any well-developed idea or solution that was discussed and which areas or ideas warrant further research or stakeholder group involvement.

Jeremy Glenn, NTIA Institute for Telecommunication Sciences (Moderator)

Kalle Kontson, Johns Hopkins University Applied Physics Laboratory (APL)

William Kozma, Jr., NTIA Institute for Telecommunication Sciences and Head of U.S. Delegation to ITU-R Study Group 3

Adrian Florea, Director of Data Science Communications Research Centre Canada

Tony Rennie, Founder and CEO, Foundry Inc.

Nick Laneman, Director of SpectrumX; Co-Director of Wireless Institute, University of Notre Dame

1530 – 1700 **Networking**

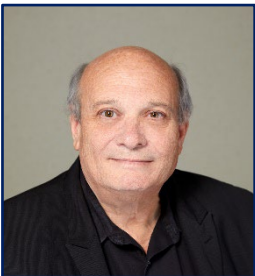
ISART 2024 SPEAKERS & BIOGRAPHIES



CLARE ALLEN

Clare Allen is a specialist in the area of radiowave propagation and interference modelling with 25 years of experience in spectrum management at the UK communications regulator, Ofcom. Part of the RF Propagation team in Spectrum Group, Allen is involved in propagation research, provides advice on propagation modelling and undertakes sharing and

coexistence studies in support of the efficient use of spectrum. Allen has been an active member of ITU-R Study Group 3, Radiowave Propagation, since 2008. During the WRC-19 study cycle Allen led work to develop a new Recommendation on the Prediction of Clutter Loss for mmWave bands and continues to be active in this area co-chairing the correspondence group on Clutter modelling. In 2020 Allen became Chair of ITU-R Working Party 3M responsible for Point-to-Point and Earth-Space propagation. At the 2023 Radiocommunications Assembly in Dubai Clare was appointed Chair of the ITU-R Study Group 3.



RICHARD BERNHARDT

Richard Bernhardt is the Vice President, Spectrum and Industry for WISPA, Broadband without Boundaries, a national trade organization representing a diverse set of ISPs and providers (<http://www.wispa.org>). WISPA through its members actively serves around nine-million end-user clients, especially in rural and suburban areas of the United States. Bernhardt

also serves as an officer and on the Board of Directors of the Wireless Innovation Forum (<http://www.winnforum.org>), a global Standards Development Organization that created the standards and protocols for the Citizens Broadband Radio Service (CBRS) and the 6 GHz unlicensed band; and is involved with standards development globally. Bernhardt also serves as the chair of the fixed wireless access task group for the OnGo Alliance (<http://www.ongoalliance.org>). He has been active in wireless, telecom, and technology roles for over thirty years.



BURAK BERKSOY

Burak Berksoy is the Director of RF Engineering at NETSCOUT, where he leads a team dedicated to creating highly accurate Radio Frequency (RF) propagation models based on Continuous Wave (CW) field measurements. These models enable wireless operators and enterprises to accurately predict and deploy their wireless networks, optimizing capital expenditures to meet performance goals effectively. Berksoy earned a Ph.D. in Electrical Engineering from the University of Central Florida and an MBA from the University of California, Berkeley. Since joining NETSCOUT in 2008, he, alongside his team, has been instrumental in assisting wireless network operators in overcoming propagation challenges across various frequencies and topographies.



TINGJUN CHEN

Tingjun Chen received the Ph.D. degree in Electrical Engineering from Columbia University in 2020, and the B.Eng. degree in Electronic Engineering from Tsinghua University in 2014. Between 2020–2021, he was a Postdoctoral Associate at Yale University. Since Fall 2021 he has been with Duke University where he is an Assistant Professor in the Departments of Electrical & Computer Engineering and Computer Science (secondary appointment). His research interests are in the area of networking and communications with a specific focus on next-generation wireless, optical, mobile networks, as well as Internet-of-Things (IoT) systems. Chen received the IBM Academic Award, the Google Research Scholar Award, the Columbia Engineering Morton B. Friedman Memorial Prize for Excellence, the Columbia University Eli Jury Award, and the Facebook Fellowship. He is also a co-recipient of several paper awards, including the ACM CoNEXT'16 Best Paper Award, ECOC'23 Best Paper Award, and Top-Scored Papers from IEEE/Optica OFC'23 and OFC'24. His Ph.D. thesis received the ACM SIGMOBILE Dissertation Award Runner-up.



ANDREW CLEGG

Andrew Clegg is the Spectrum Engineering Lead for Google. He is presently focused primarily on identifying spectrum sharing opportunities for wireless broadband networks. Prior to joining Alphabet and Google, he served as the electromagnetic spectrum manager for the U.S. National Science Foundation. Prior to NSF, he was a Lead Member of Technical Staff at what is now AT&T Mobility, and senior engineer at Comsearch. Clegg has over 25 years' experience in national and international spectrum management for both government and commercial applications. He was a member of the U.S. delegation to two World Radiocommunication Conferences (2007 and 2012). He holds a PhD in radio astronomy and electrical engineering from Cornell University.



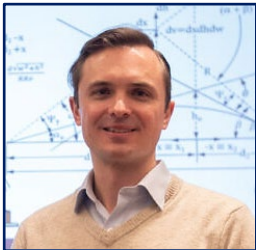
CHARLES COOPER

Charles Cooper is Associate Administrator in NTIA's Office of Spectrum Management. He leads the agency's work on national and international spectrum policy issues and oversees spectrum management efforts for federal agencies. He is also currently the Acting ITS Director. Before joining NTIA, Cooper was the Enforcement Bureau Field Director at the Federal Communications Commission (FCC) where he managed the nationwide enforcement of spectrum interference affecting public safety communications, FCC licensees and Federal agencies. Prior to serving as Field Director, Cooper was District Director of the FCC's Los Angeles Field Office.



MICHAEL G. COTTON

Michael Cotton joined NTIA/ITS in 1992, when he entered the Radio Research and Standards group. At ITS, he is currently an Electronics Engineer. He has been involved in a broad range of research topics, including applied electromagnetics, radio channel measurement and theory, interference effects on digital receivers, and noise measurement. Cotton is a project leader and has authored or co-authored more than 30 technical publications. He has shared Department of Commerce (DoC) group awards for, respectively, a 2020 Bronze Medal, for leading the four-year development and implementation of the IEEE 802.15.22.3 standard for Spectrum Characterization and Occupancy Sensing (SCOS); a 2014 Gold Medal for Scientific/Engineering Achievement, for rapidly developing a creative, innovative new method to perform electromagnetic compatibility (EMC) studies; and a 2012 Bronze Medal for the rapid development and deployment of a system to measure radar spectrum occupancy. In 2002, he earned the Gold Medal Award for research and engineering achievement in the development of national policies for UWB technologies. Cotton received a B.S. degree in aerospace engineering in 1992 and an M.Sc. degree in electrical engineering with an emphasis on electromagnetics in 1999, both from the University of Colorado Boulder.



CHARLES DIETLEIN

Charles Dietlein received his bachelor's degree at Seattle Pacific University and both his M.S. and Ph.D. degrees from the University of Colorado at Boulder. Currently a senior research engineer at NTIA/ITS, he has worked at the National Institute of Standards and Technology (NIST) in Boulder, Colorado, where he contributed to the development of the world's first real-time passive millimeter-wave/terahertz camera and the world's first traceable source of millimeter-wave and terahertz power. Over an 11-year period, he held several positions at the Department of Defense (DoD) in Washington, D.C., and subsequently served as chief of research and development at the U.S. Air Force Analysis Support Office. Dietlein was the architect and program manager for an advanced reconfigurable hardware-in-the-loop radar and communications electronic warfare emulation environment, which enables applied research in adaptive and cognitive RF technologies at low technology readiness levels while considering highly realistic electromagnetic and operational environments. The Air Force awarded him an Exemplary Civilian Service Award for his accomplishments during a detail with the Defense Technology Integration Program Office. Dietlein is chair of the 2024–2026 U.S. National Committee of USNC-URSI Commission E - Electromagnetic Environment and Interference.



MARTIN DOCZKAT

Martin Doczkat is the Chief of the Electromagnetic Compatibility Division in the Office of Engineering and Technology (OET) at the Federal Communications Commission (FCC), where he has been for eight years. Prior to joining the FCC, Doczkat provided consulting engineering services to various FCC licensees, including broadcasters.

He is a member of the Institute of Electrical and Electronics Engineers (IEEE) as well as an active participant in many of their subordinate organizations, including the International Committee on Electromagnetic Safety (ICES), Antennas and Propagation Society (APS), Broadcast Technology Society (BTS), Communications Society (ComSoc), Electromagnetic Compatibility Society (EMCS), Engineering in Medicine and Biology Society (EMBS), Microwave Theory and Techniques Society (MTTS), and Standards Association (SA). He is a United States member of International Electrotechnical Commission (IEC) Technical Committee (TC) 106, a member of the Association of Federal Communications Consulting Engineers (AFCCE), and a licensed professional engineer (PE) in the District of Columbia. He holds a Bachelor of Science (BS) degree in Electrical Engineering from Pennsylvania State University (PSU), and two Master of Science (MS) degrees, in Systems Engineering and Electrical Engineering, from The George Washington University (GWU).



DAVID DONOHO

David Donoho has studied the exploitation of sparse signals in signal recovery, including for denoising, superresolution, and solution of underdetermined equations. His research with collaborators showed that ℓ_1 penalization was an effective and even optimal way to exploit sparsity of the object to be recovered. He coined the notion of compressed sensing which has impacted many scientific and technical

fields, including magnetic resonance imaging in medicine, where it has been implemented in FDA-approved medical imaging protocols and is already used in millions of actual patient MRIs. In recent years Donoho and his postdocs and students have been studying large-scale covariance matrix estimation, large-scale matrix denoising, detection of rare and weak signals among many pure noise non-signals, compressed sensing and related scientific imaging problems, and most recently, empirical deep learning.



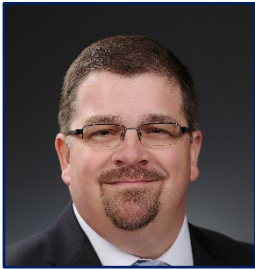
ADRIAN FLOREA

Adrian Florea is the Director of Data Science at the Communications Research Centre Canada, where his team focuses on scalable data-driven approaches for spectrum management, including propagation modeling, spectrum sharing, adaptive licensing, spectrum and compliance monitoring. Florea holds a MASC in Systems and Computer Engineering from Carleton University. He has over 35 years of experience in wireless systems engineering and design across both private and public sectors, including since 2008 with the Canadian spectrum regulator.



JULIUS FODJE

Julius Fodje is an Expert Member of Technical Staff at AT&T with the headquarters wireless engineering team. His current area of work focuses on radio access network planning, RF propagation modeling, network simulations, and the development of radio access network design standards. During his time at AT&T, Fodje has led efforts in the development of radio access network design standards for 3G, 4G, and 5G. Fodje provides advanced wireless engineering support to different internal and external organizations. Prior to joining AT&T in 2007, Fodje was RF Technical Manager at Wireless Facilities, Inc., where he led projects in various aspects of the end-to-end deployment and operations of wireless networks for different operators around the world.



STÉPHANE GAGNON

Stéphane Gagnon is Vice-President of Research and Development at the Communications Research Centre (CRC). He leads a branch of multiple teams in the areas of wireless technology: propagation and antennas; lab and outdoor wireless testing; data architecture; and data science. His branch and the CRC are working on applied research for the betterment of spectrum management for Canada. Gagnon joined the organization in 2015, and has over 30 years of experience in the telecommunications and semiconductor fields. Prior to joining the CRC, he held many different roles in various-sized enterprises including POET Technologies, Integrated Device Technology formerly Tundra Semiconductor, Motorola, and Nortel (Bell Northern Research). Gagnon's skill set is rich in leading research and development activities, in directing cross-functional teams, and in managing international customer and partner relationships. He has a strong background in pioneering technologies and innovations in wireless telecommunications. Gagnon holds a BSc in Computer Engineering from Laval University in Quebec City.



JEREMY GLENN

Jeremy Glenn is General Chair of ISART 2024. He is a policy analyst and program management specialist at NTIA's Institute for Telecommunications Science with experience in public safety communications, 5G Open RAN, and spectrum R&D. Glenn serves as Secretary/Editor of the National Spectrum Research and Development (R&D) Plan and as ITS's representative to the Wireless Spectrum R&D intergovernmental working group (WSRD) and the Wireless Innovation Forum (WInnForum). Prior to joining ITS, Glenn managed R&D prize competitions for NIST's Public Safety Communications Research Division that helped advance and deploy communications technology for first responders. He is an alumnus of OPM's flagship Presidential Management Fellowship Program (PMF) and served as a Pathways legal intern with both the DoD Inspector General's Office of General Counsel and the FDIC's Legal Information Technology Unit. He holds a B.A. in Public Policy, an M.A. in Government, and a J.D. from the Scalia Law School at George Mason University. Glenn is a licensed member of the Virginia Bar.



SHIVA GOEL

Shiva Goel is the Senior Advisor for Spectrum Policy at the National Telecommunications and Information Administration (NTIA), where he leads the agency's efforts to meet the spectrum needs of the federal government, consumers, and the commercial sector on behalf of NTIA Administrator Alan Davidson. He joined NTIA from the FCC, where he served as Legal Advisor to Commissioner Geoffrey Starks on wireless, space, and international telecommunications policy matters. Goel was previously a partner in the telecom, appellate, and litigation practices of Harris, Wiltshire & Grannis LLP. He received his law degree Order of the Coif from the University of Virginia School of Law and a BA from Cornell University.



MAX HOLLINGSWORTH

Max Hollingsworth is a Ph.D. candidate at the University of Colorado, Boulder, in the Department of Computer Science, and an intern at the Institute for Telecommunication Sciences. His thesis is titled "Harnessing Crowdsourced Cellular Data for Propagation Modeling Applications." Hollingsworth has worked at the Institute for three years, during which time he has evaluated and provided accuracy guarantees for low-cost propagation measurement systems using software-defined radios and cellular devices. Hollingsworth also shared in the 2020 Bronze Medal Group Award for working on the four-year development and implementation of the IEEE 802.15.22.3 standard for Spectrum Characterization and Occupancy Sensing (SCOS).



TED KAPLAN

Ted Kaplan is CEO and Principal System Engineer for RKF Engineering. Kaplan has 40+ years of experience solving a wide range of problems in the field of spectrum management, communications, system design, RF and network engineering. He has been the technical lead on dozens of system engineering development projects and analyzed dozens of interference-

sharing-scenarios supporting both government and commercial customers. Currently, Kaplan is providing technical support on a variety of satellite and terrestrial related projects analyzing difficult sharing scenarios and architecting innovative solutions for new designs. RKF, with Kaplan as strategic advisor, conducted sharing studies for the WiFi Coalition that played a pivotal role in the allocation of RLAN frequencies in the 6 GHz band. Kaplan is also co-founder of Kythera Space, which is focused on resource management software for satellite networks. Prior to RKF Kaplan worked for COMSAT Laboratories, Stanford Telecommunications and IIT Research Institute. Kaplan holds a BS in Electrical Engineering from the University of Pennsylvania and an MS in Electrical Engineering / Communications from the George Washington University.



IRA KELTZ

Ira Keltz is Deputy Chief of the FCC's Office of Engineering and Technology (OET). OET is the Commission's primary resource for engineering expertise and provides technical support to the Chairperson, Commissioners and FCC Bureaus and Offices. Keltz is responsible for developing national spectrum policies, including allocating spectrum, setting technical and service

rules for RF devices, and implementing procedures for equipment certification. Keltz has totaled more than 28 years at the FCC spanning two separate stints. He previously served as Chief of OET's Electromagnetic Compatibility Division and Deputy Chief of OET's Policy and Rules Division. Prior to serving in OET, Keltz held various positions in the Commission's Wireless Telecommunications Bureau. Keltz has also worked for the law firm DLA Piper as well as Loral Advanced Projects and LSA, Inc. He has been awarded the Federal Communications Bar Association's Excellence in Government Service Award and WiFi Forward's Wi-Fi Pioneer Award. Keltz earned a Master's Degree in Electrical Engineering from George Washington University and a Bachelor's Degree in Electrical Engineering from the University of Michigan.



DEREK KHLOPIN

As the Deputy Associate Administrator for Spectrum Planning and Policy in NTIA's Office of Spectrum Management, Derek Khlopin is responsible for strategic planning, spectrum affairs and information, and Intergovernmental Radio Advisory Committee (IRAC) programs. He is charged with leading OSM's work to develop and advance policies that ensure sufficient spectrum access for federal agencies to perform their missions successfully while seeking opportunities to make additional spectrum available for wireless services that advance economic opportunities across the United States. Previously, Khlopin served as Senior Advisor to the Assistant Secretary of Communications and Information and NTIA Administrator on spectrum policy, regulation and management, as well as wireless and emerging technologies. Before joining NTIA, Khlopin led the North America government affairs activities for Nokia Solutions and Networks (now Nokia), where he developed the company's regulatory and policy strategy and represented the company in the U.S. before Congress, the Federal Communications Commission (FCC), the Executive branch (including its departments and agencies), and in industry forums. He began his career as an attorney-advisor with the FCC. Khlopin holds a J.D. from the Catholic University of America Columbus School of Law and a certificate from its Law and Technology Institute.



KALLE R. KONTSON

Kalle Kontson is currently a member of the Principal Professional Staff at the Johns Hopkins University Applied Physics Laboratory (APL). Since 2015 he has supported the Defense Information Systems Agency's PEO Spectrum office, focusing on development of spectrum sharing and coexistence analysis methods. Prior to 2015 Kontson provided engineering support to various research projects as a member of the APL Asymmetric Operations Department. He has more than 50 years of C4ISR and spectrum-dependent systems engineering experience. He has served on several DoD and other Government advisory groups, including the FCC Technological Advisory Council and the Army Science Board. He has also served on IEEE standards development bodies; specifically, the IEEE 1900 series of standards for Dynamic Spectrum Management Networks. His educational background includes EE Bachelor of Science and Master of Engineering degrees from the Rensselaer Polytechnic Institute, as well as a Juris Doctorate from the University of Baltimore School of Law.

**WILLIAM KOZMA, JR.**

Since joining NTIA/ITS in 2013, computer engineer Billy Kozma has primarily focused on radiowave propagation, including applying modern data analysis and software capabilities to improving modeling techniques. Kozma leads the propagation modeling group at ITS, which is engaged in a DoD-sponsored mid-band propagation modeling project focused on improving modeling in the 3.5 GHz band to support spectrum sharing and coexistence. He also contributes to propagation modeling efforts to support the OSM and leads ITS's engagement with ITU-R Study Group 3 (Radiowave Propagation), serving as both head of the U.S. Delegation to ITU-R Study Group 3 and Chair of the group focused on aeronautical propagation (Recommendation ITU-R P.528). Kozma received his B.S. in Electrical Engineering in 2007 from the University of Pittsburgh at Johnstown, and his M.S. in Electrical and Computer Engineering in 2009 from the University of Arizona.

**NICK LANEMAN**

Nick Laneman is Director of SpectrumX - an NSF Spectrum Innovation Center, Founding Director and currently Co-Director of the Wireless Institute in the College of Engineering, and Professor in the Department of Electrical Engineering at the University of Notre Dame. He joined the faculty in August 2002 shortly after earning a Ph.D. in Electrical Engineering and Computer Science from the Massachusetts Institute of Technology (MIT). His research and teaching interests are in wireless system design, radio spectrum access, technology standards and intellectual property, and regulatory policy. Laneman is an IEEE Fellow, has received the IEEE Kiyo Tomiyasu Award, the Presidential Early-Career Award for Scientists and Engineers (PECASE), and the NSF CAREER Award, and has been recognized twice by Thomson Reuters as an ISI Highly Cited Researcher. He is author or co-author on over 145 publications and is co-inventor on 8 U.S. patents.



FRANK LIND

Frank D. Lind is a researcher at the Massachusetts Institute of Technology Haystack Observatory. At the Observatory he serves as Geospace Technology Lead and Deputy Research Director for SpectrumX. He holds bachelor's degrees in Physics and Computer Science and a doctorate in Geophysics focused on passive radar observations of the aurora borealis and space plasma physics from the University of Washington. His research at MIT focuses on radio science, advanced radar and radio arrays, space plasma physics, software radar, novel sensors and signal processing, radio spectrum coexistence, and satellite instrumentation. As part of the NSF SpectrumX Center he coordinates and leads Center Flagship project efforts. These projects currently focus on Spectrum Awareness in the 7–8.4 GHz range and Scientific Coexistence in the context of radio astronomy and weather radiometry.



WILLIAM MELVIN

William Melvin is Deputy Director for Research at the Georgia Tech Research Institute (GTRI); Director of the Sensors and Intelligent Systems Directorate at GTRI; a University System of Georgia Regents' Researcher; and an Adjunct Professor in Georgia Tech's Electrical and Computer Engineering Department. His technical leadership and research interests include all aspects of sensor technology development, applied electromagnetics, systems engineering, developmental planning, autonomous and intelligent systems and machine learning. He has authored numerous papers and reports in his areas of expertise and holds three U.S. patents on adaptive sensor technology. He is the co-editor of the popular Principles of Modern Radar book series. He served on the USAF Science Advisory Board, the Board on Army Science and Technology, the Air Force Studies Board on Developmental Planning organized through the National Academy of Science, and the White House–DoD American Mid-Band Initiative Team. More recently, he chaired a National Academies of Science, Engineering, and Medicine study on the impact of offshore wind turbine generators on marine vessel radar.



KASEY A. PUGH

Kasey A. Pugh is an electronics engineer in the Mid-band EMS Sharing Systems Branch of the Planning and Engineering Division at the Defense Information System Agency (DISA) Program Executive Office Spectrum (PEO-S). He has served as the Department of Defense (DoD) technical lead implementing dynamic spectrum sharing between the Citizens' Broadband Radio Service (CBRS) and DoD electromagnetic spectrum (EMS) systems. Pugh leads the Telecommunications Advanced Research & Dynamic Spectrum Sharing System (TARDyS3) DevSecOps initiative to enable rapid, secure, and iterative software development and deployment of a dynamic spectrum sharing system.



TONY RENNIE

Tony Rennie is the founder and CEO of Foundry Inc., a spectrum engineering consulting firm that provides technical expertise, oversight, and guidance to spectrum communities of interest. He is currently providing technical support to DoD CIO EMSEPP, DISA's PEO-Spectrum, and OUSD R&E on a variety of spectrum-related initiatives, including the National Spectrum Strategy's DoD band studies and Dynamic Spectrum Sharing Moonshot demonstration, 3.45 GHz Clutter Modeling, and Playas Research and Training center. Prior to his current engagements, Rennie served as a technical subject matter expert to the DoD CIO on the EMBRSS Feasibility Study and was the technical director for the AWS-3 Spectrum Sharing Test and Demonstration (SSTD) program. Prior to his work in spectrum engineering, Rennie founded and ran two software products, services, and training firms supporting what would become Apple's OSX. Rennie is a member of the IEEE Dynamic Spectrum Access Networks Standards Committee (DySPAN-SC) and is a former Chair of P1900.5, the Policy Language and Architectures for Managing Cognitive Radio for Dynamic Spectrum Access Applications working group. Rennie's education includes a Bachelor of Electrical Engineering degree from Southern Illinois University in 1983 and a Master of Electrical Engineering degree from the University of Illinois in 1985.



ALAN ROSNER

Alan Rosner is the Director of the Spectrum National Security Systems Program in the NTIA Office of Spectrum Management, having joined in 2023. Previously, Rosner worked for the Defense Information Systems Agency (DISA) from 2003-2023 in various technical and programmatic capacities. Prior to joining NTIA he served as Program Manager for the Thunderdome Zero

Trust project within the DISA Cyber Security and Analytics Directorate. Most of Rosner's DISA career was spent working for the Joint Spectrum Center (JSC) within DISA's Defense Spectrum Organization (DSO). He served as the Chief of the Spectrum Enterprise Services Branch at JSC and was the Program Manager for the Global Electromagnetic Spectrum Information System (GEMSIS) and Electromagnetic Battle Management (EMBM). He has significant experience in the management and development of software capabilities to enhance the government's ability to operate and evolve their use of the electromagnetic spectrum. Prior to DISA he was a consulting engineer for 15 years working on engineering regulatory matters before the Federal Communications Commission and has been involved in numerous projects including high-definition television, digital radio, satellite earth stations, cellular, radio-frequency radiation exposure, land mobile and terrestrial microwave systems. Rosner has a Bachelor of Science in Electrical Engineering (BSEE) from The Catholic University of America and is a Licensed Professional Engineer in the District of Columbia.



PRASANNA SATARASINGHE

Prasanna Satarasinghe is the chief engineers for the DoD CIO Spectrum Directorate, working on a wide range of spectrum related strategy/policy/engineer projects for the DoD.

Satarasinghe has over 30 years of experience in the Wireless and IT Industry working for wireless infrastructure vendors, wireless operators and systems integrators. He has SME

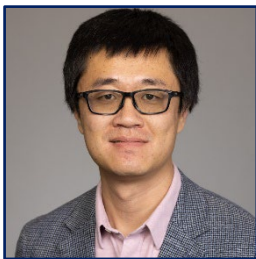
knowledge and hands-on experience in designing, deploying, and operating Cellular, Wi-Fi and Wi-Max networks. While working for wireless access and core network infrastructure vendors he developed and introduced new products to US and international customers. Before joining the government Satarasinghe designed and implemented hybrid cloud, zero trust architecture, turnkey networks (i.e. wireless and core) powered by IT/OT applications, analytics and AI & ML to support day 2 operations, for Smart Cities. At Army spectrum management office, he collaborated with the DoD CIO and DISA/DSO teams to develop and deliver innovative solutions for the DoD and commercial 5G systems to share spectrum. Satarasinghe also led and managed an engineering feasibility study with DEVCOM ARL to investigate the application of frequency band diversity, SDR and DSA technologies for mitigating interference between DoD RADAR and 5G systems. He co-led an engineering study with the NTIA ITS team to measure and analyze the impact of 5G system interference on the performance of Army Radar systems. Satarasinghe has authored 12 patents on wireless network performance & security, contributed to the IETF RFC 4186, published in IEEE & industry magazines, and worked with leading educational institutions to productize R&D concepts.



TODD SUMMERS

Todd Summers earned B.S., M.S., and Ph.D. degrees in Electrical Engineering from the University of Virginia ('98/'98/'04). His graduate research focused on SNR estimation for turbo coding and robust, hybrid space-time coding. From 1998 to 2001, Summers worked for ITT Industries (formerly Stanford Telecom), where he served in a variety of technical

roles, while also managing spectrum management and in-house research and development projects. Work focused primarily on SATCOM, particularly propagation modelling, interference mitigation, and satellite system design. In 2004, Summers joined Barron Associates, where he led numerous communications projects as the principal investigator, dealing primarily with tactical air-to-ground systems and antenna technology development. Since 2012, Summers has served as the Director of Research and Development for SoftWright LLC, the developer of the Terrain Analysis Package (TAP™), a widely used RF propagation modelling tool. In this role, he is responsible for guiding the technical direction of TAP™, as well as RF-related technical support and customer training. Summers participates in the TIA TR-8 engineering committee, and particularly the TR-8.18 sub-group, which is responsible for RF propagation modeling and system design and evaluation for LMR communication systems (with emphasis on public safety and critical infrastructure). He is the chairman for TR-8.18 Working Group 1, which maintains two Telecommunications Systems Bulletins, TSB 88.1 and TSB 88.3 addressing modeling and performance verification for narrowband LMR communications systems.



ROY SUN

Ruoyu "Roy" Sun received the B.S. degree from Tianjin University in 2004, the M.S. degree from Beijing Jiaotong University, China in 2007, and the Ph.D. degree from the University of South Carolina in 2015, all in electrical engineering. His research interests include spectrum sharing and radio propagation channel measurements and modeling.

Sun is a Principal Architect at CableLabs, Louisville CO. From 2015 to 2018, he was an Electronics Engineer at NIST, Boulder CO, doing millimeter-wave channel sounder design and channel measurements. He worked at T3G Technology Co., Ltd, MOTOROLA, and ST-Ericsson from 2007 to 2010 as a system engineer working on 2G and 3G protocol and platforms. He has published 80+ articles, served on 20+ conference Technical Program Committees, and reviewed 200+ manuscripts for academic journals and conferences. Sun is the recipient of the 2018 Neil Shepherd Memorial Best Propagation Paper Award from the IEEE Vehicular Technology Society, and the recipient of five conference best paper awards.



NEETI TANDON

Neeti Tandon is a Technical Fellow and Distinguished Member of Technical Staff at AT&T. She provides key engineering support to the Federal Regulatory, Legal, Corporate Development, and CTO organizations in technical aspects of spectrum strategy, regulatory positions, spectrum management, valuation/acquisition, and co-existence issues. Tandon began her career with AT&T in 1995 and has worked on a broad array of wireless topics including network modeling, radio capacity modeling, interference analysis, spectrum sharing and co-existence, and network deployment best practices. She has represented AT&T, and frequently holds leadership positions, in numerous external standards bodies and spectrum related industry forums, standard setting committees, and FCC directed multi-stakeholder interest groups where personnel from across relevant industries and government services debate key spectrum issues and develop consensus positions, parameters, and technical approaches.

OSCAR VALLE COLON

Oscar Valle Colon is the manager of the Special Projects team within the FAA's office of Spectrum Engineering Services. In this capacity, Valle Colon leads the office's analysis and development of innovative solutions for complex technical challenges in aviation systems and aviation spectrum. Oscar's expertise includes spectrum modeling and simulation, primary surveillance systems, secondary surveillance systems, and software development. Valle Collon has been recognized with numerous awards, including the Transportation Secretary's highest safety award. He is also a recognized leader with over 13 years of diverse experience within the military and FAA spectrum communities. Valle Collon graduated Summa Cum Laude with an Electrical Engineering degree from the University InterAmerica, in Puerto Rico. He enjoys woodworking, sports, and fishing in his spare time.



KOBUS VAN DER MERWE

Kobus Van der Merwe is the Jay Lepreau Professor in the School of Computing and Director of the Flux Research Group at the University of Utah. He joined the University of Utah in 2012 after fourteen years at AT&T Labs - Research. He does networking systems research in a broad range of areas including mobile and wireless networking, network security and cloud computing. He is the PI and Director of the POWDER project (Platform for Open Wireless Data-driven Experimental Research), one of the NSF-funded PAWR platforms. He received the AT&T Science and Technology Medal in 2010, the USENIX Test of Time award in 2015, and the University of Utah Distinguished Research Award in 2022.



SHELDON WASIK

Sheldon Wasik is the Zone Regulatory Services Coordinator in the Spectrum Management Department at the National Radio Astronomy Observatory. In his role, he handles all coordination requests in the National Radio Quiet Zone and performs the analysis in respect to the Green Bank Observatory. He also oversees the coordination efforts in the Puerto Rico

Coordination Zone, as well as additional interference and spectrum related problems for NRAO. Those projects often consist of satellite related interference, identifying unknown interference being received by NRAO telescopes, and general RF environment understanding with propagation models and research. In his free time, he enjoys playing disc golf, trying to cook something new in the kitchen (or outdoor griddle), and finding fun things to do outdoors with his dog.



SUNNY WESCOTT

CISA's Chief Meteorologist, Sunny Wescott, is a Federal Emergency Response Official specializing in national extreme weather hazards and climatological studies for impacts to public and private sector key resources. During her time in the U.S. Air Force as a Lead Meteorologist, Wescott trained on continental and oceanic weather as the Top Forecaster for her

support region and is considered a subject matter expert for multiple climatological events such as drought, subsidence, wildfires, tropical cyclones, and winter storms. Her previous roles within CISA focused on working with emergency response operations for telecommunications and critical infrastructure which integrated her background of mission support forecasting from her military experience. Wescott graduated top of her class for her degrees in Homeland Security Management, Public Safety Administration, and Atmospheric Sciences with her current role in the Infrastructure Security Division, Assistant Chief of Staff office, performing Extreme Weather Outreach by providing focused reports for regions and critical infrastructure operators before, during, and after disasters.

**CHRIS WIECZOREK**

Chris Wieczorek is Senior Director, Spectrum Policy, with T-Mobile USA, Inc. He assists in developing competition, spectrum, and technology policy and advising on legal matters pertaining the regulatory policy and procedures. Prior to joining T-Mobile he practiced patent law in Alexandria, Virginia. He also worked as an electrical engineer at Motorola in Atlanta,

Georgia and Plantation, Florida. Wieczorek received a bachelor of science in electrical engineering and a master of science in electrical and computer engineering from the Georgia Institute of Technology and his juris doctor from the Catholic University of America, Columbus School of Law. Wieczorek is a member of the Virginia bar.

**BILL YOUNG**

William Young joined MITRE in 2018 and currently serves as a subject matter expert in spectrum-dependent technologies. He currently supports several projects including the National Radio Dynamic Zone Engineering and Execution Lead Phase 1 and modeling of propagation clutter for interference analysis in the 3.45–3.55 GHz band. While at MITRE, he has led technically

diverse teams covering a range of topics, including an economic study of aeronautical mobile telemetry (AMT) spectrum and the National Advanced Spectrum and Communication Test Network (NASCTN) project quantifying the impacts of LTE signals on AMT receivers. He began his technical career at Sandia National Laboratories in 1998, followed by the National Institute of Standards and Technology (NIST) from 2010 to 2018. At NIST, he published several reports and papers on radio frequency penetration of large structures, started the Shared Spectrum Metrology Group, and served as the technical lead for the NASCTN investigation of LTE impacts on GPS L1 Band receivers. He received an MS from Washington State University, Pullman in 1998 and a PhD from the University of Colorado, Boulder in 2006, both in electrical engineering, where he focused on wireless communications, diversity antenna design, and optimization of radio frequency penetration into large buildings.



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