



**SDR Forum Workshop on
“Safely Accessing the TV White Space Spectrum – What Can We Do???”
19 June 2008**

The SDR Forum will host a workshop on June 19, 2008 evaluating the use of TV White Space for broadband internet services. Representatives from all sides of this debate will come together to educate the SDR Forum’s members and guests on this complex issue. The goal of this workshop is to provide a neutral venue for discussion, to allow the Forum’s members and guests to understand the issues and concerns, separate the facts from the myths, and identify common themes and areas of agreement between the various constituencies.

This workshop is being held in conjunction with the SDR Forum’s 59th General Meeting being held June 16 to 19 in Portland, Oregon. The output of this workshop may be used by the SDR Forum to define future work items that help to close the gap between the various opposing views, and promote the success of these next generation radio technologies in a manner that is acceptable to all parties. Following on this workshop, the SDR Forum may form a new Special Interest Group (SIG) focused on TV White Space Communications. SDRF SIGs are cross disciplinary teams comprising end-users, operators, service providers, radio manufacturers and regulators focused on the needs of a single market or market segment. The purpose of a SIG is to capture domain specific requirements, use cases and business models that will drive future regulatory and technical activities.

Workshop Program At a Glance

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| 8:30 to 8:40 | Welcome – Lee Pucker, CEO of the SDR Forum |
| 8:40 to 9:00 | Opening Remarks – John Chapin, Vanu Inc. and Chair of the SDR Forum |
| 9:00 to 9:45 | Opening Keynote, “Listen Before Talk: The Lessons learned from the FCC’s White Spaces Proceeding”, Bruce Franca, MSTV |
| 9:45 to 10:15 | “Introduction to 802.22”, Carl Stevenson, WK3C Wireless LLC and Chair of IEEE 802.22 Working Group |
| 10:15 to 10:30 | Coffee Break |
| 10:30 to 11:00 | “SDR and CR Regulatory Measurements”, Robert Sutton, TDK RF Solutions |
| 11:00 to 11:30 | “Multiple Narrowbanding Use of TV White Space”, Paul Greenis, Adapt4 |
| 11:30 to 12:00 | “Factors for Successful TVWS System Operation”, Randy Ekl, Motorola |
| 12:00 to 1:30 | Networking Luncheon with Technology Demonstrations by Adapt4 |
| 1:30 to 2:15 | Afternoon Keynote, “Effective use of the TV White Space Bandwidth”, Larry Alder, Google |



- 2:15 to 2:45 “A Spectrum Sensing Prototype for Sensing ATSC and Wireless Microphone Signals”, Monisha Ghosh, Philips
- 2:45 to 3:00 Coffee Break
- 3:00 to 3:30 “White-Space Sensing Device for Detecting Vacant Channels in TV Bands”, Oh Ser Wah, Institute for Infocomm Research
- 3:30 to 4:00 “The Probe Method and Collaborative Sensing for Safely Accessing the TV White Spaces using Dynamic Spectrum Access Technology,” Peter Tenhula, Shared Spectrum Company
- 4:00 to 4:45 Panel Discussion, “What Can We Do???” – Moderated by John Chapin
- 4:45 to 5:00 Closing Remarks and Next Steps – Lee Pucker

Program Details

9:00 to 9:45 Opening Keynote, “Listen Before Talk: The Lessons learned from the FCC’s White Spaces Proceeding”, Bruce Franca, MSTV

Mr. Franca will discuss the FCC’s white spaces proceeding. What the FCC got right and what the FCC got wrong in their proposals. He will provide his observations on the FCC testing of white spaces devices, both round one and round two testing.

Mr. Franca will talk about the authorized services that now operate in the television spectrum and what protections are needed for those services. What is the appropriate definition of harmful interference for analog and digital television service? What are the interference rejection capabilities of current television receivers? What interference potential does even “low power” unlicensed devices pose to TV reception and viewers? Why cognitive radio technology relying only on spectrum sensing can not adequately protect TV viewers and wireless microphone operations.

About the Speaker: Bruce A. Franca joined MSTV as Vice President, Policy and Technology in February of this year. Before joining MSTV, Bruce Franca was Chief of the FCC’s Office of Engineering Technology (OET), and was Deputy Chief of OET from 1985. He is a 34- year veteran of the FCC and has lead many of the Commission’s new technology efforts, such as the creation of the Personal Communications Service, Direct Broadcast Satellite Service and Digital Television. He also has significant experience with regard to Part 15 operations. Bruce Franca has overseen the FCC’s equipment authorization program and has led OET’s rule making effort to amend the Part 15 spread spectrum rules to permit digital transmissions that has led to the development of popular Wi-Fi systems. Mr. Franca was awarded the Chairman’s Special Achievement Award in 1996 for his work on DTV and the FCC Gold Medal for Meritorious Service in 2005.



9:45 to 10:15 “Introduction to 802.22”, Carl Stevenson, WK3C Wireless LLC and Chair of IEEE 802.22 Working Group

10:30 to 11:00 “SDR and CR Regulatory Measurements”, Robert Sutton, TDK RF Solutions

In addition to designing and manufacturing Anechoic Chambers and Measurement systems, TDK RF Solutions develops regulatory and performance measurement technology for advanced radio systems. UWB, CR, and SDR measurement systems are the current focus of development and rollout to the marketplace. Mr. Sutton will discuss the unique requirements for SDR and CR regulatory measurements as well as the difficulties of performance measurement of these systems.

About the Speaker: Robert Sutton is the President of TDK RF Solutions as well as an acting board member of TDK R&D Corporation. Prior to co-founding the business that ultimately became TDK RF Solutions, he worked as a scientist in the electromagnetic compatibility laboratory at AT&T Bell Laboratories. Robert received Bachelor and Master of Science degrees in Electrical Engineering with emphasis on electromagnetic field theory at the University of Texas at Austin. Much of his published and patent work covers the topics of radiating structures, electromagnetic compatibility and co-existence issues.

11:00 to 11:30 “Multiple Narrowbanding Use of TV White Space”, Paul Greenis, Adapt4

Adapt4 will discuss how multiple narrowband channels can logically be aggregated for multiple broadband type applications in TV white space. Techniques for harvesting and aggregation of channels on a non-interfering secondary use basis will be explored. What’s beyond Geo-location, database registration and assigned control frequencies for protecting incumbents? Concepts for improving the quality of service will be included.

About the Speaker: Paul Greenis is Vice President of Marketing and Sales for Adapt4 since it’s inception in 2002. Multitasking, Paul is also an inventor and co-inventor of cognitive radio and networking techniques. He helped guide Adapt4 through the FCC certification process on three cognitive radios, the XG1, XG2Plus, and the XG1Plus. Paul is also responsible for methods that enable secondary use licensing of cognitive radios and prime interface to various industry and government organizations. Through Paul’s guidance, Adapt4 won the Utilities Telecom Councils (UTC) Best Wireless Equipment product award in 2004 for the XG1 and 2008 for the XG2Plus. Through his efforts, Adapt4 was selected by the NTIA/FCC to participate in the Spectrum Sharing Innovation Test Bed.

Prior to joining Adapt4, Paul was Vice President of Product Development for SkyData/Gilat (Melbourne, FL), Director of Government Sales for Paradise DataCom, and numerous positions



at various Harris divisions, (ESD, Semiconductor, and Satellite). In the US Air Force, Paul assisted with silo instrumentation of Minuteman ICBM's at Cape Canaveral, FL. Political aspirations over an 8 year span included Chairman of Planning and Zoning, Council Member, and Mayor for the City of Indian Harbour Beach, FL. He was a founding member of the University of Central Florida's Institute of Government (Brevard County) and Secretary for the Florida League of Cities (Brevard chapter). Engineering from Bowling Green State University and Business from Rollins College

11:30 to 12:00 "Factors for Successful TVWS System Operation", Randy Ekl, Motorola

Motorola will discuss a multi-tiered approach to successful operation in the TVWS spectrum. Successful operation is defined as robust protection of incumbents and efficient use of the band for multiple services. Technical elements of Geolocation augmented by sensing will be explained, as well as database registration, for both DTV and wireless microphone protection. The combination of these mechanisms will allow secondary uses of the band. Motorola will also touch on the FCC testing.

About the Speaker: Randy Ekl is a Distinguished Member of the Technical Staff for the Advanced Technology and Strategy organization in Motorola's Government and Public Safety business. He has spent the past eight years identifying and maturing the technology and business use cases for broadband technologies including WLAN systems, Ad Hoc networks, and IP networks. Over the past two years Randy has focused on maturing Cognitive Radio technologies which can be applied to TV White Space. Randy led the technical development of Motorola's TVWS system demonstration to the FCC in August 2007, and has participated in the current White Space Device testing. Randy received Bachelor of Science degrees in Electrical Engineering, Computer Science and Mathematics at Rose-Hulman Institute of Technology, and Master of Science degrees in Computer Science and Electrical Engineering at the University of Illinois at Chicago. He holds twelve US patents, with many pending.

1:30 to 2:15 Afternoon Keynote, "Effective use of the TV White Space Bandwidth", Larry Alder, Google

The vast majority of viable spectrum in this country simply goes unused, or else is grossly underutilized. Unlike other natural resources, there is no benefit to allowing this spectrum to lie fallow. The airwaves can provide huge economic and social gains if used more efficiently, as seen today with the relatively tiny slices utilized by mobile phones and WiFi services. The unique qualities of the TV white space -- unused spectrum, large amounts of bandwidth, and excellent propagation characteristics -- offer a once-in-a-lifetime opportunity to provide open spectrum for innovative wireless broadband uses for all Americans.

In order to make effective use of the TV white space bandwidth, technologies are required to protect current licensed users of the band. In this talk, we will discuss technologies that will fully protect licensed users of the band and unlock the vast potential of this spectrum.



About the Speaker: Larry Alder has been a Product Manager at Google since Sept 2005 focused on Google's mission of making information "Universally Accessible". In that spirit, Larry was co-lead of Google's Municipal Wifi activities including the Free Municipal Wifi network providing coverage to the entire city of Mountain View. Larry is also engaged in on other wireless and policy initiatives at Google include TV whitespaces and 700Mhz. Prior to joining Google, Larry spent 10 years at ArrayComm in roles that include VP of Technology Development and VP of Product Management. Prior to joining ArrayComm, Larry received his PhD from Stanford University in the specialty of Control Theory, and spent three years as a Senior Control Systems Engineer at Adept Technology.

2:15 to 2:45 "A Spectrum Sensing Prototype for Sensing ATSC and Wireless Microphone Signals", Monisha Ghosh, Philips

Spectrum sensing is the key enabler for dynamic spectrum access in the television (TV) bands as it can allow secondary networks to reuse spectrum without causing harmful interference to primary users. In this presentation we will describe a sensing prototype that has been developed to demonstrate robust sensing of TV signals as well as wireless microphone signals in the laboratory and field. We will present the algorithms as well as simulation, lab and field test results that validate the prototype's capability to robustly identify these signals down to a level of -116 dBm.

About the Speaker: Monisha Ghosh is a Principal Member of Research Staff and Project Leader in the Wireless Communications And Networking department at Philips Research where she is currently working on cognitive and cooperative radio networks. She is actively involved in the White Space Coalition as well as in IEEE 802.22 working on developing sensing and cognitive protocols for the TV bands. She received her B.Tech. in Electronics and Electrical Communication Engineering from the Indian Institute of Technology, Kharagpur, India, in 1986, and M.S. and Ph.d. in Electrical Engineering in 1988 and 1991 respectively from the University of Southern California, Los Angeles. From 1991 to 1998 she was a Senior Member of Research Staff in the Video Communications Department at Philips Research, where she was primarily involved with developing the ATSC 8-VSB standard for digital television broadcasting. From 1998 to 1999 she was at Lucent Technologies, Bell Laboratories, working on OFDMA-based wireless cellular systems. She has also participated in IEEE 802.11n developing multiple-antenna communication methods. Her research interests include multiple-antenna systems, equalization, estimation theory, error-correction and digital signal processing for communication systems. She is also an Adjunct Faculty at Polytechnic University, Brooklyn

3:00 to 3:30 "White-Space Sensing Device for Detecting Vacant Channels in TV Bands", Oh Ser Wah, Institute for Infocomm Research

Measurements performed at several locations clearly show that frequency spectrum is under-utilized. This wastage may be avoided if other non-incumbents can occupy the spectrum whenever it is available. Cognitive radio is a strong candidate to ensure better spectrum utilization by providing access in an opportunistic manner. In particular, spectrum sensing is a



key enabler technology to identify spectrums that are unoccupied, a.k.a. white space. Here we present our spectrum sensing prototype, and measure its sensing performance in actual environments. Results show that our algorithm is robust under realistic conditions. This confirmation will give much needed confidence in the capability of cognitive radio systems to detect the operation of primary users and protect their use of spectrum.

About the Speaker: Ser Wah Oh is a Research Scientist at the Institute for Infocomm Research (I²R), Singapore, where he assumes the roles of Project Manager and Principal Investigator focusing on white-space device development and powerline communications. He was previously in charge of algorithm development for 3G WCDMA over software-defined radio platform. Prior to joining I²R, he was a Technical Manager at STMicroelectronics in charge of teams in Singapore and Beijing R&D Centers. He was responsible for 3G WCDMA and TD-SCDMA physical layer development including algorithms, firmware and hardware designs and realizations. Ser Wah obtained his B.Eng. and Ph.D. degrees from the University of Malaya, Malaysia and Nanyang Technological University, Singapore, respectively. He published around 30 papers and held one US patent with several pending. He was also a recipient of the IEEE ICT 2001 Paper Award and served as Publicity Chair, Track Chair and TPC committees for various conferences and seminars.

3:30 to 4:00 “The Probe Method and Collaborative Sensing for Safely Accessing the TV White Spaces using Dynamic Spectrum Access Technology,” Peter Tenhula, Shared Spectrum Company

In response to the FCC’s 2000 *Notice of Inquiry* on Software Defined Radios, Shared Spectrum Company (SSC) was the first to propose that new entrants be authorized to access the “holes” between licensed television stations using innovative interference avoidance techniques. One approach uses “probe” signals from white space devices to determine the likelihood of interference to primary systems. SSC has also developed ways to address the “hidden node” problem through the use of “group behavior” collaborative sensing techniques. This session will provide attendees an introduction to these two approaches for ensuring safe operation in the TV White Spaces.

About the Speaker: Peter Tenhula is Vice President and General Counsel of Shared Spectrum Company (SSC). In this capacity, Peter serves as SSC’s top legal executive and as a senior strategic advisor. He is responsible for planning and directing all aspects of the SSC’s legal and external affairs to ensure maximum protection of its legal rights and compliance with its legal obligations. Peter supports the regulatory functions of SSC’s ongoing R&D projects and he develops and oversees the execution of the company’s intellectual property strategy. Before becoming SSC’s first General Counsel, Peter served for two years as the company’s Vice President for Regulatory Affairs and Business Development, focusing on the regulatory and policy aspects of implementing SSC’s dynamic spectrum access (DSA) technology.



Prior to joining SSC in February 2006, Peter served at the U.S. Federal Communications Commission for 15½ years, where he held several positions including Acting Deputy Chief of the Wireless Telecommunications Bureau, Director of the Spectrum Policy Task Force, Senior Legal Advisor to Chairman Michael Powell, Special Counsel to General Counsel William Kennard and staff attorney in the Office of General Counsel and the Mass Media Bureau. At the FCC, he had important substantive and leadership roles in a wide range of cutting edge wireless and spectrum policy matters, including the development of Personal Communications Services (PCS), implementation and oversight of the spectrum auction program, the approval of ultra-wideband (UWB) and Software Defined Radio (SDR) technologies, the removal of barriers to secondary spectrum markets and the release of the groundbreaking report of the FCC's Spectrum Policy Task Force.

Before joining the Commission, Peter served as a legal intern with U.S. Representative Michael G. Oxley and the National Association of Broadcasters. He received his undergraduate degree in Telecommunications from Indiana University, Bloomington, and earned a law degree from Washington University in St. Louis, Missouri.