NSF Workshop on Spectrum Measurements & Spectrum

QUESTIONS RESPONSES 40

40 responses

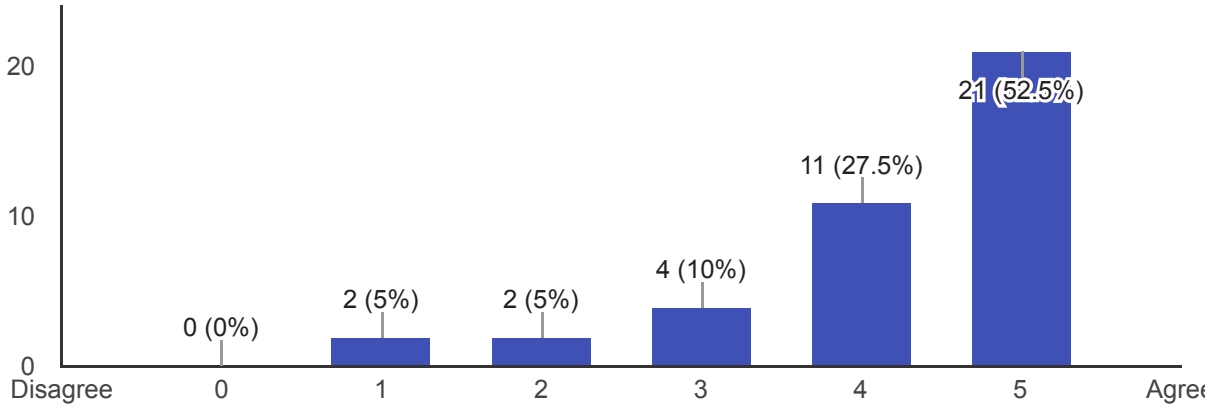
SUMMARY INDIVIDUAL

Accepting responses

Application Area

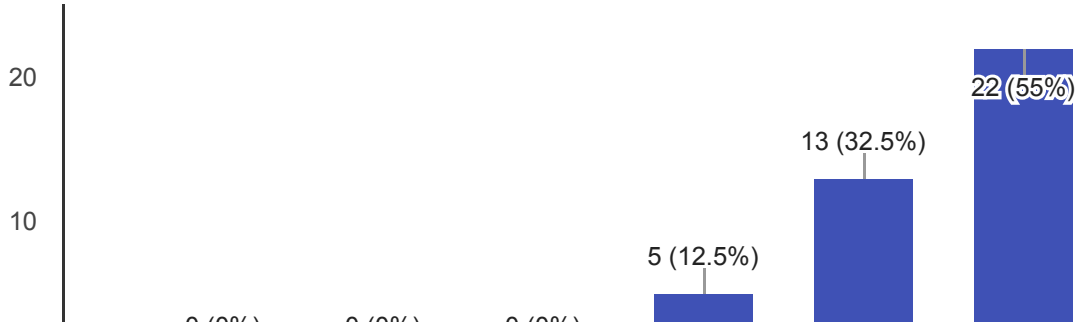
Measurements should inform the process of identifying and prioritizing bands for potential relocation or sharing by validating analytical methods, assumptions, and analysis approaches

(40 responses)



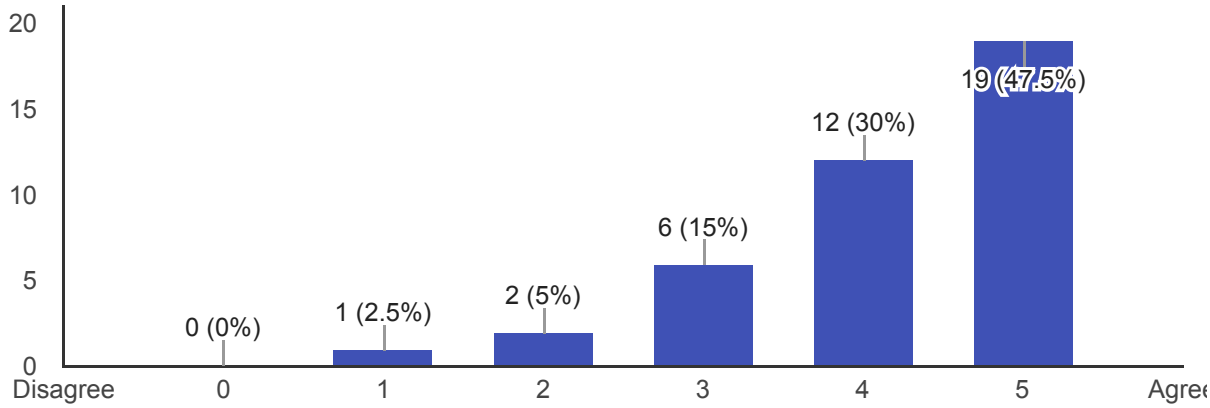
Measurements should inform entrant users of the spectrum availability and the specific incumbent system operating locally to make near real time spectrum use decisions

(40 responses)



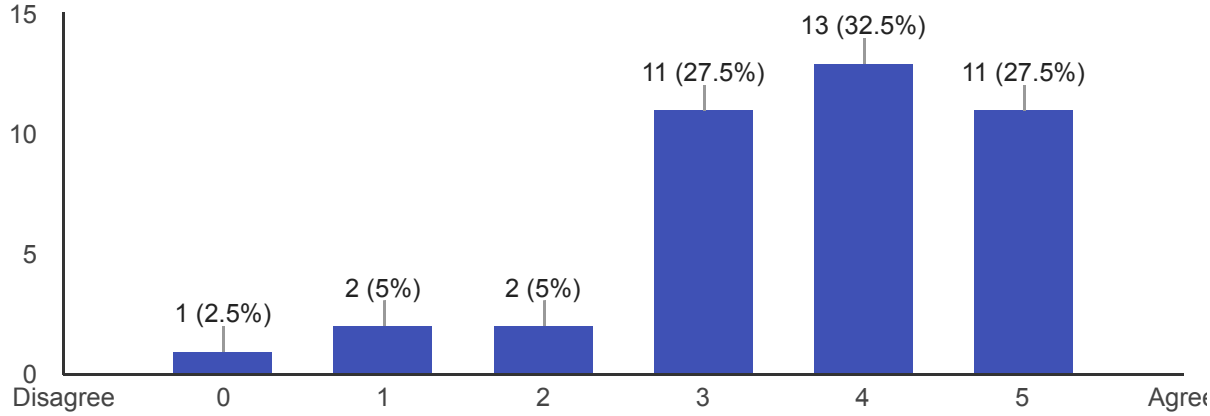
Measurements should support spectrum enforcement where unauthorized or out –of-spec operations are characterized and localized

(40 responses)



Measurements should support the identification of “ducting” and other anomalous propagation loss estimation

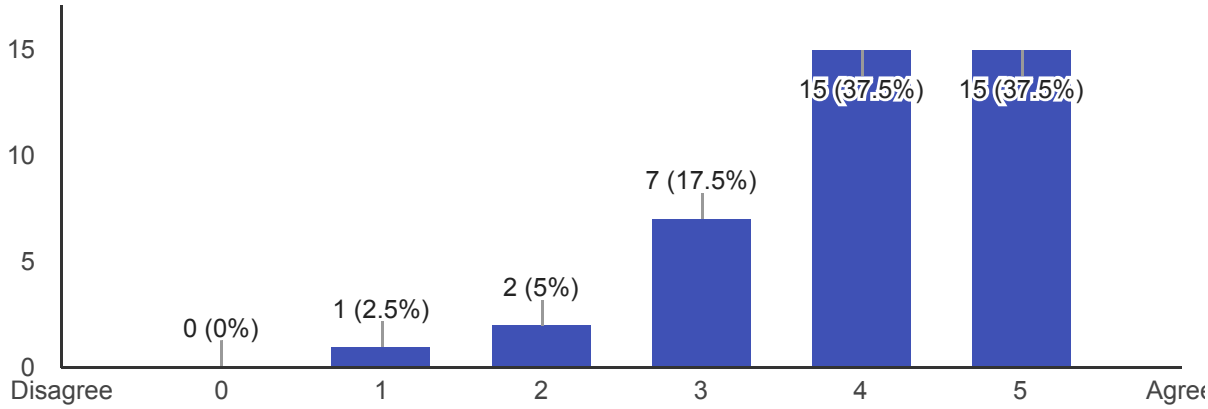
(40 responses)



The measurement system in any given geography will likely have to

perform many functions simultaneously

(40 responses)



The measurement system in any given geography will likely have to perform many functions simultaneously

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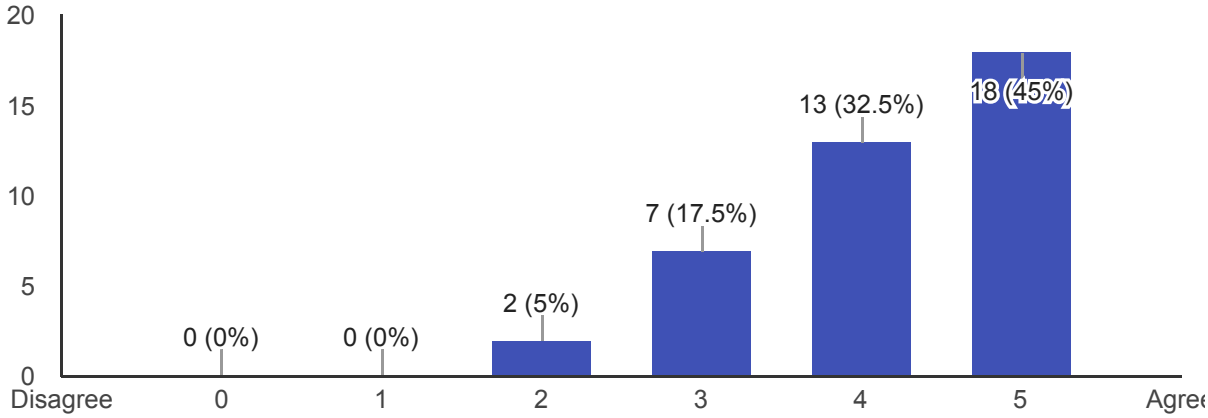


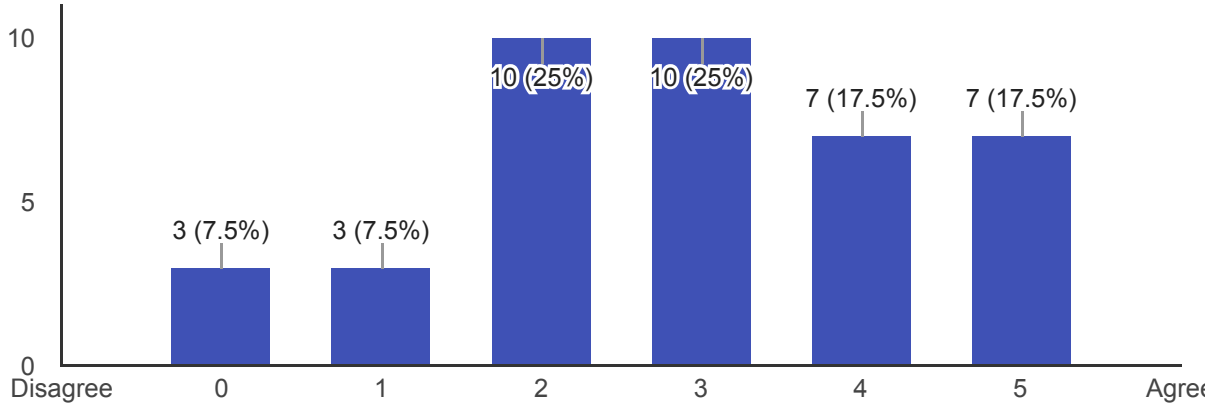
Deployment Area

Measurement systems should be located mostly in urban areas where there is high commercial and private spectrum use

(40 responses)

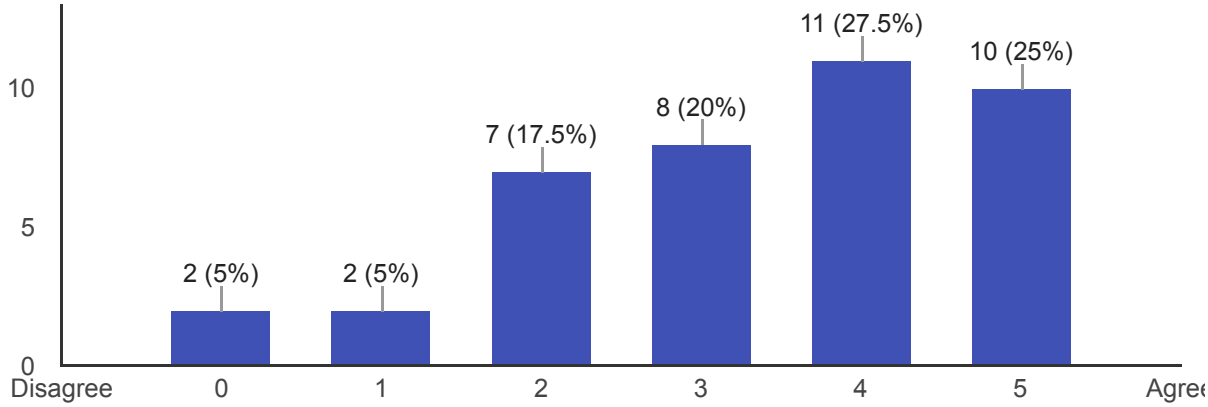
Measurement systems should initially be located mostly in rural areas where there is a transition between commercial and DoD spectrum use

(40 responses)



Measurement systems should provide near continuous spatial coverage in the deployment area

(40 responses)

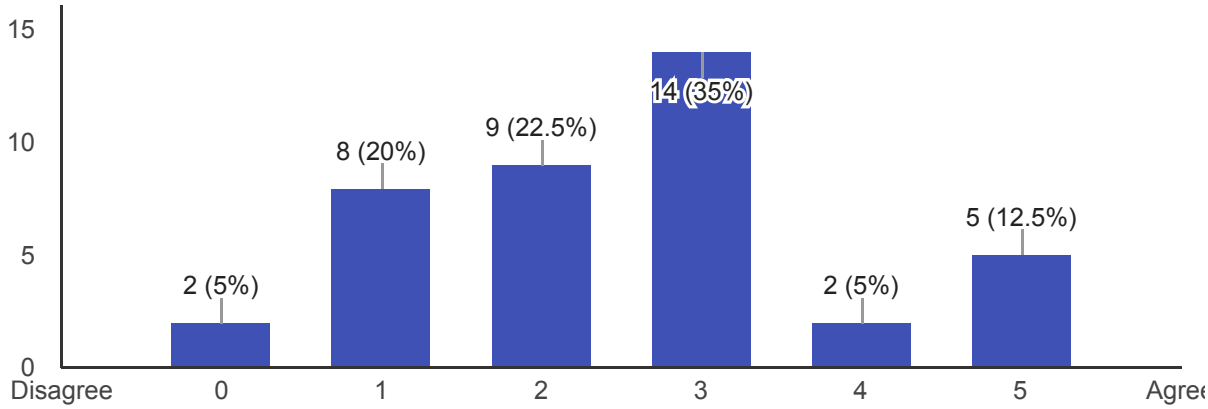


Types of Signals to Be Measured

Measurement systems should focus on measuring airborne

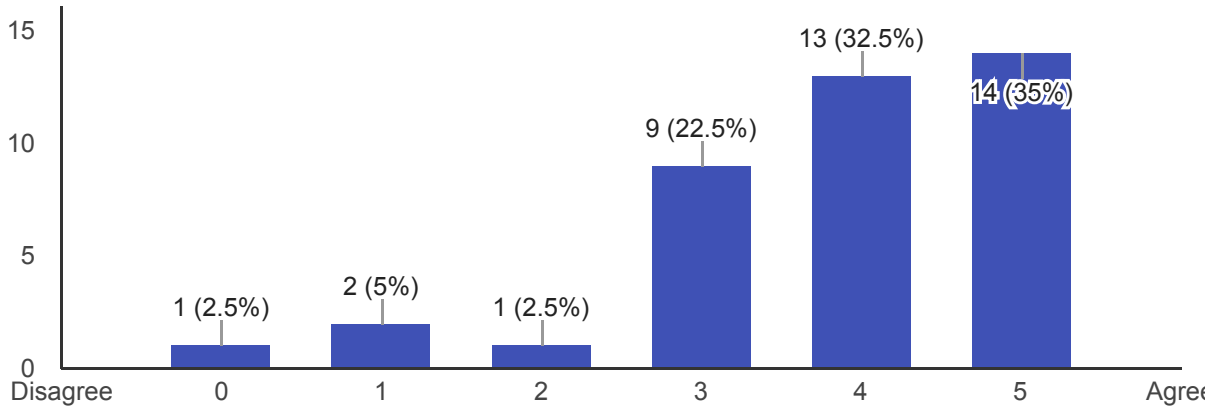
(including satellite) transmitters

(40 responses)



Measurement systems should focus on measuring ground mobile transmitters

(40 responses)



Measurement systems should focus on measuring terrestrial fixed transmitters

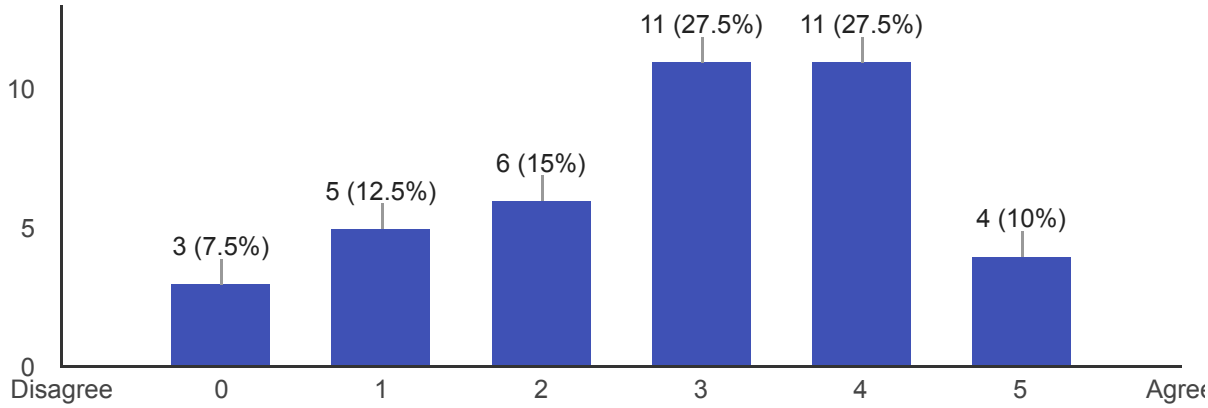
(40 responses)

15

13 (32.5%)

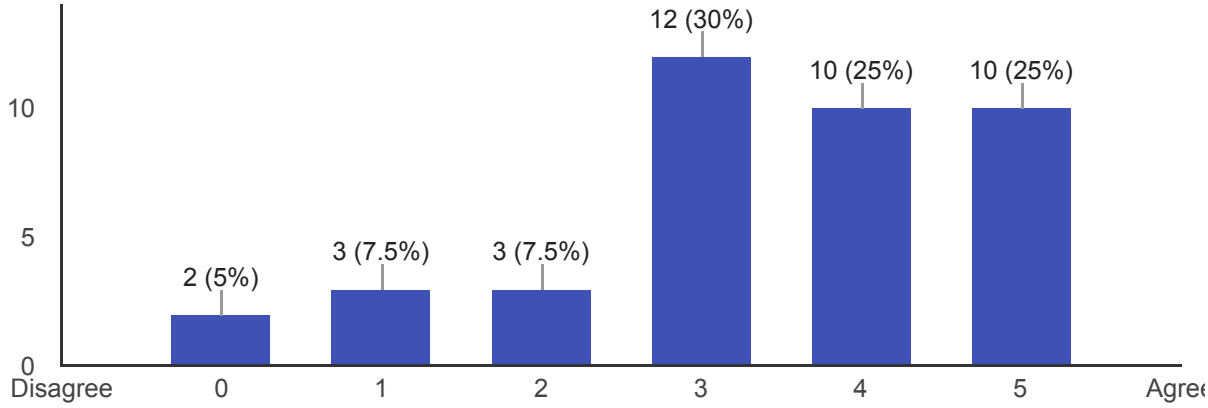
Measurement systems should focus on measuring transmitters with highly directional antennas

(40 responses)



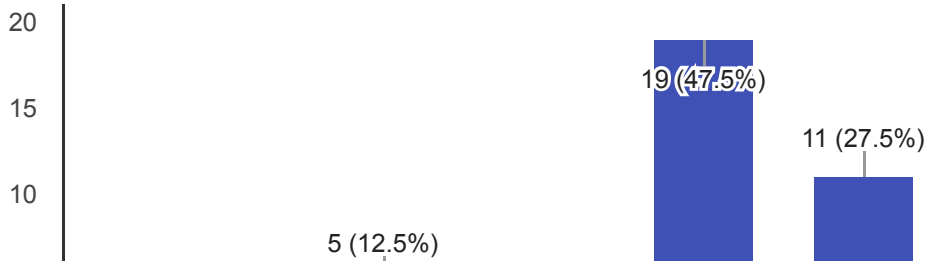
Measurement systems should focus on measuring intermittent and/or difficult to detect signals

(40 responses)



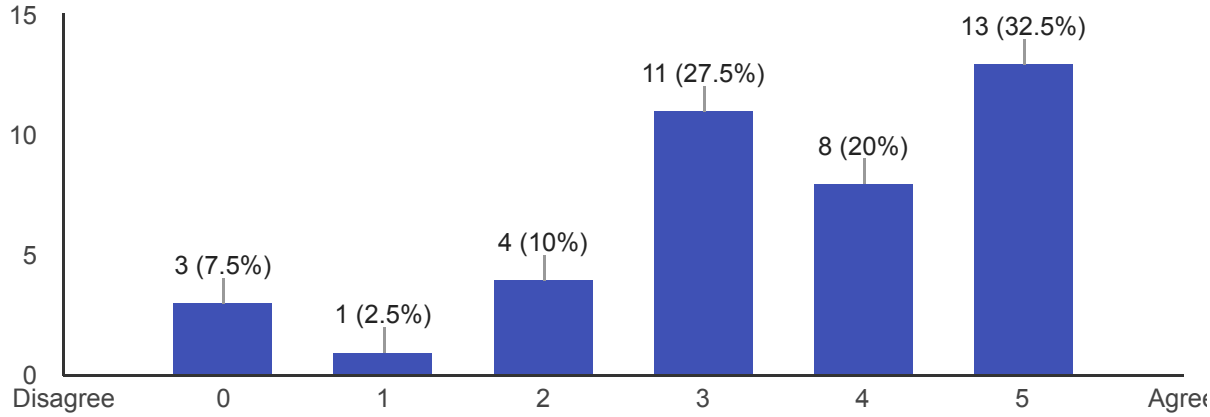
Measurement systems should focus on measuring man-made noise, spurious emissions and inter-modulation emissions and other unintended signals

(40 responses)



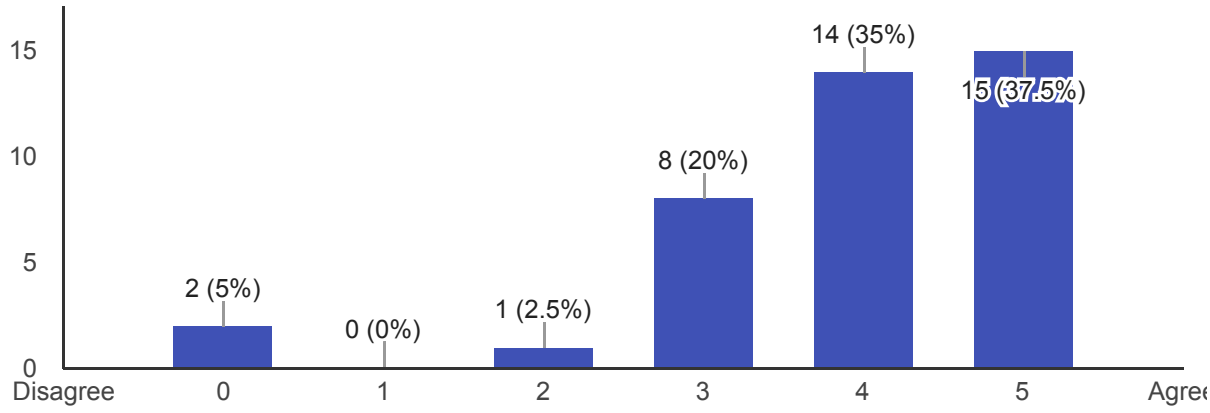
Measurement systems should focus on the 100 MHz to 1,000 MHz frequency range

(40 responses)



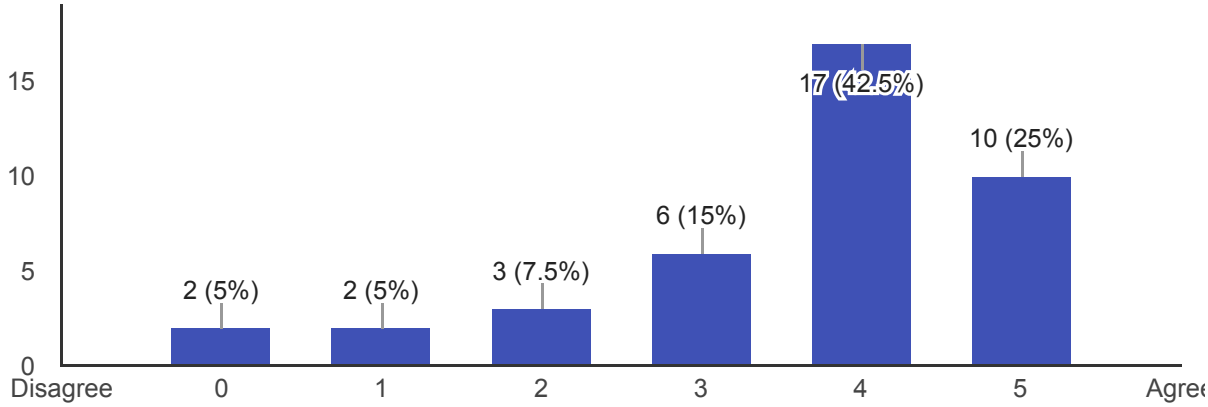
Measurement systems should focus on the 1,000 MHz to 3,000 MHz frequency range

(40 responses)



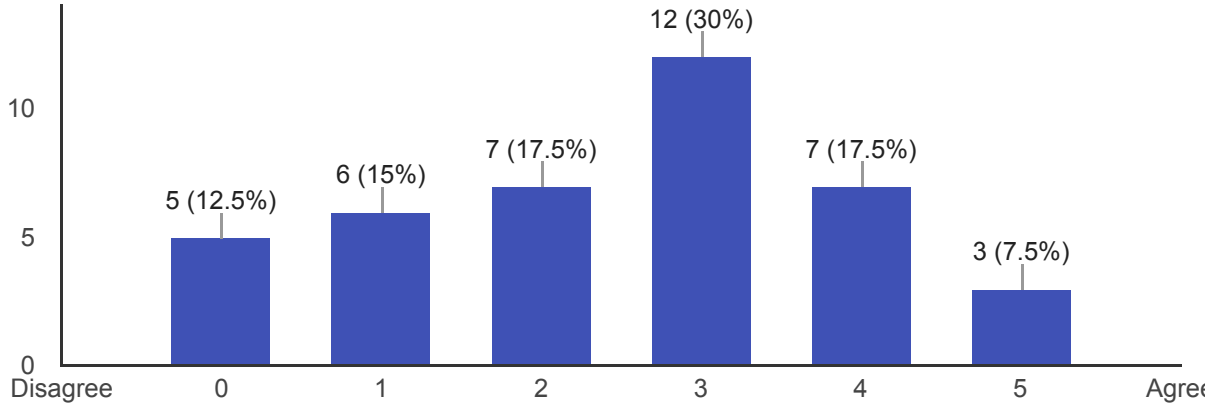
Measurement systems should focus on the 3,000 MHz to 6,000 MHz frequency range

(40 responses)



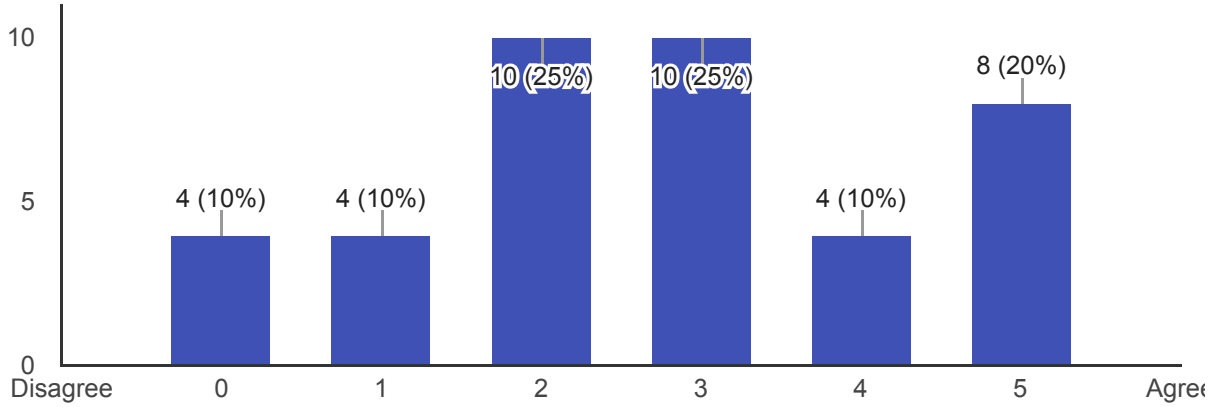
Measurement systems should focus on >6,000 MHz frequency range

(40 responses)



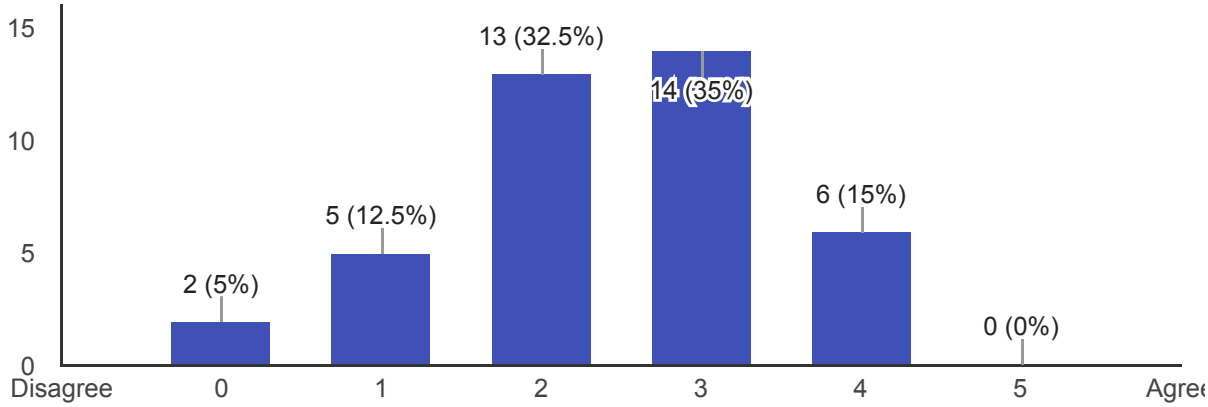
Measurement systems should not be focused and should cover the full frequency range to millimeter wave bands

(40 responses)



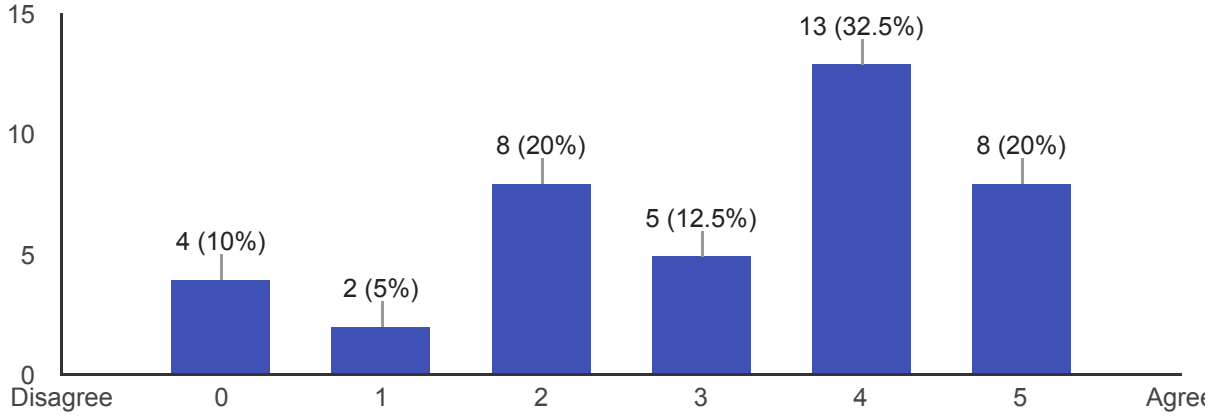
Measurement systems need to be calibrated to within 0.5 dB accuracy (including antenna gain and power measurement)

(40 responses)



Measurement systems need not be calibrated so long as they provide consistent measurements

(40 responses)

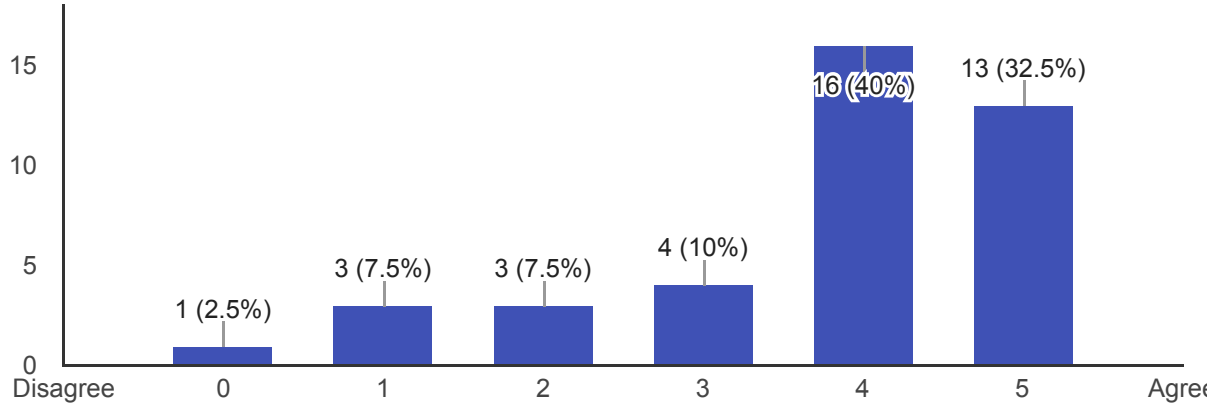


Measurement systems need to by time synchronized to within 5 us accuracy

(40 responses)

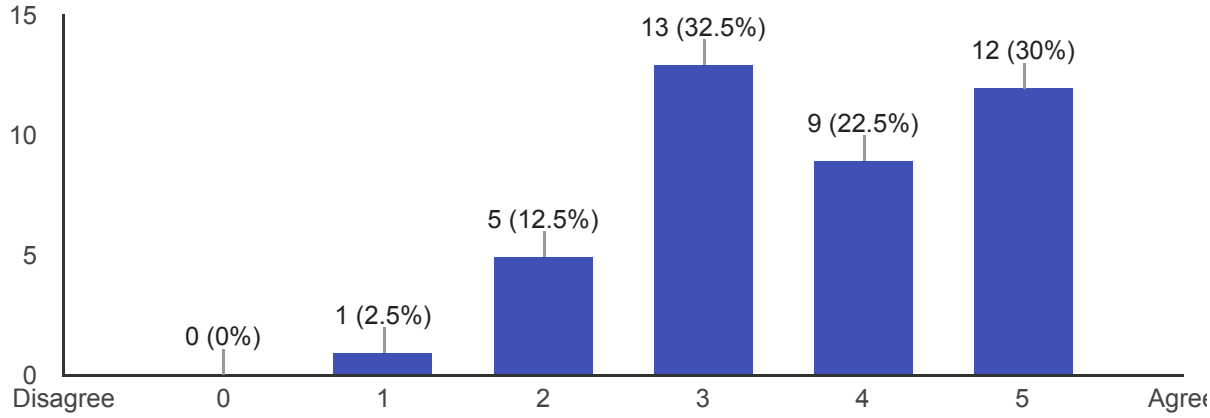
Measurement systems need not be time synchronized so long as they are means of there are means of aligning events after the fact.

(40 responses)



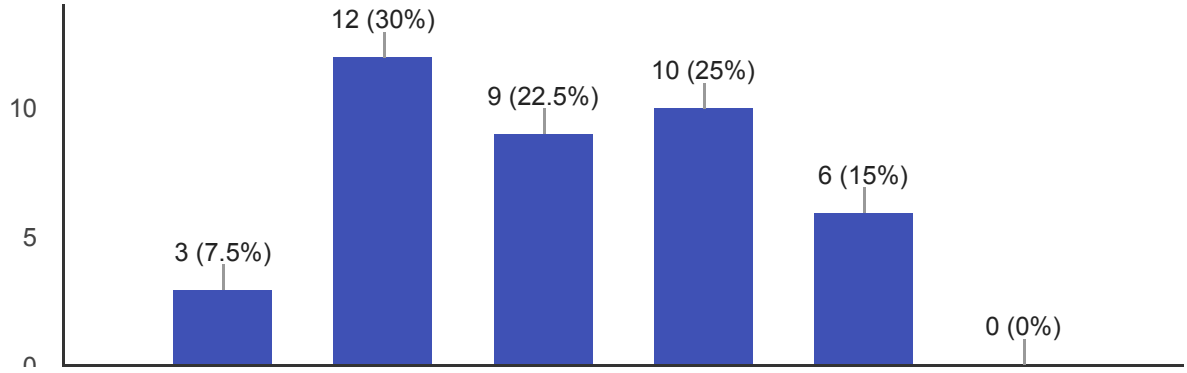
Measurement systems need to determine the emission type of signals (aka the signature of the signal) and other detailed parameters (e.g., bandwidth, burst length, etc.)

(40 responses)



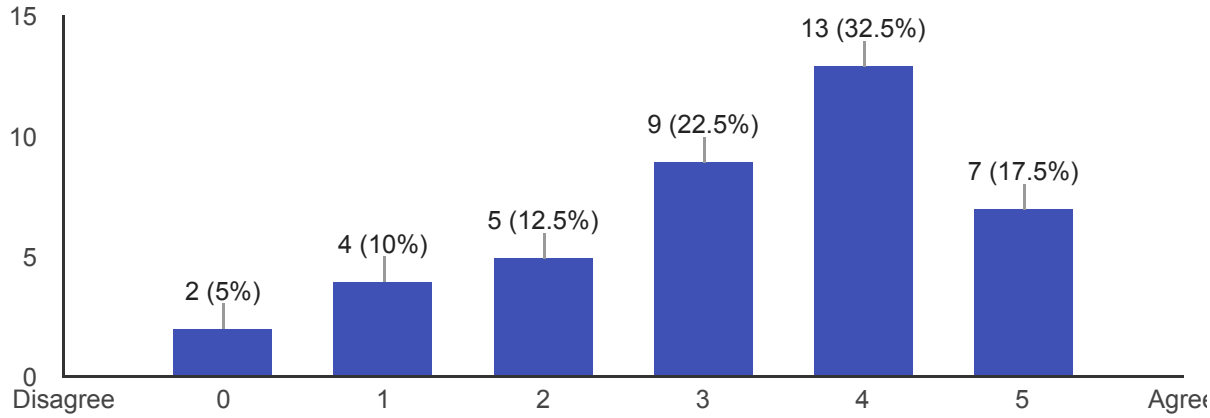
Measurement systems need to localize signals to within 10 meter accuracy

(40 responses)



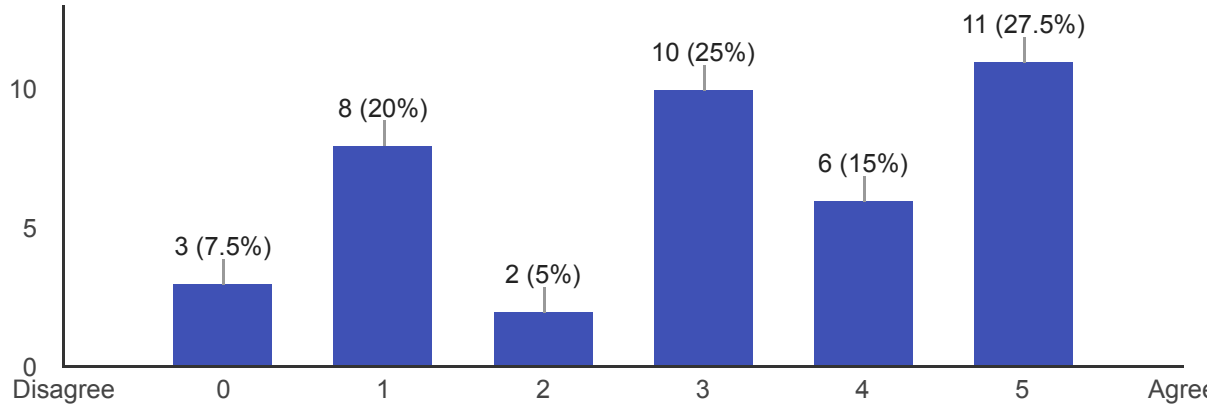
Measurement systems need to localize signals to within 100 meter accuracy

(40 responses)



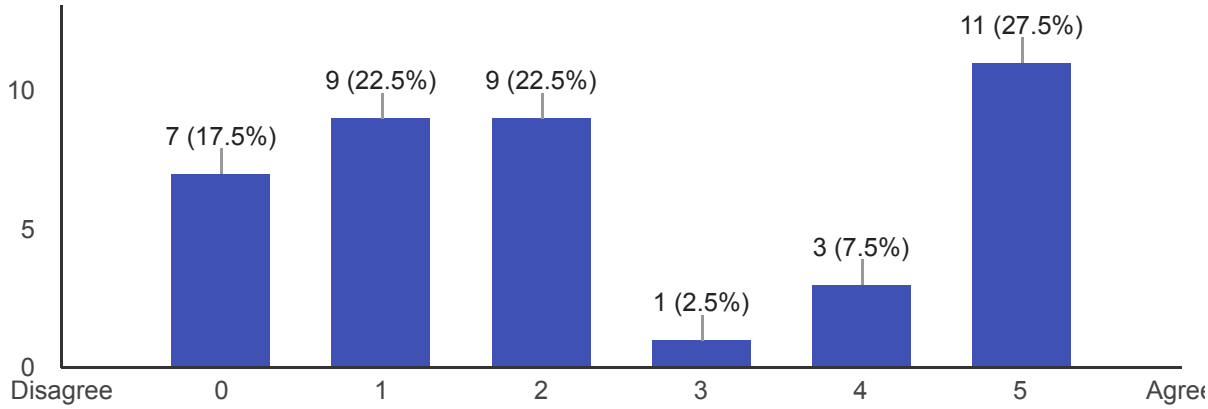
Measurement systems need to localize signals to within 1 km accuracy

(40 responses)

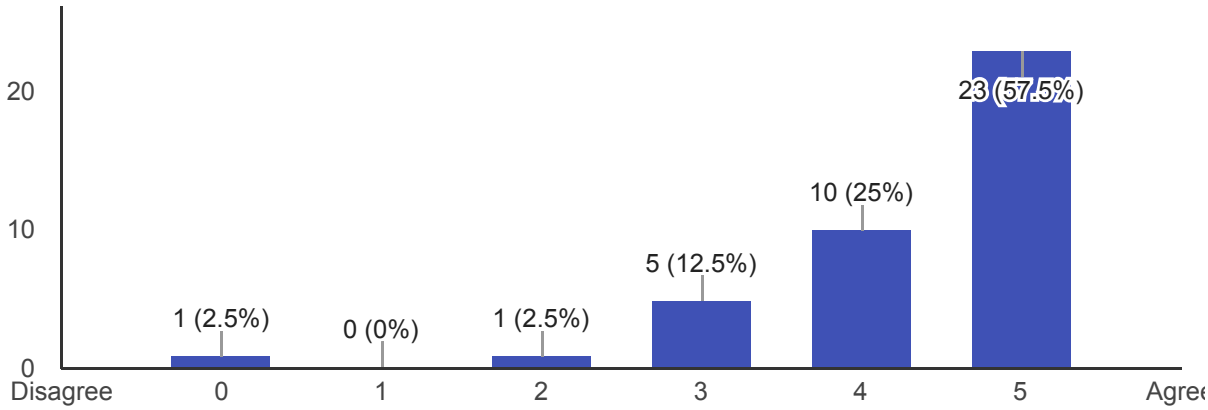


Measurement systems need to localize signals to within 10 km

accuracy
(40 responses)



Measurement localization accuracy will depend on the signal being analyzed
(40 responses)



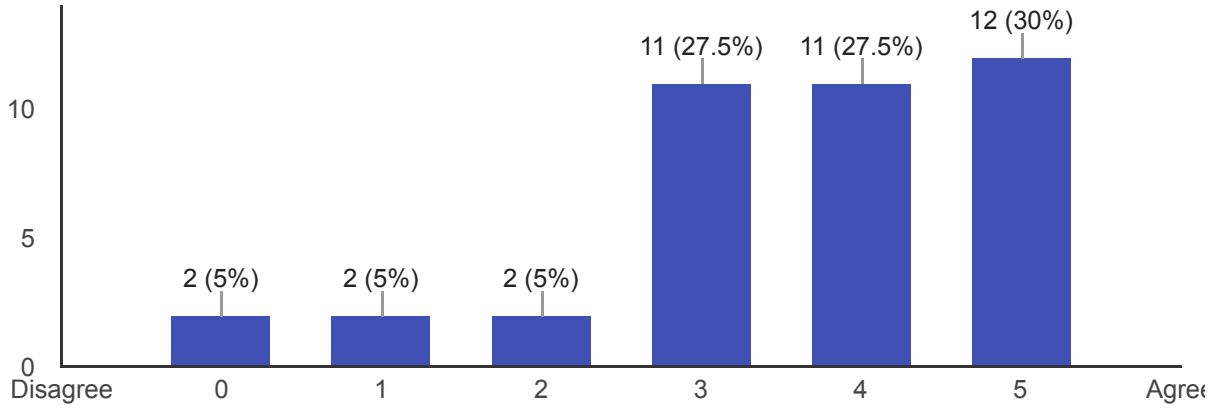
Measurement systems need to have high dynamic range to avoid inter-modulation and image signals
(40 responses)

15

13 (32.5%)

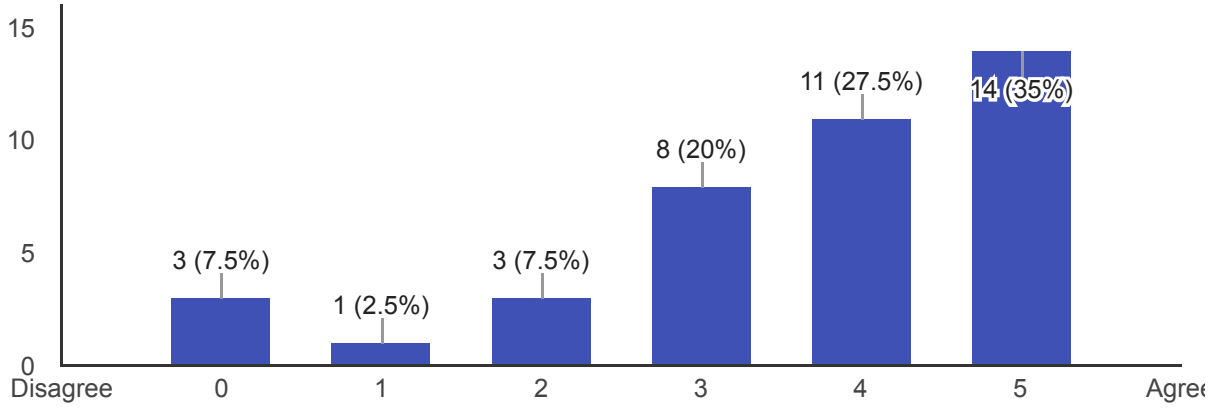
Measurement systems need to react to events within seconds. For example, if an unauthorized user is detected, a report needs to be generated within 30 seconds.

(40 responses)



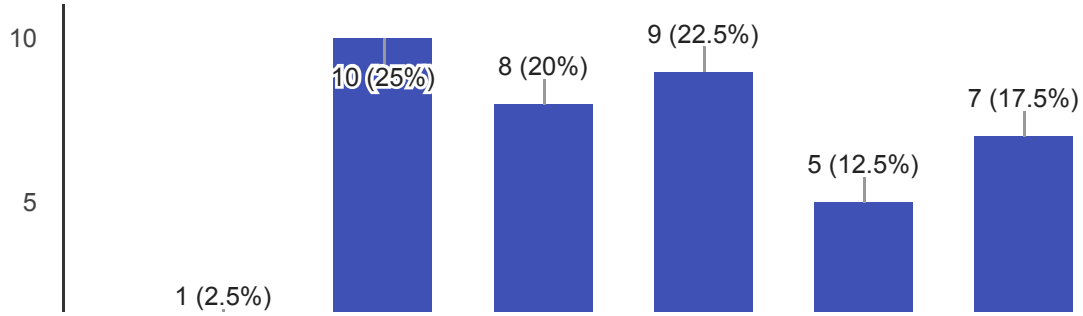
Measurement systems need to provide log files, I/Q signal history, and other detailed reports on events

(40 responses)



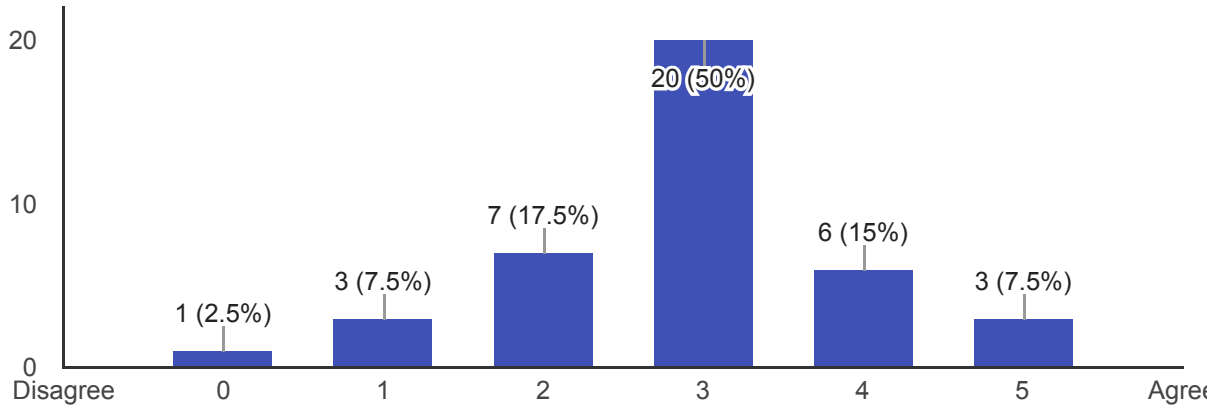
Measurement systems need to limit the amount of data collected to avoid privacy issues and therefore should not collect and store I/Q data

(40 responses)



Measurement systems need to have very high detection sensitivities (i.e., sub-noise detection)

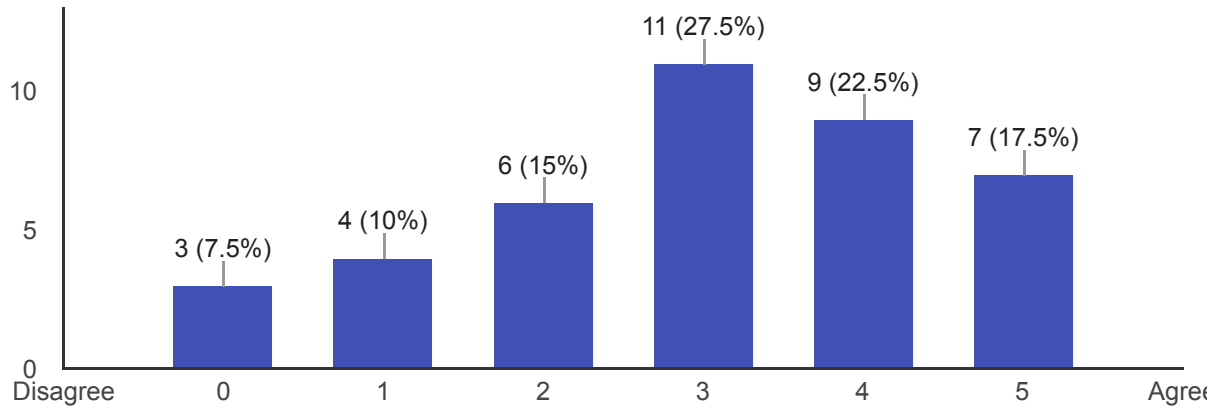
(40 responses)



System Costs

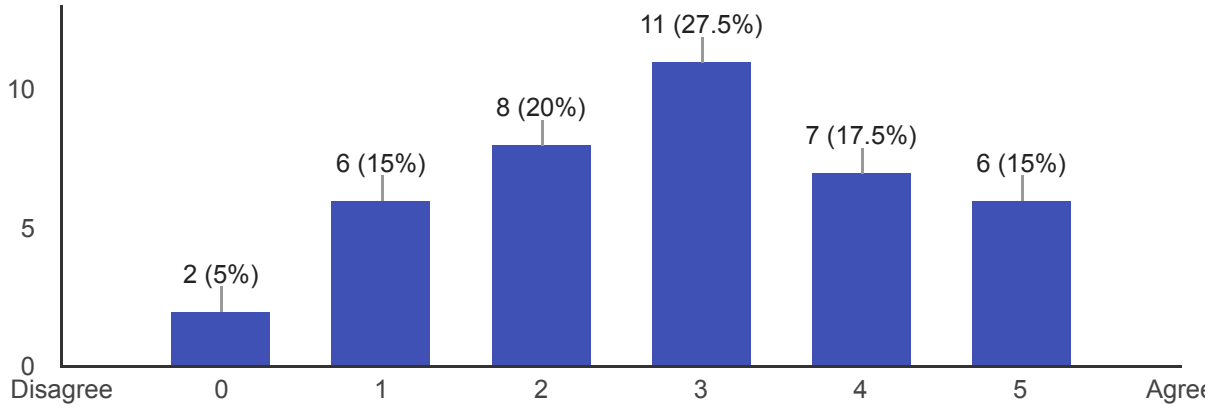
Measurement system costs (including sensor, installation, backhaul, etc.) for a major city like Chicago needs to be less than $1M (for all of the sensors) to install and $0.5 M per year to operate

(40 responses)



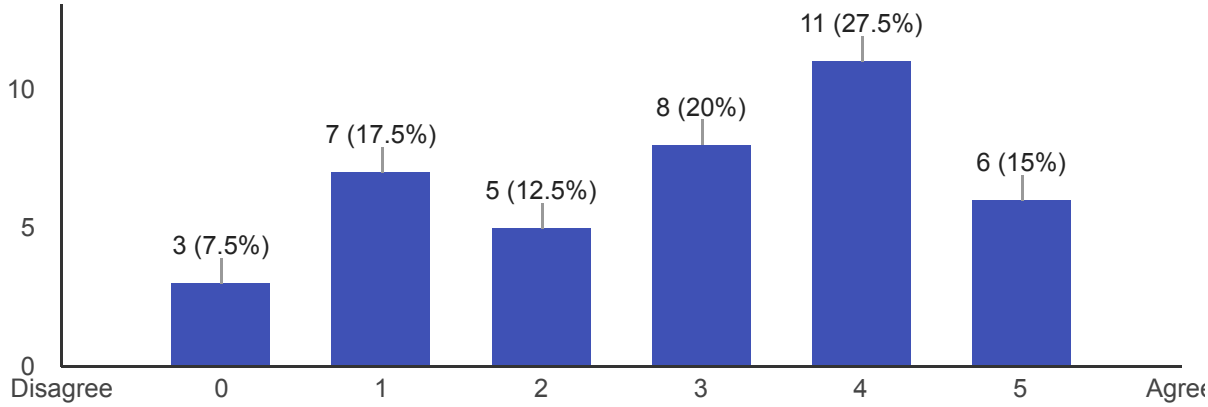
Measurement system costs (including sensor, installation, backhaul, etc.) for a major city like Chicago needs to be less than $10M (for all of the sensors) to install and $1.0 M per year to operate

(40 responses)



Measurement system costs (including sensor, installation, backhaul, etc.) for a major city like Chicago should be integrated with other sensors that measure for instance, pollution, noise, auto traffic, etc. with an incremental installation cost of less than $1M and incremental operational cost of less than $250k.

(40 responses)



Attendee Information

Name (39 responses)

Mark McHenry

Mark McHenry

Abhay Samant

Joydeep Acharya

Thyaga Nandagopal

Marko Hoyhtya

Aaron Striegel

Steve Satoh

Amir Soltanian

Steve Stanton

Mariya Zheleva

Ivan Seskar

Braden Eggerl

Kobus Van der Merwe

Danilo Erricolo

Greg Buchwald

Yang Weng

Walter Johnston

Craig Partridge

Martin Doczkat

Mark Gibson

Roger Peterson

Paul Kolodzy

Nada Golmie

Phil Fleming

Michael Cotton

Raymond Shen

Tanim Taher

Paul Brown

Randal Neal

Dennis Roberson

Randall Berry

Bob Pavlak

Bert Hochwald

Monisha Ghosh

Jonathan Chisum

Allen MacKenzie

Bruce Devine

Danijela Cabric

Short biography (37 responses)

Abhay Samant is Section Manager of RF and wireless communications at National Instruments. He is a senior member of IEEE and has over 18 years of experience in the areas of RF, wireless communications, and signal processing. Abhay has multiple patents in the areas of GPS, WLAN, and signal intelligence. He is co-author of the book, LabVIEW for Signal Processing and has published numerous conference and journal papers. In previous roles, Abhay has served as the Regional Marketing Manager for NI (India, Russia, Arabia), R&D Head for NI-India and has played multiple engineering and management leadership roles at NI R&D in Austin. Abhay received his MS in Computer Science from the University of Illinois at Urbana-Champaign in 1996 and his MS in Electrical Engineering from the University of Kentucky at Lexington in 1994. He is currently pursuing his Ph.D. in Electrical Engineering from the Indian Institute of Technology (IIT). Abhay's research interests include hybrid, reconfigurable architectures for MAC-PHY technologies for wireless communications, design of cost-effective IoT systems, channel sounding, and developing creative technologies for making learning fun. Abhay's research areas also include application of communication signal processing techniques onto real-time high performance computing architectures and development of scalable and flexible test-bed architectures for spectrum monitoring, signal intelligence, and radar applications.

Joydeep Acharya obtained my PhD degree in Electrical Engineering from the Wireless Information Networks Laboratory (WINLAB), Rutgers University in 2009. He is currently a Senior Staff Research Engineer at Hitachi America's Wireless Systems Research Lab (WSRL) working on telecom network analytics, IoT platforms and connectivity for multiple verticals such as connected cars, smart buildings etc. Previously he was leading the physical layer research and standardization in LTE-Advanced and traffic management in the cellular core network. He has a long experience in the 3GPP standardization in RAN 1, 2 and SA 2 working groups. He has co-authored a book on Heterogeneous Networks for LTE-Advanced which was published by Wiley on April, 2014. He is the author of several IEEE conference and journal papers and inventor of several patents filed worldwide.

Program Manager, National Science Foundation

Marko Höyhtyä obtained his M.Sc. degree in Information Engineering and D.Sc. degree on Telecommunication Engineering from the University of Oulu. From the beginning of 2005 he has been with VTT Technical Research Centre of Finland where he is currently working as a senior scientist and a project manager. Between February 2007 and February 2008 he made one year research visit at the Berkeley Wireless Research Center, CA. His research interests include adaptive algorithms, transmitter power control, and spectrally efficient communication. He is especially interested in application of spectrum sharing techniques in satellite communications and has lead European Space Agency funded studies in this area. He has been actively working on spectrum measurements over 5 years. He is a senior member of IEEE.

Prof. Aaron Striegel is currently an Associate Professor and serves as Associate Chair in the Department of Computer Science & Engineering at the University of Notre Dame. He received his Ph.D. in December 2002 in Computer Engineering at Iowa State University under the direction of Dr. G. Manimaran. Prof. Striegel's research interests focus on instrumenting the wireless networked ecosystem to gain insight with respect to user behavior and global network performance. Further research interests of Prof. Striegel include computer security and the adaptation of low-cost gaming peripherals for rehabilitation. Prof. Striegel has received several best paper awards including USENIX LISA, IEEE Healthcom, and HotPlanet. Prof. Striegel has received various research and equipment funding from NSF, DARPA, Sprint, Intel, Google, and Alcatel-Lucent. He has also been the recipient of a NSF CAREER award in 2004 and has been a recent participant in NAE symposia on Engineering Education and the Informed Brain in the Digital World.

VP & General Manager RFS Test Products, PCTEL Inc.
35 Years of contribution within the wireless industry spanning initial AMPS product development, Public Safety and converged mobility products, Software Defined Radio sensors for 2G, 3G, 4G and WiFi, RF Interference Management Systems.

bio was requested

Steven W. Stanton
Product Planner
Real-Time Spectrum Analyzer Product Line

As Product Planner in the RTSA Product Line, Steve is responsible for leading the product definition teams that gathers customer requirements for Real-Time Spectrum Analyzers.
During his 30 years at Tektronix, Steve has held positions as Product Specialist, Applications Engineer, Account Manager and Product Manager. Prior to his career at Tektronix, Steve worked as a microwave design engineer.

Dr. Mark A. McHenry is President of Shared Spectrum Company, which he founded in 2000. He has conducted many projects (software development, field measurement, and analysis) related to spectrum use and spectrum sharing. McHenry has served as a member of NTIA’s Commerce Spectrum Management Advisory Committee since 2006. McHenry served on the President’s Council of Advisors on Science and Technology Spectrum study in 2012. McHenry was named Engineer of the Year by the District of Columbia Council of Engineering and Architectural Societies in February 2006. McHenry was a co-founder of San Diego Research Center, Inc., which focused on DoD test and training systems. McHenry was a Program Manager at the Defense Advanced Research Projects Agency, where he managed multiple tactical wireless related programs. McHenry received the Office of Secretary of Defense Award for Outstanding Achievement in 1997 and the Office of Secretary of Defense Award for Exceptional Public Service Award in 2000. McHenry was an engineer at SRI

International, Northrop Advanced Systems, McDonnell Douglas Astronautics, Hughes Aircraft, and Ford Aerospace.

McHenry received his Ph.D. in Electrical Engineering from Stanford University, M.S. in Electrical Engineering from the University of Colorado, and B.S. in Engineering and Applied Science from the California Institute of Technology. McHenry has 21 issued patents in spectrum and radio frequency areas and 30 published journal and conference papers.

Mariya Zheleva is an assistant professor in the Department of Computer Science at University at Albany SUNY. Prior to joining the tenure-track faculty in 2016, she was a visiting assistant professor at the University. Mariya completed her PhD in Computer Science at University of California Santa Barbara in 2014. Her research is in the field of wireless networks and focuses on spectrum sensing, characterization and management for new generation Dynamic Spectrum Access. She has also done work on small local cellular networks and network performance measurement and characterization. Her work was published in top-tier conferences, interdisciplinary journals and featured in popular media. Mariya is currently serving on the organizing committee of DySPAN2017 and on several technical program committees.

Ivan Seskar is Associate Director at WINLAB, Rutgers University responsible for experimental systems and prototyping projects. Mr. Seskar is currently PI for two NSF GENI projects - the “meso-scale” Open-Flow virtual network deployment at Rutgers University and the Open WiMAX/LTE base station project which resulted in campus deployments at several US universities as well as the PI of an ongoing NSF CRI project aimed at deployment of a wideband cognitive radio platform (“WiSER”). He is also co-PI for the NSF-supported ORBIT project at WINLAB and has led technology development and operations activities since the testbed was released as a community resource in 2005 and for which the team received 2008 NSF Alexander Schwarzkopf Prize for Technological Innovation. His technical interests include experimental protocol evaluation, radio technology, software defined and cognitive radios, vehicular networking and wireless systems in general. Ivan is a Senior Member of the IEEE, member of ACM and co-founder and CTO of Upside Wireless Inc.

Sales Specialist with Rohde & Schwarz USA

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 after fourteen years at AT&T Labs - Research. He does networking systems research in a broad range of areas including network management, control and operation, mobile networking, network evolution, network security and cloud computing. He is leading an effort to build a testbed, called PhantomNet, to enable research at the intersection of mobile networking, software defined networking and cloud computing.

DANILO ERRICOLO
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Email: derric1@uic.edu, URL: http://erricolo.engr.uic.edu/

PROFESSIONAL PREPARATION
• Laurea degree of Doctor in Electronics Engineering (summa cum laude), Politecnico di Milano, Milan,

Italy, 7/1993
• Ph.D. Electrical and Computer Engineering, University of Illinois at Chicago, 12/1998
• Post-Doctoral Fellow, Wireless Communications, University of Illinois at Chicago, 1/1999-12/1999

APPOINTMENTS
University of Illinois at Chicago: Professor (8/2012 – present), Associate Professor (8/2007 - 8/2012), Associate Professor (tenure track 8/2004 - 8/2007), Research Scientist (1/2000 - 8 2004)

SYNERGISTIC ACTIVITIES
• Research activities on electromagnetic scattering and propagation, electromagnetic compatibility, radar, wireless communications, and magnetic resonance imaging, funded by the Air Force Office of Scientific Research, the Defense Advanced Research Project Agency, and the National Science Foundation. Coauthored more than 220 peer-reviewed publications. Advisor of 12 Ph.D. (7 graduated), 12 M.S. (11 graduated), and 32 undergraduate students.
• United States National Committee of the International Union of Radio Science (USNC-URSI), a committee of the National Academies
o Chair, USNC-URSI Commission E, Electromagnetic Environment and Interference (2009-2011)
o Chair, USNC-URSI Student Paper Competition (2009-2014)
o Elected, USNC-URSI Member at Large (2012-2017)
• Chairmanships of international scientific conferences
o General Chairman, 2012 IEEE International Symposium on Antennas and Propagation and USNC-URSI National Radio Science Meeting, Chicago, IL, July 8-14, 2012
o Vice Chair, XXIX URSI General Assembly, Chicago, IL, USA, 7-16 August, 2008
• Institute of Electrical and Electronics Engineers (IEEE)
o Chair, Distinguished Lecturer Program, Antennas and Propagation Society, 2015-present
o Elected, Administrative Committee Member, Antennas and Propagation Society, 2012-2014
o Chair, Chicago Chapter, Antennas and Propagation/Microwave Theory and Techniques Societies, 2011-present
• Associate Editor: IEEE Antennas and Wireless Propagation Letters (2001-2014); IEEE Transactions on Antennas and Propagation (2013-present); Radio Science (2014-present)
• Awards: IEEE Fellow, UIC Teaching Recognition Program, College of Engineering Faculty Undergraduate Advising Award, UIC Areas of Excellence Program Award Recipient

Greg is a Distinguished Member or the Technical Staff, Motorola Solutions, Inc. Duties include RF systems research, RF regulatory engineering guidance, experimental hardware implementation, and industry involvement. Recent assignments have included proof of concept systems for incident area broadband communications systems including airborne solutions, increasingly spectrally-efficient narrow-band solutions, industry and consortium involvement in dynamic spectrum access methods combined with incumbent service protection (ex: GPS/NPSTC recent issues), and exploration of future needs for mission critical communications including 5G. Greg is also a member of the Motorola Science Advisory Board Associates (SABA), he currently holds 20 issued US patents, and is a team member of the Motorola Spectrum and Spectrum-related Issues Center of Excellence. Greg started his career with Motorola, Inc as co-op student in 1980 and current has 35 years with the corporation.

Yang Weng is an Electronics Engineer in the Spectrum Engineering and Analysis Division of the Office of Spectrum Management within NTIA. She joined NTIA in 2005, during which time she has been involved in developing measures to assess spectrum efficiency, and recommending changes to NTIA Spectrum Standards for the Fixed Service. Working closely with NTIA/ITS, she also worked on measurements of microwave signals using ITS's Radio Spectrum Measurement System, and evaluated potential applications of such measurements. In addition, she participated in the NTIA Spectrum Sharing Innovation Test-Bed Pilot program, and was a liaison to the Enforcement Subcommittee of Commerce Spectrum Management Advisory Committee (CSMAC) from 2014 to 2015.

Prior to NTIA, Ms. Weng held positions of Director of Engineering, RF Manager and Senior RF Engineer

at MCI Worldcom Broadband Solutions, where she was responsible for designing and deploying wireless broadband networks in 13 markets. She was also involved in spectrum sharing opportunities and mitigating interference between emerging two-way broadband services and existing one-way broadcast operations in 2500-2690 MHz, Multichannel Multipoint Distribution Service (MMDS). She has an MSEE from University of Kentucky.

Walter Johnston
Walter Johnston is currently Chief, Electromagnetic Compatibility Division for the FCC where he is responsible for the evaluation of new technologies and services. Prior to the FCC, he served as CTO for several companies focused on data and VoIP services. He has held senior positions in Telcordia and was Vice President at BellAtlantic/NYNEX, now Verizon, where he was responsible for the development of new broadband data services including the company's first Internet service offering. While at Verizon he also directed the trial of one of the nation's first high speed regional Internet networks as part of the National Science Foundation's Internet program and also established one of the nation's largest experimental broadband networks, a statewide facility connecting research organizations throughout New York State. Mr. Johnston served as program manager for the introduction of optical technology to the Bell System while he was at AT&T. He began his career with Bell Laboratories where he was responsible for design and development of a number of computer systems automating processes within the telephone network. He has a B.S./EE and an M.S./CS both from Polytechnic Institute of New York.

Dr. Craig Partridge is Chief Scientist for Networking at Raytheon BBN Technologies. He is a member of the NSF CISE Advisory Committee, Chair of the ACM Fellows Committee, a Fellow of ACM and IEEE, a former chair of ACM SIGCOMM, and a former editor-in-chief of both IEEE Network Magazine and ACM Computer Communication Review. His research interests are in data networking, broadly defined - any problem in moving coherent data from one place to another is of interest. Craig received his A.B., M.Sc. and PhD degrees from Harvard University.

Dr. Mark A. McHenry is President of Shared Spectrum Company, which he founded in 2000. He has conducted many projects (software development, field measurement, and analysis) related to spectrum use and spectrum sharing. McHenry has served as a member of NTIA's Commerce Spectrum Management Advisory Committee since 2006. McHenry served on the President's Council of Advisors on Science and Technology Spectrum study in 2012. McHenry was named Engineer of the Year by the District of Columbia Council of Engineering and Architectural Societies in February 2006. McHenry was a co-founder of San Diego Research Center, Inc., which focused on DoD test and training systems. McHenry was a Program Manager at the Defense Advanced Research Projects Agency, where he managed multiple tactical wireless related programs. McHenry received the Office of Secretary of Defense Award for Outstanding Achievement in 1997 and the Office of Secretary of Defense Award for Exceptional Public Service Award in 2000. McHenry was an engineer at SRI International, Northrop Advanced Systems, McDonnell Douglas Astronautics, Hughes Aircraft, and Ford Aerospace.

McHenry received his Ph.D. in Electrical Engineering from Stanford University, M.S. in Electrical Engineering from the University of Colorado, and B.S. in Engineering and Applied Science from the California Institute of Technology. McHenry has 21 issued patents in spectrum and radio frequency areas and 30 published journal and conference papers.

Martin Doczkat is the Chief of the Technical Analysis Branch in the Federal Communications Commission's Office of Engineering and Technology, where his primary functions are promoting efficient use of spectrum, new technologies, wireless propagation modeling, and radiofrequency safety. He holds a Bachelor of Science (BS) degree in Electrical Engineering from The Pennsylvania State University, and two Master of Science (MS) degrees, in Electrical Engineering and Systems Engineering, from The George Washington University. He is a licensed professional engineer (PE) in DC, a member of the Institute of Electrical and Electronics Engineers (IEEE), a member of American

National Standards Institute (ANSI), a United States member of International Electrotechnical Commission (IEC), and a member of the Association of Federal Communications Consulting Engineers (AFCCE).

Mark Gibson
Director, Business Development
Comsearch

With over 30 years of spectrum management experience, Mark is responsible for developing domestic and international business opportunities for Comsearch. In addition to leading Comsearch's technical and business development efforts numerous wireless and spectrum-related products and services, he has led efforts to address spectrum sharing between Federal government and commercial users. He is a co-chair of the Commerce Spectrum Management Advisory Committee, where he has also co-chaired working groups related to spectrum sharing and data exchange issues.. He has led Comsearch's spectrum management efforts including the development of spectrum sharing analysis protocols and sharing criteria, as well as development of Comsearch's engineering services and software products. He has led Comsearch's efforts in working with the American Society for Healthcare Engineering as their technical partner for WMTS frequency coordination. He has authored several papers on spectrum sharing and relocation and has advised numerous wireless participants in their system design. He received his BSEE from the University of Maryland.

Paul Kolodzy: asked for bio

NADA GOLMIE (nada@nist.gov) received her Ph.D. in computer science from the University of Maryland at College Park. Since 1993, she has been a research engineer at the National Institute of Standards and Technology. She is currently the chief of the wireless networks division in the Communications Technology Laboratory. Her research in media access control and protocols for wireless networks led to over 100 technical papers presented at professional conferences, journals, and contributed to international standard organizations and industry led consortia. She is the author of "Coexistence in Wireless Networks: Challenges and System-level Solutions in the Unlicensed Bands," published by Cambridge University Press (2006). She leads several projects related to the modeling and evaluation of future generation wireless systems and protocols and serves as a co-chair for the 5G mmWave Channel Model Alliance.

Philip J. Fleming
Senior Technology Advisor
Mobile Networks CTO Office
Nokia Networks
Phil Fleming has broad experience in wireless communication technologies and special expertise in converting research and advanced technology concepts into business value for wireless equipment suppliers and operators. He started his engineering career in 1982 at Bell Laboratories and joined Motorola in1991. While at Motorola, he was Fellow of the Technical Staff and Senior Director of the Advanced Radio Technology and Engineering team from 2005 to 2011. In 2011, he and his team joined Nokia Network's CTO office and in January 2013, he was appointed CTO of North America and Head of the Advanced Technologies group in Nokia Network's Technology and Innovations. He is currently Senior Technology Advisor in the CTO Office of the newly formed Mobile Networks Business Unit.

Michael Cotton is Division Chief of the Telecommunications Theory Division and program leader of NTIA's Spectrum Monitoring Pilot Program at the Institute for Telecommunication Sciences in Boulder, Colorado. Michael joined NTIA/ITS in 1992. He has been involved in a broad range of research topics including applied electromagnetics, atmospheric effects on radiowave propagation, radio channel measurement and theory, interference effects on digital receivers, ultrawideband technologies, spectrum sharing with Federal systems, and spectrum occupancy measurements. Michael has

received DOC Gold Medal Awards for research and engineering achievement in the development of national policies for UWB technologies in 2002 and 3.5 GHz spectrum sharing in 2015. In 2010 and 2011, Mr. Cotton was the General Chair for the International Symposium on Advanced Radio Technologies (ISART) on Developing Forward-Thinking Rules and Processes to Fully Exploit Spectrum Resources. Michael has authored or co–authored over thirty technical publications. He received a B.S. degree in Aerospace Engineering in 1992 and an M.S. degree in Electrical Engineering with an emphasis on electromagnetics in 1999, both from the University of Colorado at Boulder.

Raymond Shen, PhD is the Signal Monitoring Solutions Manager for Keysight Technologies, with 17 years of experience in wireless signals and signal monitoring. Shen has a BS EE from Caltech, and MS EE/PhD EE from Stanford University.

Tanim Taher completed his PhD in Electrical Engineering at Illinois Tech in May 2014 working under Professors Dennis Roberson and Miles Wernick. His research area concentrated on wideband spectrum measurements and automated signal extraction with occupancy modeling. He is currently employed in Austin, Texas as an RF Systems Engineer at National Instruments where he works in customer facing projects related to wireless test and measurement, communication systems and 5G prototyping technology.

Paul Brown is the Chief Scientist for Paradigm4, the company sponsoring the development of SciDB. Prior to working for Paradigm4, Paul was a Senior Technology Staff Member working at the IBM Research Group's Almaden Research Lab for a decade, and prior to that he was the 'Chief Plumber' at INFORMIX. Paul has worked for a series of Relational and Object-Relational DBMS providers all starting with the letter 'I' as an engineer and software architect: Ingres, Illustra, INFORMIX and IBM. He is the author of several research papers and books on data management issues. His research interests include scalable data management and analysis and data management in support of scientific research.

Randy Neal is a SIGINT systems engineer and former employee of the National Security Agency. He holds a Bachelor of Science in Electrical Engineering from Virginia Tech. During his 7 years of work with the NSA he became a distinguished COMINT analyst and served as a lead field site engineer supporting the signals analysis mission. He has been with Rohde & Schwarz for 8 years. At Rohde & Schwarz, Randy is responsible for the design, implementation and fielding of COMMINT systems to support both national and tactical customers.

Prof. Roberson is Illinois Institute of Technology's Vice Provost, Research, and Research Professor in Computer Science. He is an active researcher and co- founded IIT's Wireless Network and Communications Research Center. He is also President and CEO of Roberson and Associates. His research focuses on dynamic spectrum sharing, and spectrum measurement/management. He serves on several technology-based company boards. He was Motorola's EVP/CTO complementing a corporate career at IBM, DEC, AT&T and NCR. He is a frequent speaker at universities, companies, workshops and conferences around the globe. Prof Roberson has BSEE and BS Physics degrees from WSU and a Stanford MSEE.

Randall Berry received his PhD from MIT in 2000 and subsequently joined Northwestern University where he is currently a Professor in the Department of Electrical Engineering and Computer Science and Director of the Master of Science in Information Technology Program. He is a fellow of IEEE. His research interests include spectrum sharing, network economics and wireless resource allocation.

Engineering R&D management of wide area cellular network systems (30+ years). Spectrum engineering technical analysis at the FCC (4+ years)

Monisha Ghosh is currently a Research Professor at the University of Chicago. Previously she was a Principal Engineer at Interdigital, researching wireless technologies for 5G cellular and next generation

Wi-Fi systems. Prior to this, she worked at Philips Research, Briarcliff Manor, and Bell Laboratories, Murray Hill, on various communication systems such as the HDTV broadcast standard, cable standardization and on cognitive radio for the TV White Spaces, and briefly in clinical informatics. She has been an active contributor to many industry standards and was recognized with a Certificate of Appreciation for her outstanding contributions to IEEE 802.22. Her research interests are broadly in the area of signal processing and communications. She received her Ph.D. in Electrical Engineering from the University of Southern California in 1991, and her B. Tech from the Indian Institute of Technology, Kharagpur in 1986. She is a Fellow of the IEEE.

Dr. Chisum is an Assistant Professor of Electrical Engineering at the University of Notre Dame. His research interests include microwave and millimeter-wave circuits and antenna systems for wireless communications, electronic warfare, and spectrum sensing. He is also interested in hardware implementation of compressive sensing, electrically small antennas, non-Foster's circuits, and low-power analog signal processing. Prior to joining the University of Notre Dame he was a member of technical staff in the Wideband Tactical Networking group at MIT Lincoln Laboratory where he worked on millimeter-wave electronic warfare components and systems.

Allen B. MacKenzie is an Associate Professor in the Bradley Department of Electrical and Computer Engineering at Virginia Tech, where he has been on the faculty since 2003. He is the associate director of Wireless @ Virginia Tech. During the 2012-2013 academic year, he was an E. T. S.
Walton Visiting Professor at Trinity College Dublin.

Prof. MacKenzie's research focuses on wireless communications systems and networks. His current research interests include cognitive radio and cognitive network algorithms, architectures, and protocols and the analysis of such systems and networks using game theory. His past and current research sponsors include the National Science Foundation, Science Foundation Ireland, the Defense Advanced Research Projects Agency, and the National Institute of Justice.

Prof. MacKenzie is a senior member of the IEEE and a member of the ASEE and the ACM. Prof. MacKenzie is an area editor of the IEEE Transactions on Communications, an associate editor of the IEEE Transactions on Mobile Computing, and an associate editor of the IEEE Transactions on Cognitive Communications and Networking. He is the author of more than
50 refereed conference and journal papers and a co-author of the book Game Theory for Wireless Engineers.

Bruce Devine served in the US Air Force for 20 years from 1982 through 2002, the first 10 years were spent in electronic warfare systems repair and the second 10 years were spent supervising calibration laboratories (PMEL's). During his last 6 years of service in the Air Force, Bruce started Test Equipment Plus where he bought, repaired, and sold used Agilent/HP RF test equipment. In 2010, Bruce made a radical change in his business model by designing and manufacturing the USB-SA44, a USB-powered 4.4GHz RF spectrum analyzer which proved disruptive to the spectrum analyzer market. Since then Test Equipment Plus has been adding more models of spectrum analyzers, tracking generators, and even a vector signal generator. To eliminate brand confusion, Bruce began doing business as Signal Hound early in 2014 when he also started focusing on developing cost-effective instruments targeted to best serve the spectrum monitoring market.

Danijela Cabric received the Dipl. Ing. degree from the University of Belgrade, Serbia, in 1998, and the M.Sc. degree in electrical engineering from the University of California, Los Angeles, in 2001. She received her Ph.D. degree in electrical engineering from the University of California, Berkeley, in 2007, where she was a member of the Berkeley Wireless Research Center. In 2008, she joined the faculty of the Electrical Engineering Department at the University of California, Los Angeles, where she is now Associate Professor. Dr. Cabric received the Samueli Fellowship in 2008, the Okawa Foundation Research Grant in 2009, Hellman Fellowship in 2012 and the National Science Foundation Faculty Early Career Development (CAREER) Award in 2012. She served as an Associate Editor in IEEE Journal

on Selected Areas in Communications (Cognitive Radio series) and IEEE Communications Letters, and TPC Co-Chair of 8th International Conference on Cognitive Radio Oriented Wireless Networks (CROWNCOM) 2013. She is now Associated Editor of IEEE Transactions of Cognitive Communications and Networking. Her research interests include novel radio architecture, signal processing, and networking techniques for cognitive radio, 5G and massive MIMO systems.