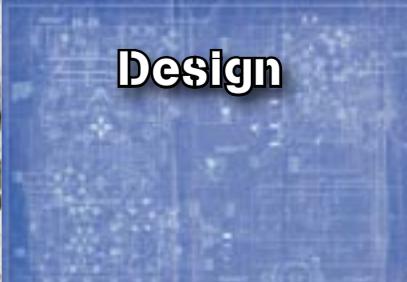




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# SDR'09

**Technical Conference and Product Exposition  
1-4 December 2009 • Washington, DC**

*The premier event for bringing next generation radio technologies to life.*

Thank you for joining us in Washington, DC, for the conference attendees have called the "most valuable conference [to] attend each year," and "the SDR conference." Attracting more than 400 attendees representing all aspects of the reconfigurable radio value chain, from research through deployment, SDR'09 is the ideal place to make an impact on the SDR community and make valuable connections along the way. The only conference of its kind centered on reconfigurable radio technologies, SDR'09 will feature tutorials, workshops, demonstrations and more than 100 technical papers in 20 technical sessions.

"Excellent tutorials and papers are presented, and is an excellent way to see where and what are the latest technologies"  
- Janette Briones, NASA Glenn

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**Carlo Magrassi**  
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**Christian Serra**  
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**Kazuho Miki**  
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Established in 1996, the SDR Forum is a non-profit international industry association dedicated to promoting the success of next generation radio technologies. The Forum's 100-strong membership comprises world class technical, business and government leaders from EMEA, Asia and the Americas. SDR Forum is the only organization in the world dedicated to serving the industry's needs through advocacy, opportunity development, commercialization and education. For more information, please visit [www.sdrforum.org](http://www.sdrforum.org).



## Program at a Glance

### Monday, 30 November

18:00-20:00 **Early Registration** (Regency Foyer)

### Tuesday, 1 December

7:30 **Breakfast** (Regency Foyer), **Speakers' Breakfast** (Location TBA, check registration desk)

	Regency A	Regency B	Regency C	Regency D	Regency E
8:30	<b>Tutorial</b> Digital Software Defined Radio Test <i>Jean Dassonville</i>	<b>Tutorial</b> VoIP Radio Networks <i>John Shanton</i>	<b>Tutorial</b> Building Software Defined Radios with SysML, UML, and MARTE <i>Vincent Kovarik</i>	<b>Tutorial</b> Agilent / Zeligsoft Rapid Prototyping <i>Greg Jue and Toby McClean</i>	<b>Tutorial</b> Advances in Automated Software Testing and Quality Technologies and Implementation in use for Waveforms <i>Elfriede Dustin</i>

12:00 **Lunch** (Independence B)

13:30 **Conference Welcome, John Glossner**, SDR'09 Conference Co-Chair (Regency EF)

13:40 **Keynote:** "R&D Strategies and Activities for Future Wireless System- from Cognitive Radio and SDR perspective," **Kazuho Miki**, Department Manager, Network Systems Research Department, Hitachi, Ltd. (Regency EF)

14:20 **Keynote:** "Flexible Radio Solutions: Hardware and Software to get the Best out of the Terminal and the Spectrum," **Jan Craninckx**, Chief Scientist, Analog Wireless Research Group, IMEC (Regency EF)

15:00 **Coffee Break** (Regency Foyer)

	Regency A	Regency B	Regency C	Regency D	Regency E	Regency F
15:15	<b>Session 1.1</b> SDR & CR Security <i>Chair: Timothy Newman</i>	<b>Session 2.1</b> Configurable RF, RF Spectrum Interference & Receiver Mitigation Techniques <i>Chair: Robert Normoyle</i>	<b>Session 3.1</b> SDR implementations on GPU, DSP, FPGA, or GPP <i>Chair: John Glossner</i>	<b>Session 4.1</b> SDR Modeling <i>Chair: Sébastien Le Nours</i>	<b>Tutorial</b> Software Defined Workflow Using Simulink and the USRP2 <i>John Irza</i>	<b>Tutorial</b> An Affordable COTS Reference Platform for SCA Development - The 'IBM PC' of Military SDR <i>Steve Jennis</i>

18:00 - 21:00 **Technology Showcase and Welcome Event**, Sponsored by General Dynamics, featuring demonstrations, food, and entertainment in the exhibition hall. The demonstration sessions with food and refreshments will be followed by the announcement of the SDR Forum Award winners, dessert and entertainment by The Capitol Steps, a musical political satire group with 29 albums to their name.

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**Locations:**

18:00 - Demos: Independence B

19:30 - Awards and entertainment: Regency EF

**WiFi is available throughout the conference, courtesy of The SDR Forum.**  
**Please see the registration desk for details.**

**Program at a Glance**

**Wednesday, 2 December**

- 7:30 **Breakfast** (Regency Foyer), **Speakers' Breakfast** (Location TBA, check registration desk)
- 8:30 **Introduction to Day Two and Announcements: John Glossner** (Regency EF)
- 8:40 **Keynote: Danny Weitzner**, Associate Administrator for Policy, NTIA (Regency EF)
- 9:20 **Coffee Break** (Regency Foyer)

	Regency A	Regency B	Regency C	Regency D	Regency E	Regency F
	<b>Session 1.2</b>	<b>Session 2.2</b>	<b>Session 3.2</b>	<b>Session 4.2</b>	<b>Session 5.2</b>	<b>Tutorial</b>
9:40	Smart Radio Challenge and SDR in Education <i>Chair: Carl Dietrich</i>	SCA for SDR <i>Chair: Eric Nicollet</i>	Public Safety <i>Chair: Charles Bostian</i>	Analysts Workshop <i>Chair: Manuel Uhm</i>	Regulatory Workshop <i>Chair: Peter Tenhula</i>	RF Performance Specification, Measurement <i>Robert Normoyle</i>

11:50 **Lunch and Exhibits** (Independence A and B)

	Regency A	Regency B	Regency C	Regency D	Regency E	Regency F
	<b>Session 1.3</b>	<b>Session 2.3</b>	<b>Session 3.3</b>	<b>Session 4.3</b>	<b>Session 5.3</b>	<b>Tutorial</b>
13:50	SDR implementations on GPU, DSP, FPGA, or GPP <i>Chair: R. Muralidharan</i>	SCA for SDR <i>Chair: Eric Nicollet</i>	Multimode Systems <i>Chair: Rick Taylor</i>	Analysts Workshop <i>Chair: Manuel Uhm</i>	Regulatory Workshop <i>Chair: Peter Tenhula</i>	BIST and Digital Self-Calibration of RFICs <i>Mohammed Ismail</i>

16:00 **Coffee Break** (Regency Foyer)

16:15 **Keynote** "Next Generation Communications Technology for Public Safety and Disaster Response," **Joe Heaps**, Deputy Chief, Information & Sensor Technologies Division Manager, Communications Technology Portfolio, *National Institute of Justice, Office of Justice Programs* (Regency EF)

17:00 **Regulatory Panel Session** "Setting the Global Regulatory Agenda"  
Moderator: **Paul Kolodzy**, *Kolodzy Consulting*, and Vice Chair of the SDR Forum Regulatory Committee (Regency EF)

18:00 - 20:00 **Exhibitors' Reception** (Independence A and B)



**Do you tweet?**  
Use #SDR09 to tweet with your peers about the event.

**Additional information, including technical paper listings and workshop and tutorial abstracts begin on page 5.**

**CALL FOR PRESENTATIONS**

**2010 European Reconfigurable Radio Technologies Workshop and Product Exposition**  
23-25 June, 2010 • Mainz, Germany

In June 2010, The SDR Forum will host a multi-day workshop bringing together the advanced wireless community to explore the evolution of reconfigurable radio over the next several years. Reconfigurable radio technologies are becoming essential to support the requirements of the wireless market: network operators and wireless service providers in all market domains need to contain their capital and operational expenditures while supporting a proliferation of wireless standards and wireless end users, be they business travelers or first responders in a national emergency, are demanding radio technologies that allow them to communicate with whoever they need to, whenever they need to and wherever they are. This workshop will explore these requirements across domains and present innovative solutions in development to address them.



[www.sdrforum.org/2010EuropeWorkshop](http://www.sdrforum.org/2010EuropeWorkshop)



## Program at a Glance

### Thursday, 3 December

- 7:30 **Breakfast** (Regency Foyer), **Speakers' Breakfast** (Location TBA, check registration desk)
- 8:30 **Introduction to Day Three and Announcements: John Glossner** (Regency EF)
- 8:40 **Keynote** "EDA's Approach to SDR - One Architecture and One Standard for a European Joint and Combined Capability," **Carlo Magrassi**, Deputy Chief, Executive Strategy, European Defence Agency, Brussels (Regency EF)

	Regency A	Regency B	Regency C	Regency D	Regency E	Regency F
	<b>Session 1.4</b>	<b>Session 2.4</b>	<b>Session 3.4</b>	<b>Session 4.4</b>	<b>Session 5.4</b>	<b>Tutorial</b>
9:40	CR Spectrum Access and Sensing <i>Chair: Klaus Moessner</i>	Baseband Technologies and Algorithms <i>Chair: Daniel Iancu</i>	Power Management in SDRs <i>Chair: Panagiotis Demestichas</i>	SATCOM Workshop <i>Chair: Bob Schutz</i>	JTRS SBIR Industry Day <i>Chair: John Armantrout</i>	Rapid Implementation of SDR in a Unified Development Environment <i>Brian Dalio</i>

11:50 **Lunch and Exhibits** (Independence A and B)

	Regency A	Regency B	Regency C	Regency D	Regency E	Regency F
	<b>Session 1.5</b>	<b>Session 2.5</b>	<b>Session 3.5</b>	<b>Session 4.5</b>	<b>Session 5.5</b>	<b>Tutorial</b>
13:50	CR Spectrum Access and Sensing <i>Chair: Klaus Moessner</i>	Baseband Technologies and Algorithms <i>Chair: Daniel Iancu</i>	Other Applications <i>Chair: John Glossner</i>	SATCOM Workshop <i>Chair: Bob Schutz</i>	Government R&D Programs Workshop <i>Chair: Claude Bélisle</i>	A Platform-Based Approach to Realizing High Performance DSP Systems in FPGAs <i>Chris Dick</i>

- 16:00 **Break** (Regency Foyer)
- 16:15 **Invited Paper** "Requirements and Challenges for SDR implementation," Christer Svensson, Professor in Electronic Devices, Linköping University, Sweden (Regency EF)
- 16:40 **Keynote: Christian Serra**, Chief Scientist, Thales Communications and Technical Director, a4ESSOR S.A.S. (Regency EF)
- 17:20 **Keynote: "The WHYs of SDR," Chris Brady**, Vice President, Assured Communications Systems Communication Networks Division, General Dynamics C4 Systems (Regency EF)
- 18:00-20:00 **SDR Forum Members Reception and Annual Meeting** (Regency EF)

### Friday, 4 December

- 7:30 **Breakfast** (Regency Foyer), **Speakers' Breakfast** (Location TBA, check registration desk)

	Regency A	Regency B	Regency C	Regency D	Regency E	Regency F
	<b>Session 1.6</b>	<b>Session 2.6A</b>	<b>Session 3.6</b>	<b>Session 4.6</b>	<b>Tutorial</b>	<b>Tutorial</b>
8:30	Other CR <i>Chair: Wolfgang Koenig</i>	Location Based Techniques <i>Chair: Mayan Moudgill</i>	High Speed ADCs for SDR <i>Chair: Mohammed Ismail</i>	SDR Forum Projects Overview	"SCA-Based Education and Rapid Prototyping with OSSIE: A Hands-On Tutorial" <i>Carl Dietrich</i>	Multirate Signal Processing in Communication Systems <i>fred harris</i>
		<b>Session 2.6B</b>				
		Infrastructure <i>Chair: Nadeem Bukahari</i>				

- 10:40 **Coffee Break** (Regency Foyer)
- 11:10 **Keynote: "Where Will ITS Be in the New Transportation Bill?" Thomas E. Kern**, Executive Vice President, Intelligent Transportation Society of America (Regency EF)
- 11:40 **Endnote: "Looking ahead to 2010," Lee Pucker**, CEO, SDR Forum (Regency EF)
- 12:20 **Conference Close and Satisfaction Survey Prize Drawing** (Regency EF)

Complete our survey and be registered to win!  
[www.sdrforum.org/SDR09survey](http://www.sdrforum.org/SDR09survey)

8:30 Tutorials

**Tutorial: "Digital Software Defined Radio Test"**

Jean Dassonville, *Agilent Technologies*

*Regency A*

This tutorial presents the topic of digital software defined radio test. Specifically we will dive into the baseband devices, covering timing, microprocessor and FPGA tools that can greatly minimize the test time required. Included are techniques for probing high speed digital interfaces, measurement and timing correlation between microprocessor, DSP and memory devices as well as methods for easily accessing the signals embedded in FPGAs. Additionally, we will cover some aspects of waveform modulation quality given that many of these measurements are now made from a digital interface.

**Tutorial: "VoIP Radio Networks"**

John Shanton, *Thales Communications, Inc.*

*Regency B*

This tutorial is a survey of Voice Over Internet Protocol (VOIP) for wireless radio networks. Special attention is given to the implications of VOIP transport for the link layer and physical layer of networked radio systems. The issues of latency, link quality, and throughput are discussed for emerging radio networks. The relationship of latency to RTP and special adaptations are discussed. An overview of traditional Internet based full duplex digital voice communications will be given. The special issue of bridging full duplex digital voice packets onto half duplex radio networks is discussed.

This tutorial will give an overview of the higher layer SIP (Session Initiation Protocol) as used in Internet based telephony. SIP as applied to radio networks and especially the issues of mapping SIP to mobile and rapidly changing radio networks is covered. At the end of the session, an application overview will be given that describes an actual VOIP network (MMAR) that integrates ground based narrowband radios by bridging them into a Tactical Data Link airborne radio network and ultimately connects radios to VOIP personal computers on the ground. This will show the special considerations of bridging a handheld PTT tactical radio that is bridged and transported via RTP and the network setup using SIP.

**Tutorial: "Building Software Defined Radios with SysML, UML, and MARTE"**

Vincent Kovarik, *Harris Corporation*

*Regency C*

Software defined radio development is a complex process involving many diverse stakeholders. Modeling allows raising the level of abstraction in systems development. There are two main specifications for modeling SDR systems: Software Communications Architecture and OMG PIM and PSM for Software Radio. These SDR specific specifications have focused on the software architecture aspect of the radio system, and do not address the system aspect or detailed design of the software.

The Systems Modeling Language (SysML) provides the model-

ing concepts for capturing the specification and design of a system or system-of-systems. This specification and/or design can then be analyzed, verified and validated to ensure that specific requirements and constraints are satisfied. The SysML can be used to model the system side of a SDR.

The Unified Modeling Language (UML) is a general purpose modeling language that is often used for architecting and designing software applications. The UML provides the concepts to model both the structural and behavioral aspects of a software application. In the context of SDR, the UML can be used to model the detailed structural design and behavior of the software side of the radio.

While the UML is a general purpose modeling language, the MARTE specification provides the concepts necessary for modeling real-time and/or embedded systems. The concepts allow for the specification of rich quality of service requirements and timing constraints. This model can then be analyzed at design time to verify that it will meet the requirements captured in the model.

This tutorial shows how an SDR can be designed from requirements to detailed design using SysML, UML and MARTE. We then explore the different types of analysis that can be done using this model. More specifically we will:

1. Show how to model SDR systems with SysML
2. Show how to model the detailed design of the software aspects of an SCA SDR using UML
3. Show how to annotate the UML model with the concepts from MARTE to enable the analysis of the SDR systems software
4. Show how to link the different models in order to build a consistent model of the system.

The tutorial will use a case study; an SDR waveform that is from the public domain; to help emphasize the material covered.

**Tutorial: "Agilent / Zeligsoft Rapid Prototyping,"**

Tim McGuire, *Zeligsoft*

*Regency D*

The development of SCA waveforms is a complex process that requires dealing with different system design aspects, including signal processing, component definition, and component distribution on physical processing elements. Software defined radio development is an iterative process. Iterative development allows developers to deal with greater complexity.

The ability to rapidly prototype SCA waveforms is key to reducing risk early in the development process and avoiding "big bang" integration. In particular, rapid prototyping enables:

- Exploration of alternate designs
- Validation of different system aspects
- Execution of the models early in the development process and at different development stage

Tooling provides assistance for reducing complexity and rapid prototyping with automation, generation and validation. Integration points between the different tools and technologies are available to help engineers to bring hardware, software and signal processing together into one software defined radio.



**Tuesday, 1 December, Morning (continued)**

This tutorial introduces a rapid prototyping approach for SCA waveforms that is based on the integration of Agilent Technologies SystemVue and Spectra CX. The main phases of this approach consist of:

- **Golden Waveform Design.** This phase consists in defining the signal processing elements of the waveform using SystemVue. The SystemVue model is exercised to conduct early validation of the golden waveform, for both baseband PHY and link-level RF/channel compliance, using algorithmic verification against IP reference models and test equipment.
- **Signal Processing Code Generation.** This phase consists in generating and compiling the C++ source code. The source code is examined to determine interfaces for communication, which are then used to create ports on SCA components. The SystemVue generated code is exported along with an .XML description.
- **SCA Component-Based Design.** This phase consists in creating an SCA component-based model to encapsulate the golden waveform signal processing elements. This involves designing the overall waveform architecture and partitioning of the signal processing elements into SCA components. Spectra CX is used

in this phase to design the waveform, validate key aspects, and generate SCA required code.

- **Deployment Modeling and Analysis.** This phase consists in choosing component build environments for component distribution on physical processing elements. The build environment for each component is created and modified to include the SystemVue generated header files and link to the correct libraries. The SCA component source code and build environments are generated and compiled from Spectra CX. The final products are SCA component binaries with behavior generated from SystemVue.
- **Execution.** This phase consists in running and testing the SCA waveform on the platform (host or target) – with the “OE-in-the-loop”. Components are deployed to the platform based on their implementation dependencies and device allocation properties. The waveform running in the SCA operating environment will be shown to exhibit the same behavior as the SystemVue model.

The tutorial will use a sample waveform to demonstrate the typical use of the tool chain and will highlight the interaction points between the different tools. Special attention will also be paid to the iterative nature of the process.

**Tutorial: “Advances in Automated Software Testing and Quality Technologies and Implementation in use for Waveforms,”**  
 William Stubbs, IDT  
 Regency E

This presentation discusses Certification, Validation, Testing and Tools used for verifying the quality and portability of radio waveforms, and our various efforts to streamline use of relevant tools throughout a QA process and automated software testing implementations, by automating the test automation via use of existing open source tools, component reuse and incorporating all tools and results into a centralized repository, which we call the Portability Compliance Checker (PCC).

Our PCC framework presented here provides software implementation and utilities in support of JTRS waveform Portability Assessment Procedures along with QA verification to include automated software testing, all combined into one central repository/framework.

**Please refer to the CD in provided in your complimentary attendee bag for the full Conference Proceedings. Presentations not available on the disc will be collected and loaded to the SDR’09 proceedings page: <http://bit.ly/378gsH> The specific location and password to access these presentations will be distributed to conference attendees immediately following the event.**

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Tuesday, 1 December, Afternoon

15:15 Technical Sessions and Tutorials

Session 1.1: SDR and CR Security, Chair: Timothy Newman, Regency A

- 15:15 "Policy-Based Approach for Secure Radio Software Download," **Antonietta Stango; Neeli R. Prasad**, *Aalborg University*
- 15:35 "Signal Classifiers using Self-Organizing Maps: Performance and Robustness," **Awais Khawar, T. Charles Clancy**, *University of Maryland*
- 15:55 "A High Assurance Wireless Computing System (HAWCS) Architecture for Software Defined Radios and Mobile Wireless Platforms," **David Murotake, Antonio Martin**, *SCA Technica*
- 16:15 "Information Assurance Considerations for Lightweight Software Defined Radio Systems," **Paul Philip**, *US Dept of Defense*; **Mark Buckner, Michael R. Moore**, *Oak Ridge National Laboratory*,

Session 2.1: Configurable RF, RF Spectrum Interference & Receiver Mitigation Techniques, Chair: Robert Normoyle Regency B

- 15:15 "A 10 MHz - 4 GHz Direct Conversion CMOS Transceiver for SDR Applications," **Gio Cafaro**, *Motorola*
- 15:35 "Cognitive AntiJam Radio System (CARS)," **Raghavendra S. Prabhu, Esteban Luis Valles**, *University of California, Los Angeles*; **Philip Dafesh**, *The Aerospace Corporation*
- 15:55 "SDR Implementation Issues: RF Front End Nonlinearity and Dynamic Computing Resource Allocation," **Feng Ge, Charles Bostian**, *Virginia Tech*
- 16:15 "An SDR RFFE Reference Design for Femtocells," **Russell Cyr, Erik Org**, *BitWave Semiconductor*
- 16:35 "A State Variable Based Tunable Notch Filter for Wideband Applications," **Divi Gupta, Dev V Gupta, Patrick A Kelly**, *University of Massachusetts*; **Zhiguo Lai, Abbie Mathew**, *NewLANS, Inc.*

Session 3.1: SDR Implementations on GPU, DSP, FPGA, or GPP, Chair: R. Muralidharan Regency C

- 15:15 "SDR Comes of Age: Technology Meets Economics," **Manuel Uhm**, *Xilinx*
- 15:35 "Speed Up Of Link Simulator Using GPU For SDR Systems," **KiWook Son**, *Hanyang University*
- 15:55 "The Implementation of OFDM Waveforms on an SDR Development Platform supporting a Massively Parallel Processor," **Brian A. Dalio, Kevin Shelby**, *Coherent Logix*

- 16:15 "A Low-Cost Embedded SDR Solution for Prototyping and Experimentation," **Christopher R. Anderson, George Schaertl**, *US Naval Academy*; **Philip Balister**, *OpenSDR*
- 16:35 "Using Intel Architecture for implementing SDR in Wireless Basesations," **Rajesh Gadiyar, John Mangan**, *Intel*
- 16:55 "How to obtain more powerful SDRs using multi-core architectures," **Raúl Dopico López, José María Camas Albar**, *Indra Sistemas S.A.*; **Miguel A. Melchor**, *Tecnalia*; **David Castells-Rufas**, *Universitat Autònoma de Barcelona*

Session 4.1: SDR Modeling, Chair: Christophe MOY Regency D

- 15:15 "Executable models for performance assessments of adaptive mobile systems," **Anthony Barreteau**, *University of Nantes*
- 15:35 "Leveraging Software Flexibility for Managing Power Consumption in Baseband Processing," **Joseph D. Gaeddert, Jeffrey Reed**, *Virginia Tech*

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**Tuesday, 1 December, Afternoon (continued)**

- 15:55 "Real time scheduling analysis for DSP base band processing in multi-channel SDR set," **Noel Tchidjo moyo, Eric Nicolet, Frederic Lafaye**, *Thales*; **Christophe Moy**, *Supelec*
- 16:15 "High Productivity Computer Systems: delivering information superiority with specific applications for Software Define Radios and Cognitive Computing," **James Rodenkirch**, *Southern Methodist University*
- 16:35 "A Co-Design Methodology Based On Model Driven Engineering For SDR Equipments," **Stephane Lecomte**, *Thomson*; **Christophe Moy**, *Supelec*; **Pierre Leray**, *IETR/Supelec Campus de Rennes*; **Samuel Guillouard**, *Thomson*

**Tutorial: "Software Defined Radio Workflow Using Simulink and the USRP2"**  
**John Irza**, *The MathWorks*  
*Regency E*

In this tutorial, we introduce a user-friendly software-defined radio (SDR) development workflow for prototyping, research and education in wireless communications and networks. This workflow consists of multiple SDR platforms capable of digital modulation with synchronization and full control over the physical to network layer of the radios and an interface to the Simulink software package. Using the Universal Software Radio Peripheral 2 (USRP2) platform as the RF front end, this interface will use Simulink for software radio development and signal processing libraries. This combination of hardware and software will enable simple design and verification of radio systems in simulation, while allowing the user to easily test the system with live, over the air transmission. The use of Simulink for radio development will provide streaming access to the USRP2 via a user-friendly workflow environment. These commonly available software packages and the USRP2 will make communication system prototyping both affordable yet highly versatile, enabling research and development groups around the world to conduct advanced experiments into new wireless communications and networking architectures including cognitive radio. The interface will allow students to become familiar with tools used in industry while learning communications and networking concepts through labs designed for undergraduate coursework. The 3 hour hands-on tutorial will include the following topics: 1. MATLAB and Simulink as Verification Tools: Radio development will include impairments such as fading and transmission delay, requiring equalization and synchronization. 2. Simulink-based Wireless Communication Experimentation using the USRP2 Platform: Simulink blocks interfacing to the USRP2 will be added to the modeled developed in the first section of the tutorial. 3. Advanced Communication Systems Education and Training using Simulink and USRP2: Cognitive radio techniques including spectrum sensing and dynamic spectrum access will be introduced to the models developed in the first two sections of the tutorial.

**Tutorial: "An affordable COTS Reference Platform for SCA Development - The 'IBM PC' of Military SDR"**  
**Steve Jennis**, *PrismTech*  
*Regency F*

Much attention in the last few years has been focused on the evolution of the Software Communication Architecture (SCA) - as the software infrastructure standard for military SDR. The SCA facilitates waveform application portability, platform interface standardization, and fielded radio reconfiguration; all in support of delivering new communication functionality to the war-fighter faster and at less expense than traditional hardware-defined radios. Furthermore, the original goals of the SCA included the opening up of the military radio supplier eco-system to new platform technologies (e.g. FPGAs), new waveform application and development tool vendors (e.g. MDE specialists), and the leveraged use of COTS SDR technologies; again, all in pursuit of lower costs and the faster fielding of new capabilities in a communications world of rapidly changing requirements and technologies.

SCA operating environments (OEs) and development tools have evolved at a rapid pace in the past few years, making SCA-compliance possible today for even small form-factor radios with significant SW&P constraints. Technological evolution continues apace with new benchmarks for performance, footprint, processor coverage, and tool productivity being announced in every COTS product release cycle (e.g. Spectra v2.1 by PrismTech).

However, despite these software advances, the industry has been missing an affordable COTS reference platform for SCA developers. COTS SCA radios with sophisticated development tools often cost over \$100,000 today. This is a severe inhibitor to market growth and customer choice, as without a COTS reference platform new vendors find it difficult, as well as expensive, to provide SCA-compliant solutions.

This paper and demonstration introduces an affordable COTS reference platform/radio complete with leading-edge features like SCA Everywhere (GPP, DSP and FPGA coverage), model driven engineering tools, and sophisticated SCA-compliance validation all for a very affordable entry-level price. This platform has the potential to become the IBM PC of SCA/SDR and so open up the market to SCA developers thus driving down costs, improving choice and growing the market for SCA/SDRs.

The presenter will explain in detail the technical challenges involved in producing a sophisticated, yet affordable, SCA reference platform, with particular reference to ensuring SCA compliance, supporting waveform portability and evolution (across a multi-processing environment), meeting radio SW&P constraints, and providing highly productive development tooling. Significant new technologies and optimizations are involved in packaging SCA for small form-factor radios. This presentation and demonstration will address those technologies and show how PrismTech is leading the field in producing COTS SCA products.

**Tuesday, 1 December, Afternoon (continued)**

**18:00 Technology Showcase and Welcome Event,**  
(Demos: Independence B, Awards and entertainment following:  
Regency EF) featuring the demonstrations:

- “Real-time Wideband SDR Signal Recording Strategies,” **Rodger Hosking**, *Pentek*
- “Adaptive Coding Modulation and Application Layer,” **Eugene Grayver, Eric J McDonald, Joseph Kim, David Kun**, *The Aerospace Corporation*
- “TUBITAK-UEKAE Tools Demonstrations”
- “CRAMNET: Opportunistic Cognitive radio for MANET with adaptive PHY and dynamic routing capability,” **Raghavendra S, Matti Raustia, Tuomo Hänninen**, *Centre for Wireless Communications University of Oulu*
- “Demonstration of cognitive spectrum sensing technologies,” **Thierry Dubois**, *IMEC*

- “Demonstration of Software Defined Radio-based test bed simulating the physical layer of UAV communication links,” **Alexander Young, Charles Bostian**, *Virginia Tech*
- “Demonstration of a 10 MHz - 4 GHz Direct Conversion CMOS Transceiver for SDR Applications,” **Gio Cafaro**, *Motorola*
- “Cognitive Management of Reconfigurable Infrastructures and Equipment,” **Aggelos Saatsakis, Nikos Koutsouris, Kostas Tsagkaris, Panagiotis Demestichas**, *University of Piraeus*; **Klaus Nolte, Ferenc Noack, Christian Lange, Thomas Loewel**, *Alcatel-Lucent Deutschland AG*
- “An implementation of novel multi-band/mode SDR platform,” **Kosuke Yamazaki, Yuji Ikeda, Toru Kitayabu, Issei Kanno, Hiroyasu Ishikawa**, *KDDI R&D Laboratories*
- “Demonstration of SDR OFDM transmit/receive and waveform development environment using a massively parallel processing architecture,” **Michael Doerr**, *Coherent Logix*

**Wednesday, 2 December, Morning**

**Session 1.2: Smart Radio Challenge and SDR in Education,**  
Chairs: **Timothy Newman and Carl Dietrich**  
*Regency A*

- 9:40 “Using Software Defined Radio in Multidisciplinary Senior Design Projects at California State University, Northridge,” **Sharlene Katz, James Flynn**, *California State University*
- 10:00 “Spectrum Access for First Responders using Cognitively Intrepid Radio Emergency Network,” **S M Hasan**, *Virginia Tech*; **Philip Balister**, *OpenSDR*; **Joseph D. Gaeddert, Carlos Aguayo Gonzalez, Kye Hun Lee, Haris I. Volos, Shereef Sayed, Chen Zhang, Xuetao Chen, Timothy R. Newman, Carl B. Dietrich**, *Virginia Tech*; **Andrew Cormier**, *Southwest Research Institute*
- 10:20 “Virginia Tech CWT’s Smart Radios - Challenges, Solutions and Lessons from the 2007 & 2008 Competitions,” **Alex Young, Mark D Silvius, Terry Brisebois, Feng Ge, Rohit D Rangnekar, Charles Bostian**, *Virginia Tech*
- 10:40 “Novel Spatial and Temporal Spectrum Sensing System for Interference Avoidance in Dynamic Spectrum Access,” **Reginald Cooper, Kevin C. Borries, Xiaohui Wang, Daniel Stancil**, *Carnegie Mellon University*
- 11:00 “An Ultra Low Cost Software Defined Radio Laboratory for Education and Research,” **Yair Linn**, *Universidad Pontificia Bolivariana*

- 11:20 “A Real-Time Traffic Information System for Vehicle Navigation,” **Delia Rodríguez de Llera González**, *Universidad Carlos III de Madrid*; **Georgios Panagiotou, Xin Liu, Chithrupa Ramesh, Ana Rusu**, *Royal Institute of Technology (KTH)*; **Abdullah Mansoor**, *National University of Sciences and Technology (NUST)*, Pakistan; **Mohammed Ismail**, *Ohio State University*

**Session 2.2: SCA for SDR, Chair: Eric Nicollet**  
*Regency B*

- 9:40 “Rapid Porting of SCA-compliant FM3TR Waveform,” **Per Johansson, Zhongren Cao, William Hodgkiss**, *University of California, San Diego*
- 10:00 “SCA Compliant, Suite B Compatible Multiband Handheld Radio,” **Igor Spivak**, *Harris Corporation*
- 10:20 “SCA Core Framework Advanced Features,” **Steve Bernier, Charles Auger, Juan Pablo Zamora Zapata, Hugues Latour, Mathieu Michaud-Rancourt**, *The Communications Research Centre Canada*
- 10:40 “Radio Management Across Multiple Standards: A Micro-Kernel Approach,” **Vincent Kovarik**, *Harris Corporation*
- 11:00 “TUBITAK Reference Waveform (TRWF),” **Adem Zumbul**, *TUBITAK*

Presentation materials for the four SDR’09 Workshops supplied by the presenters will be available to conference attendees at: <http://www.sdrforum.org/pages/SDR09workshops/>  
Access information is available at the registration desk.



**Wednesday, 2 December, Workshops**

**Sessions 4.2 and 4.3: Analysts Workshop, Regency D**

SDR has begun to move beyond the innovators and early adopters as defined by Geoffrey Moore in "Crossing the Chasm" into the early majority phase defining the mainstream market. In this phase, adopters select a technology not because it is innovative or visionary but because it has been shown to successfully solve a problem within their specific market. Examples of SDR adoption illustrating the transition to the mainstream are abundant:

- \* Thousands of software defined radios have been successfully deployed in defense applications
- \* Cellular infrastructure systems are increasingly using programmable processing devices to create "common platform" or "multi-mode" base stations supporting multiple cellular infrastructure standards
- \* Cellular handsets are increasingly utilizing System on Chip (SoC) devices that incorporate programmable "DSP Cores" to support the baseband signal/modem processing
- \* Satellite "modems" in the commercial and defense markets make pervasive use of programmable processing devices for intermediate frequency and baseband signal processing

While these types of systems are often not marketed as "SDR's", they utilize SDR technologies to solve market specific problems; cost of development, cost of production, cost of upgrades and maintenance, time to market in supporting new and evolving air interface standards, or problems associated with network interoperability. This workshop, hosted by Manuel Uhm of Xilinx and Chair of the SDR Forum Markets Committee will explore the use of SDR and SDR technologies in commercial, civil and defense markets, future trends, and key challenges that need to be addressed in further advancing SDR technologies into the mainstream.

**09:40-11:50 Morning Workshop Session 4.2**

**"What is the True Value Proposition of SDR in Base Stations?"**  
**Aditya Kaul, Senior Analyst Mobile Networks, ABI Research**

The most common and largely misunderstood value proposition has been software upgradeability, which means that through a software upgrade, one can update a piece of hardware to reflect changes in baseband technology. In most software upgradeable cases, as the technology changes in the baseband, the radio head portion of the base station would need to be replaced to reflect new frequencies, channel bandwidths, etc.

In recent years this has been changing as vendors have introduced solutions that have reconfigurable radio heads, which can be re-utilized to support different technologies and even simultaneously support technologies - all through software control. This has given rise to the Single/Multi RAN base station: one base station that covers all technologies.

**"The Future of Next-generation Wireless Technologies,"**  
**Michael Thelander, CEO, Signals Research Group, LLC**

This session looks at the real-world performance capabilities of next-generation wireless technologies, including HSPA+ and OFDMA-based air interfaces. Results from very detailed device/chipset and commercial network performance benchmark tests will be used to determine the likely adoption and usage models for these technolo-

gies, as well as the potential role for SDR-based solutions for device chipsets and as part of an infrastructure supplier's upgrade path. The session will conclude by looking at the network economics of these technologies in order to quantify the potential cost-savings associated with a software-based migration strategy versus new infrastructure [hardware] rollouts.

**"Processors for Digital Signal Processing: A Changing Landscape,"**  
**Jeff Bier, President, BDTI**

For most of the past 25 years, designers of demanding, digital-signal-processing-centric systems have largely relied on ASICs and digital signal processors (DSPs) as their main processing engines. Lately, however, the landscape of processing engine options has been shifting radically. As single-core DSPs have reached the point of diminishing returns, established processor vendors and start-ups alike have been increasingly relying on multi-core architectures. But multi-core architectures bring significant challenges in the realm of software development methodologies and tools. Meanwhile, massively parallel architectures, in the form of FPGAs and GPUs, are increasingly seeing use as DSP engines, but these technologies bring their own development challenges. And, as digital signal processing applications become more complex (and incorporate increasing amounts of non-signal-processing functionality) general-purpose CPUs are becoming an attractive option for some applications. In this presentation, Jeff Bier will present highlights of some of BDTI's recent and ongoing evaluations of tradeoffs and trends in processing engines for signal processing applications.

**13:50-16:00 Afternoon Workshop Session 4.3**

**"Broadband Public Safety Communications,"** **Emil Olbrich, National Institute of Standards and Technology Office of Law Enforcement Standards (NIST OLES)**

This session will include:

- \* Very brief overview of NIST OLES
- \* Overview of SDR usage in public safety comms and what NIST OLES is doing with SDR
- \* Market Size and Opportunity
- \* Current state of applicable technology, regulations and business models for SDR within public safety
- \* Technical, regulatory and business issues hampering adoption

**"US Military SDR Markets - A Market Perspective,"**  
**Bradley J. Curran, Senior Industry Analyst, Frost & Sullivan**

The military have communications problem. Current systems are dying at an alarming rate due to end of service life and intense operation that speeds normal attrition. JTRS, the key DoD solution, is not yet available, and program schedules and funding have been delayed. The increasing capability gap is being filled by replacing and upgrading current radios such as SINCGARS, buying interim radios with SDR and by emphasizing development of JTRS GMR and HMS networking. Troops under fire are not waiting for formal doctrine, tactics, techniques, and procedures to be developed to solve a problem that they immediately face. The resulting gap between current equipment and the budgetary and technological timeline for the next generation of SDR presents a unique opportunity for firms competing in this business.

Wednesday, 2 December, Workshops (continued)

Sessions 5.2 and 5.3: Regulatory Workshop, Regency E

Hosted by Peter Tenhula of Shared Spectrum Company and Chair of the SDR Forum Regulatory Committee and Paul Kolodzy of Kolodzy Consulting and Vice Chair of the SDR Forum Regulatory Committee, this one day workshop will explore the regulatory landscape impacting the deployment of Software Defined Radio, Cognitive Radio and Dynamic Spectrum Access Technologies. The workshop is being held in conjunction with the SDR '09 Technical Conference and Product Exhibition and will address topics that include:

- \* Establishing a global regulatory framework that promotes the adoption of reconfigurable radio technologies and dynamic spectrum access (DSA).
- \* Bringing together a multidisciplinary line up of regulatory/public policy officials and experts from around the world working on issues relevant to reconfigurable DSA radio technologies - technologists/engineers, economists, social scientists, and even lawyers.
- \* Developing a regulatory agenda that promotes the adoption of reconfigurable DSA radio technologies.
- \* Identifying regulatory barriers and misconceptions that may impact new business opportunities for reconfigurable DSA radio technologies.
- \* Describing current regulatory constraints that may impact the feasibility of potential technical options for deploying reconfigurable DSA radio technologies.

09:40-11:50 Morning Workshop Session 5.2

Keynote: Julius P. Knapp, Chief, FCC Office of Engineering Technology

Panel 1: "Future Dynamic Spectrum Access Regulatory Models: Can they be both 'dynamic' and 'regulatory'?"

This panel of world-renown spectrum policy experts will provide a diverse and multidisciplinary set of high-level perspectives on potential or ideal regulatory approaches that would not only enable, but promote deployment of DSA and reconfigurable radio technology. Issues to be addressed will include (1) regulatory and market barriers, constraints and misconceptions about such technologies; (2) regulatory, market and technical opportunities such as the availability of "digital dividend" spectrum, secondary market leasing/trading, the emergence of RFICs, femtocells, and multi-band software defined radios; (3) the "low-hanging" fruit for regulatory changes to promote SDR and cognitive radio deployments; (4) appropriate and inappropriate regulatory "models" for DSA; and (5) other contentious, controversial and compelling problems and solutions confronting and confounding regulators around the world. Moderator: Peter Tenhula, Chair, SDR Forum Regulatory Committee, Participants:

- \* **Bill Lehr**, Director of Communications Futures Program, MIT
- \* **Peter Stanforth**, CTO, Spectrum Bridge
- \* **Jon Peha**, Chief Technologist, Federal Communications Commission
- \* **Wayne A. Leighton**, Ph.D., Partner, Empiris, LLC

13:50-16:00 Afternoon Workshop Session 5.3

Panel 2: Specific Applications and Opportunities for Implementation of Reconfigurable Radio Technologies and Dynamic Spectrum Access Regulatory Approaches

This panel of subject-matter specialists will provide their unique observations and assessments of particular market segments and focus areas where near-term deployment of DSA and reconfigurable radio technology will achieve important public policy objectives. Representatives and experts from the military, homeland security and public safety communities will shed light on the benefits such technologies can bring and the regulatory obstacles that are in their way. Advocates for affordable, sustainable and ubiquitous wireless broadband services, especially in rural areas, will explain the societal and economic benefits of such services and how new, innovative technologies can sway policy makers to open up new doors to funding sources and a friendly regulatory environment. Representatives from both incumbent and emerging service providers will be invited to share their requirements for interference protection, spectrum efficient technology solutions and relief from antiquated regulations. Moderator: Bruce Oberlies, Senior Director of Advanced Technology, Motorola, Panelists:

- \* **Fred Frantz**, Director, Advanced Research Dept., Global Security & Engineering Solutions a division, L-3 Services
- \* **Richard Engelman**, Director, Spectrum Resources Government Affairs, Sprint Nextel Corporation
- \* **David Hartshorn**, Secretary General, Global VSAT Forum
- \* **Howard McDonald**, Team Lead for Dynamic Spectrum Access (DSA) Activities, Defense Spectrum Organization, DISA

Panel 3: The World's Regulatory View of Software Defined and Cognitive Radio: A WRC 12 Preview

On the agenda for the upcoming World Radio Conference (WRC) is an item (AI 1.19) that will "consider regulatory measures and their relevance, in order to enable the introduction of software-defined radio and cognitive radio systems, based on the results of ITU-R studies." The International Telecommunications Union (ITU) is currently studying whether there is a need for regulatory measures to enable the introduction of these systems. This panel of ITU experts will provide a timely preview of this and other relevant WRC agenda items. They will address the important issues now under consideration and debate within the international community and ITU working groups, including: (1) how can the ITU facilitate the deployment of software defined radios (SDR) and cognitive radio systems (CRS) in the various existing radiocommunication services; (2) are changes to the ITU Radio Regulations needed to enable these technologies; and (3) how do the definitions, description, or characterization of SDR or CRS effect the studies and debates? Moderated by Chris Hofer, International Team Lead - DoD WRC Coordinator, DSO, Panelists:

- \* **Rob Kubik**, Director of Telecom Relations Global, Motorola
- \* **Mike Chartier**, Director of Spectrum Policy, Intel
- \* **Bernd Wolf**, Federal Network Agency, Germany

Reminder: Don't miss the evening Regulatory Panel (see page 14)

## Wednesday, 2 December, Morning (continued)

### Session 3.2: Public Safety, Chair: Charles Bostian Regency C

- 9:40 "Public Safety Coverage Enhancements Using Simple Cognitive Radio Concepts," **Richard Taylor**, *Harris Corporation*
- 10:00 "Information Process Architecture (IPA): A Systems Architecting and Engineering Approach for the Development and Documentation of Complex Information and Communications Systems," **James Rodenkirch**, *Southern Methodist University*; **Peter G. Cook**, *Peter G. Cook Consultancy*
- 10:20 "Public Safety Interference Environment - Raising Receiver Performance Requirements," **Bruce Oberlies**, **Lawrence Ecklund**, **Stephen Kuffner**, **Brad Hiben**, *Motorola*
- 10:40 "Blind Signaling Identification for Multimode SDR Receiver with Applications to Public Safety Communications," **Ercument H Zorlu**, *Tubitak-UEKAE*; **Huseyin Arslan**, *University of South Florida*; **Murat Ceven**, **Ibrahim Olcer**, *Tubitak-UEKAE*; **Hamza Ozer**, *Turkish National Research Institute of Electronics and Cryptography*

### Tutorial: "RF Performance Specification, Measurement "

**Robert Normoyle**, *DRS Signal Solutions*; **Bob Cutler**, *Agilent*; **Chuck Dexter**, *DRS Signal Solutions* and **Marshall Cross**, *MegaWave Regency F*

This tutorial is composed of three sessions that will provide an understanding of RF performance parameters for antennas and transceivers and how to measure them using the latest test equipment. It also covers built-in-design approaches to dynamically measure the RF performance of a deployed software defined radio (SDR). The four sessions will be given by experts in the industry with respect to the technology subject matter. The first session will be given on antennas will be given by MegaWave, which will focus on practical methods and procedures to measure the electrical characteristics and performance of VHF and UHF antenna systems. The second session will be given by DRS Signal Solutions, which will explain the critical RF performance parameters of SDR transceivers. The third session will be given by Agilent and will demonstrate the latest RF test tools and how they can be used to measure both antenna and transceiver RF performance.

- "Specifying Antenna performance," **Marshall Cross**, *MegaWave*
- "Specifying and RF Tuner Performance in Receiving Systems," **Charles Dexter**, *DRS Signal Solutions*
- "Measurement Techniques and Tools of RF of Antennas and Receivers," **Bob Cutler**, *Agilent*



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See the full conference schedule for Xilinx program details:

- Analyst Workshop
- "A Platform-Based Approach to Realizing High Performance DSP Systems in FPGAs" Tutorial
- Sessions: 1.5, 2.5 and 3.1

Wednesday, 2 December, Afternoon

Session 1.3: SDR Implementations on GPU, DSP, FPGA, or GPP #2, Chair: R. Muralidharan  
Regency A

- 13:50 "An Universal Framework for Scalable Software Defined or Cognitive Radios Running on Desktop Computers," **Piotr Szegvari, Christian Hentschel**, *Brandenburg University of Technology*
- 14:10 "Performance of Select Baseband Processing LTE UE Blocks on a Flexible Software Based Baseband Processor," **Babak Beheshti**, *New York Institute of Technology*, **John Glossner, Saurabh Lahoti, Sitij Agrawal**, *Sandbridge Technologies*
- 14:30 "A Unified Wireless Platform Architecture for a Wide Variety of Wireless Systems," **Hiroyuki Shiba**, *NTT*
- 14:50 "On the Hardware Design of Front-End Processings in the SDR Systems," **Najam ul Islam Muhammad, Raymond Knopp**, *Institut Eurecom*; **Renaud Pacalet**, *ENST*
- 15:10 "Integration of FPGAs into SDR via Memory-Mapped I/O," **Matthew Carrick, Shereef Sayed, Carl B. Dietrich, Jeffrey Reed**, *Virginia Tech*
- 15:30 "Implementation of a 350 Mbps FPGA-Based Modem," **Michael Rugar, John Glancy**, *Naval Research Laboratory*; **Benjamin Egg**, *fred harris and Associates*

Session 2.3 - SCA for SDR, Chair: Eric Nicolle  
Regency B

- 13:50 "Global Military SDR Solutions - Practical Approaches for SCA Based Radio Compliance and Deployment," **Mark Turner**, *Harris Corporation*
- 14:10 "NATO RTO/IST RTG on SDR: Demonstrating Portability and Interoperability of SCA-based Waveforms," **Sarvpreet Singh, Markus Antweiler**, *FGAN e.V*; **Marc Adrat**, *Fraunhofer FKIE / KOM*
- 14:30 "A Simple, Lightweight Communications Architecture Facilitating SCA Application Portability," **Charles Linn**, *Harris Corporation*
- 14:50 "The Waveform Dashboard: An interactively configurable GUI for prototype SCA-based SDR waveforms," **Deepan Seeralan, Stephen Edwards, Carl B. Dietrich**, *Virginia Tech*
- 15:10 "Software Communication Architecture Radio Environment Performance Considerations," **Timothy Schoenfelder**, *Rockwell Collins*
- 15:30 "A Novel Approach to Diagnosing Problems in SCA Waveforms During Development and Porting," **Shazad Aslam-Mir, Larry Dunst, Brandon Duthler**, *DataSoft*

Session 3.3: Multimode Systems, Chair: Rick Taylor  
Regency C

- 13:50 "An implementation of novel multi-band/ mode SDR platform for simultaneous multiple radio communication system," **Kosuke Yamazaki**, *KDDI R&D Labs*
- 14:10 "Multiradio Scheduling and Resource Sharing on a Software Defined Radio Computing Platform," **Kees van Berkel, David van Kampen, Orlando Moreira**, *ST-Ericsson*; **Petr Kourzanov, Marinus Splunter**, *NXP Semiconductors*; **Antti Piipponen, Kalle Raiskila, Sverre Slotte, Tommi Zetterman**, *Nokia*
- 14:30 "Software Architecture for Cooperative Applications," **Thomas Tsou**, *Virginia Tech*
- 14:50 "Distributed Wireless Computing With Multiple Domains," **Sabares Moola, Carlos Aguayo Gonzalez, Carl B. Dietrich, Jeffrey Reed**, *Virginia Tech*
- 15:10 "A Generic Architecture for Smart Multi-Standard Software Defined Radio Systems," **Seyed Aidin Bassam, Mohammad Mojtaba Ebrahimi, Andrew Kwan, Mohamed Helaoui, Pouya Aflaki, Oualid Hammi, Fadhel Ghannouchi**, *University of Calgary*

Tutorial: "BIST and Digital Self-Calibration of RFICs"  
Mohammed Ismail, Ohio State University  
Regency F

To achieve the highest performance/price ratios of a handheld wireless devices, the current trends in wireless chip set development call for multi-standard nanometer CMOS radios integrated on a single chip. This represents a grand challenge to the yield of such chip sets and typically requires several silicon spins which will increase the NRE development costs and may result in significant product delays and in missing important market windows. To meet this challenge we present design techniques for built-in self-test (BIST) and digital self calibration of multi-band,multi-mode CMOS radio systems and demonstrate the validity of these techniques in the design of WiMAX/LTE CMOS radio front ends. The presentation will also review the basic principles of zero-IF CMOS multi band,multi mode radios form antenna to bits and will present a compact transceiver architecture suitable for TDD radio systems.

The tutorial is intended for RFIC ,baseband and SoC design engineers, researchers and graduate students as well as product and marketing managers . The material will be given at an introductory level. So newcomers to the field will be welcome.

The tutorial will cover the following main topics:

- Evolution of the wireless technology beyond 3G
- The nanometer CMOS RF radio design problem
- Built-in-self-test and self aware RFIC design
- Digital self-calibration techniques
- Case studies of an RF front-end for WiMAX/LT



## Wednesday, 2 December, Afternoon (continued)

### 17:00 Regulatory Panel Sessions: "Setting the Global Regulatory Agenda"

The analysts will be pleased to field questions from the audience regarding market sizes, opportunities, technology adoption and other issues pertaining to SDR adoption in various market segments.

This concluding panel will feature members of the SDR Forum's Regulatory Advisory Committee, which was established to provide advice and guidance to the Forum in support of the work of its Regulatory Committee. The Advisory Committee is made up of regulatory and public policy officials and experts from around the world who are working on or knowledgeable about issues relevant to reconfigurable radio technologies. The panelists will provide their unique insights on various activities of domestic and

international regulatory bodies of interest to the SDR and cognitive radio community. They will help identify what early incremental steps must be taken to proactively identify and remove regulatory barriers and misconceptions that may impact the ability to promote deployment of DSA and reconfigurable radio technology. Moderator: Paul Kolodzy, Panelists:

- **Bernd Wolf**, *Federal Network Agency, Germany*
- **Alan Scrim**, Chief, Spectrum Analysis and Frequency Management Branch, *Communications Electronics Research Development and Engineering Center (CERDEC)*
- **Bill Lane**, Chief Engineer, Public Safety and Homeland Security Bureau, *Federal Communications Commission (FCC)*
- **Byron Barker**, Chief, Strategic Planning Division, Office of Spectrum Management, *NTIA*

## Thursday, 3 December, Morning

### Session 1.4: CR Spectrum Access and Sensing - Chair: Klaus Moessner *Regency A*

- 9:40 "Cooperative Detection in Cognitive Networks to Interference Control in Licensed Systems," **A. C. Mendes, R. B. Dutra**, *Brazilian Research Institute/Digital Systems Group*
- 10:00 "A Study on Spectrum Management Technique by Using Adaptive Low Duty Cycle," **Keisuke Sodeyama**, *Yokohama National University*
- 10:20 "A Policy Reasoner for Policy-based Dynamic Spectrum Access," **Behnam Bahrak, Amol Deshpande, Jung-Min Park**, *Virginia Tech*
- 10:40 "Addressing the Hidden Incumbent Problem in 802.22 Networks," **Kaigui Bian, Jung-Min Park**, *Virginia Tech*
- 11:00 "Evaluation of Energy Based Spectrum Sensing Algorithm For Vehicular Networks," **Catalin Lacatus**, *University of Texas at San Antonio*, **Rama K Vuyyuru, Onur Altintas**, *Toyota InfoTechnology Center*, **Dusan Borota, Ivan Seskar**, *Rutgers University*
- 11:20 "A Spectrum Sharing Criterion Based on Capacity Conservation Ratio of Primary User," **Kei Inage, Takeo Fujii**, *The University of Electro-Communications*; **Kazushi Muraoka, Masayuki Ariyoshi**, *NEC*

### Session 2.4: Baseband Technologies and Algorithms, Chair: Daniel Iancu *Regency B*

- 9:40 "Area-efficient HW-Implementation of the FFT for OFDM Applications," **Rainer Storn**, *Rohde & Schwarz GmbH & Co. KG*
- 10:00 "A Receiver Structure that Performs Simultaneous Spectral Analysis and Time Series Channelization," **fred harris**, *San Diego State Univ.*, **Robert McGwier**, *IDA Center for Communications Research, Princeton*

- 10:20 "Preamble Structure for fast Acquisition and Equalization of QAM Signals," **fred harris**, *San Diego State Univ.*
- 10:40 "FPGA Implementation of a Near-ML Sphere Detector for 802.16e Broadband Wireless Systems," **Chris Dick, Raghu Rao**, *Xilinx*; **Milos Trajkovic, Slobodan Denic, Dragan Vuletich**, *Signum Concepts*, **Kiarash Amiri**, *Rice University*; **fred harris**, *San Diego State University*
- 11:00 "Physical Layer Description Standard for Software Defined Radio," **Eugene Grayver**, *The Aerospace Corporation*
- 11:20 "Architectural Decisions for SDR in MIMO applications," **Erik Org, Russell Cyr**, *BitWave Semiconductor Inc.*

### Session 3.4: Power Management in SDRs, Chair: Panagiotis Demestichas *Regency C*

- 9:40 "Adaptive Method for Measuring Received Signal Power Using Probability Judgment Formula for SDR Based Multi-Mode Terminals," **Yuji Ikeda, Yasuhiko Hiehata, Kosuke Yamazaki, Issei Kanno, Hiroyasu Ishikawa**, *KDDI R&D Laboratories*
- 10:00 "Dynamic Power Consumption Monitoring in SDR Regulatory Compliance," **Carlos Aguayo Gonzalez, Jeffrey Reed**, *Virginia Tech*
- 10:20 "Power consumption minimization for MIMO systems using cognitive," **An He, Timothy R. Newman, Jeffrey Reed, Bill Tranter**, *Virginia Tech*; **Masoud Sajadieh, Marian Verhelst, Srikathyayani Srikanteswara**, *Intel*; **Kyung K. Bae**, *Liberty University*
- 10:40 "Waveform Level Computational Energy Management in Software Defined Radios," **Dinesh Datla, Thomas Tsou, Timothy R. Newman, Jeffrey Reed, Tamal Bose**, *Virginia Tech*
- 11:00 "Use of Novel Power Control Mechanisms in an SCA Waveform and Platform," **Shazad Aslam-Mir, Larry Dunst, Brandon Duthler**, *DataSoft*; **Philip Balister**, *OpenSDR*

Sessions 4.4 and 4.5: SATCOM Workshop, Regency D

Recent market studies commissioned by the SDR Forum show that most satellite terminals and hubs in deployment today utilize some form of SDR technology. As these platforms become more powerful, the role of the SDR becomes increasingly important, allowing dynamic control of adaptive behavior of the information exchange and processing at all nodes in the network. Over time, such behavior may further evolve to allow for autonomous operation utilizing cognitive radio technologies and automatic information processing.

Hosted by Bob Schutz of ViaSAT and Chair of the SDR Forum Satellite Communications Special Interest Group, This workshop will explore the evolution of Satellite Communications over the next several years, defining the requirements for SATCOM systems in various market segments and then evaluating the roles of SDR and CR technology in addressing those requirements in all three key (the earth station, the satellite, and the user terminal).

09:40-11:50 Morning Session 4.4

Session 1: Architectures for SATCOM Systems - Commercial, Civil and Defense

"Satellite Communications - The Basics" Bob Schutz, ViaSAT

The goal of this session is to present an overview of satellite communications and highlight the unique nature of SATCOM. This session will also introduce the basic terminology and services provided by SATCOM systems.

Unique characteristics of satellite communication systems are presented along with the role of each of the key elements of SATCOM systems - earth stations, satellites, and user terminals. The physics of LEO (Low Earth Orbit) and GEO (Geosynchronous Earth Orbit) and discussed along with the primary services such as earth monitoring services, broadcast, point to point communications, SATCOM and IP services, and SATCOM and emergency services. Finally, the economics of SATCOM systems will be discussed along with a number of key challenges for SATCOM such as spectral sharing between SATCOM and terrestrial communications and frequency reuse.

"The Inmarsat Roadmap for SDR in Its Future Mobile Satellite Terminals" Eyal Trachtman, Director, Inmarsat R&D

The talk starts with an overview of the Inmarsat broadband global area network (BGAN) air interface complexity and challenges of SDR terminal implementation, followed with overview of the Inmarsat SDR strategy, drivers, and potential applications in the military and government satcom markets. The longer terms strategy covers the roadmap of Inmarsat satcom terminals and applications into the next generation of Inmarsat satellites. Finally, the innovative concept of providing a real-time data relay service to LEO spacecraft, using the Inmarsat-4 GEO satellite constellation and the Inmarsat BGAN system and ground infrastructure and a SDR type BGAN terminal onboard the LEO spacecraft, will be described as an application of the Inmarsat SDR strategy.

"NASA's CONNECT Project" Thomas Kacpura, NASA Glenn Research Center

The purpose of CONNECT project is to demonstrated three different SDRs on an International Space Station payload. Each of the SDRs is compliant with the Space Telecommunications Radio System

architecture, which is an architecture for space SDRs. This presentation will describe the challenges of specifying, testing and integrating SDRs on the payload from three different vendors. A case study will present integrating a waveform, STRS operating environment, with a SDR platform all from different provider organizations.

"Converging MILSATCOM with the GIG" Llewellyn D. Means Jr., SATCOM & Wireless Engineering Division DISA GE22

Panel Discussion 1: "Key Drivers in Satellite Communications"

This panel will compare and contrast architectures associated with commercial, civil, and defense SATCOM systems and define key roadmap drivers common across all markets

13:50-16:00 Afternoon Session 4.5

Session 2: SATCOM Systems and Implementations

"Adaptable Architectures for Advanced Space Based Communications Systems," Vince Kovarik, Senior Systems Engineer, Harris Corporation

Achieving NASA's lunar and Mars exploration objectives will require significant advances in space-qualified communications systems. The communications capabilities required by lunar missions and beyond cannot be supported through simple, point-to-point radio communications. While such radio links will may provide basic elements of the system, the number of communications sources, sensors, radios, etc. will necessitate the formation of networks. These networks will require the ability to form automatically, adapt to changing topologies, recover from faults, compensate for interference or other external factors inhibiting communications, and additional capabilities as mission needs evolve over the life of their deployment. The communications systems supporting these missions will require significant advances in the architecture and design over current systems. This paper presents work in progress to meet the needs of the next generation space-based communications and networking.

"Exploiting the Link: Improving CubeSat Communications through the use of Software Defined Radios," Professor James Cutler, University of Michigan

In this presentation, we examine methods to maximize data download for small satellites by beginning transmission at a high elevation angle. This elevation angle reduces the slant distance and allows the link to be closed at a higher constant data rate. Though the transmission time is shorter, the total data downloaded is greater. We examine this method for a variety of pass configurations and compare it to distributions of passes for known ground stations around the world. The results of this study (analytic, numerical and empirical) are presented along with recommendations for strategies for maximizing the amount of data transmitted for a given satellite orbit. Analysis is also presented for optimizing the data rate through the use of a dynamic data rate, where the data rate continuously changes based upon the availability of link margin. These links are able to be completed without feedback through the use of self-clocking signals. Finally, comparisons of small satellite data downlinks are used to illustrate the advantages of both of these methods. Recommendations for radio development are given for the small satellite community.

(Workshop details continue on next page)



**Thursday, 3 December, Workshops (continued)**

**Sessions 4.4 and 4.5: SATCOM Workshop, Regency D (continued)**

**"SDR and CR in Satellite Communications,"** *Cyrus Sy, Spectrum Signal Processing, Tine Pederson, Gatehouse*

The goal of this session is to discuss the role of SDR and CR technology as it relates to the three primary elements of SATCOM systems and both near-term and long-term implications of development of advanced cognitive SATCOM systems.

The role of SDR and CR technology in SATCOM will be discussed in the context of traditional SATCOM services, and advanced SATCOM services that will be expected in the future. Also discussed is the role of CR technology in mitigating regulatory challenges between SATCOM and Terrestrial communications. Hybrid (convergent) SATCOM systems will be defined and presented as well as the effect hybrid systems will have on the future of Satellite communications.

**"Government Reference Architecture (GRA) for SATCOM Terminals,"** *Tom Rittenbach, Senior System Engineer, CERDEC S&TCD SEAMS Directorate*

This purpose of this paper is to document an architectural valida-

tion approach for the Government Reference Architecture (GRA) for SATCOM terminals.

The approach integrates the Virginia Tech OSSIE SCA Core Framework with a UML model of the GRA, coupled with low-fidelity models of the SATCOM components.

This approach uses the Rhapsody tool to implement the GRA-based testbed from documentation through executable code generation. The end result is a system that demonstrates the portability of the GRA while simultaneously validating the GRA against a representative system. Furthermore, the system demonstrates the reduced development time required for architecture extensions through the incorporation of existing projects and automated code generation.

**Panel Discussion 2: "Satellite Communications and The SDR Forum"**

During this session, project concepts proposed by the SDR Forum Satellite Communications Special Interest Group will be presented and discussed, and other potential projects of relevance to the audience will be explored.

**Sessions 5.4 and 5.5: Government R&D Programs Workshop, Regency E**

Hosted by Claude Bélisle of Communications Research Centre Canada, this workshop will allow government organizations to present key issues in radio communications which they will be looking to industry and academia to address over the next 3 to 5 years through R&D activities. The objective of the workshop is to provide the SDR Forum's members and guests with insight into the Government's mid to long term communications requirements, and to help the Forum and its members to identify technology areas where investment is required to meet those requirements. This workshop will help the Forum to set strategy for the next several years and may act as a basis for the SDR Forum's R&D agenda.

09:40-11:50 Morning Session 5.4

**JTRS SBIR Industry Day - collocated with SDR'09**

In this session, representatives of the JPCE JTRS will provide an overview of the JTRS SBIR program and present an overview of the topics covered in their 10.1 solicitation.

Attendance in this session is free, but registration is required.

13:50-16:00 Afternoon Session 5.5

**"Wireless Research at DARPA" Dr. Bruce Fette, Program Manager, Strategic Technology Office, DARPA**

Dr. Fette joined DARPA in April 2009, as a program manager in the Strategic Technology Office. His interests cover many fields including cognitive radio, cognitive networking, signal processing, LSI, radio communications components, subsystems, and system applications enabled by next generation radio technologies. Dr. Fette's current programs involve cognitive techniques to enhance the scalability of radio communication networks, enhance the usability to the solders on the edge, improve situation awareness, and to lower radio system costs. Dr. Fette has been a major participant in many Software Defined Radio programs, including the Speakeasy program sponsored by DARPA. Dr. Fette was a founding member of the SDR Forum, and performed many roles there, most recently that of Technical Chair. In this capacity he also initiated the SDR Forum's Techni-

cal Conference. Dr. Fette earned his BSEE degree from University of Cincinnati, and MSEE and PhD from Arizona State University.

**"The New Broadband Agenda: Benefits and Challenges to Federal Agencies" Byron Barker, Chief, Strategic Planning Division, NTIA**

Byron Barker serves as the Chief of the Strategic Planning Division within the Office of Spectrum Management the Department of Commerce's National Telecommunications and Information Administration (NTIA). The division has the responsibility to plan, develop, and promote a future Federal spectrum management framework ensuring spectrum access that satisfies our nation's vital interests of national security, public safety and economic opportunity, now and in the future, through long range strategic planning, policies, comprehensive strategies and the incorporation of technology innovation.

**"Navy S&T Initiatives for Software Defined Radios" Ray Cole, Networks and Communication Systems Branch, Naval Research Laboratory**

Mr. Cole has been involved in many of the DoD telecommunication initiatives for over 40 years. Many of the products that started in the early 70s as technology developments are still in use by all the services. Mr. Cole currently heads up the Networks and Communication Systems Branch at the Naval Research Laboratory. The Branch conducts research and development in the area of military networks and communication systems.

**"SDR and Cognitive Radio R&D Initiatives at CERDEC S&TCD's SDR Lab," Tim Leising, Team Leader, SDR Lab group, CERDEC**

Tim Leising is an Electrical Engineer for the US Army Communications Electronics Research and Development Engineering Center's (CERDEC) Space & Terrestrial Communications Directorate. Tim is the Team Lead for CERDEC S&TCD's Software Defined Radio Laboratory and coordinates SDR and Cognitive Radio R&D efforts between CERDEC, industry, and academia. Tim is actively involved and supports various DoD software defined radio projects including the Joint Tactical Radio System. Tim has earned a BSEE from the State University of New York at Buffalo and a MEEE from Stevens Institute of Technology.

Thursday, 3 December, Morning (continued)

**Tutorial: "Rapid Implementation of SDR in a Unified Development Environment" Brian Dalio, Coherent Logix  
Regency F**

OFDM-based waveforms are increasing in importance, for both wired and wireless applications. In this paper, we present the agile development, implementation, and verification of an OFDM waveform PHY level on a Software Defined Radio development platform which supports a custom massively parallel processor. The SDR platform is supported by a tailored and highly productive development system emphasizing the value of a structured development process that takes the developer through modeling, trade-off analysis, implementation, and verification. We present

details of the OFDM models themselves, the design and trade-off process used to create them, their characterization and verification, and their ultimate performance characteristics. Central to the SDR platform is a custom massively parallel processor which is used for all signal processing, control, and data management aspects of the OFDM waveform. We present the architectural details of this computational fabric and discuss its advantages and disadvantages in the implementation of OFDM waveforms in particular and SDR applications in general. Finally, we present an analysis of the cost and time of implementation of the waveform versus its final performance characteristics and the path for future development of the specific waveform, the SDR platform, and the computational fabric.

Thursday, 3 December, Afternoon

**Session 1.5: CR Spectrum Access and Sensing #2, Chair: Klaus Moessner  
Regency A**

- 13:50 "Spectrum Sensing on LTE Femtocells for GSM Spectrum Re-Farming using Xilinx FPGAs," **Jörg Lotze, Suhaib A Fahmy, Baris Ozgul, Linda Doyle, Trinity College Dublin; Juanjo Noguera, Xilinx, Inc.**
- 14:10 "Dynamic Spectrum Allocation in Cognitive Radio Using Markov Models," **Ihsan A Akbar, Harris**
- 14:30 "Spectrum Access Scheduling among Heterogeneous Wireless Systems," **Lichun Bao, Shenghui Liao, University of California, Irvine**
- 14:50 "Blind signal identification for ISM band cognitive radio design," **Omar Zakaria, Huseyin Arslan, University of South Florida**
- 15:10 "Genetic Algorithm based Optimised Collaborative Spectrum Sensing for Cognitive Radio Network," **Kamran Arshad, University of Surrey**
- 15:30 "Cognitive Radio Access for Public Safety," **Robert Foster, Peter A. Tenhula, Mark Mchenry, Filip Perich, Shared Spectrum Company**

- 14:50 "SDR Waveform Development : Towards Tool Assisted Mapping And Evaluation In The Nucleus Concept," **Venkatesh Ramakrishnan, Torsten Kempf, Jeronimo Castrillon, Gerd H. Ascheid, Rainer Leupers, Heinrich Meyr, RWTH Aachen University; Markus Antweiler, FGAN; Marc Adrat, Fraunhofer FKIE / KOM**
- 15:10 "Implementation of a 2-FSK Continuous Waveform Using Software Defined Radio Platform," **Jesús García Lledó, Javier Bermejo Parra, Polytechnic University of Madrid**
- 15:30 "A Joint Modulation Identification and Frequency Offset Correction Algorithm for QAM Systems," **Evren Terzi, Hasan Basri Celebi, Huseyin Arslan, University of South Florida**

**Session 2.5: Baseband Technologies and Algorithms #2, Chair: Daniel Iancu  
Regency B**

- 13:50 "An embedded controlled flexible baseband processing approach," **Thomas Loewel, Ferenc Noack, Christian Lange, Andreas Wich, Wolfgang Koenig, Alcatel Lucent**
- 14:10 "A Software Solution for IEEE 802.11g Baseband Receiver," **Meng Yu, Daniel S Iancu, Vaidyanathan Ramadurai, John Glossner, Mayan Moudgill, Hua Ye, Murugappan Senthilvelan, Saurabh Lahoti, Sitij Agrawal, Jose Graziani, Sandbridge Technologies; Zhenyu Tu, Lehigh University**
- 14:30 "Wireless Networks In-the-Loop: Software Radio as the Enabler," **Jens P. Elsner, Martin Braun, Stefan Nagel, Kshama Nagaraj, Friedrich Jondral, University of Karlsruhe**

**Session 3.5: Other Applications, Chair: John Glossner  
Regency C**

- 13:50 "Interfacing a Reasoner with an SDR: a Platform and Domain API Independent Approach," **Jakub Moskal, Mieczyslaw Kokar, Northeastern University**
- 14:10 "A Hierarchical Channel-Aware Scheduling Scheme Provisioning for IEEE 802.16e/Mobile WiMAX," **Daniel Ndiki, S. Hussein, Hermann Helgert, George Washington University**
- 14:30 "A Software Defined Radio Transformation, Extended Band Manpack," **John Shanton III, Thales Communications**
- 14:50 "Metalanguage for ubiquitous practical cognitive networking," **Todor Cooklev, Indiana University/Purdue University; Mark Cummings, en Via**
- 15:10 "Demonstration of an Airborne Software Reprogrammable Payload," **Ryan Hauer, Thomas Pickard, Christopher Huffine, Naval Research Laboratory; Tim Meehan, Vista Research**
- 15:30 "Wireless Embedded System for ITS application with SDR based Central Processing and Co-ordination," **Rabindranath Bera, Sikkim Manipal University**

Thursday, 3 December, Afternoon



**Thursday, 3 December, Afternoon (continued)**

**Tutorial: "A Platform-Based Approach to Realizing High Performance DSP Systems in FPGAs,"** Chris Dick, *Xilinx*  
Regency F

FPGAs have become key components in implementing high performance DSP systems, especially in the areas of digital communications, video, and image processing. The compute/memory bandwidth of a modern FPGA far exceeds that of a microprocessor or DSP processor running at clock rates two to ten times that of the FPGA, and with their capability for realizing highly parallel arithmetic micro-architectures, FPGAs are ideally suited for creating custom data path processors. Despite these characteristics, FPGAs have not been broadly adopted in the DSP community because traditional programming models are based around hardware description languages (HDLs) like VHDL and Verilog, and electronic design automation tools that are foreign to most signal processing engineers.

In the recent years, a number of commercial design tools have made strides in bridging the gap between the C programming language and HDLs, and between the MATLAB / Simulink environment (The Mathworks, Inc.) and HDLs and hardware-centric intellectual property (IP) libraries especially targeting FPGAs. This workshop describes a platform-based approach to

realizing DSP systems in FPGAs that combines algorithm-centric programming models, high-level modeling environments, automatic code generation, standard hardware platforms, and embedded software. We demonstrate ways in which the platform provides descriptive expressiveness, fine-grained control of hardware architecture, and faithful simulation semantics from a system level environment. With interfaces and abstractions to implement data paths, control, and embedded software, each in a language suited to a particular function, and with heterogeneous simulation semantics and deployment, this platform enables a DSP design team to target FPGAs with less FPGA-specific expertise than ever before possible. To further highlight the utility of a model based design approach to realizing FPGA embedded systems we provide a detailed overview of how Simulink-based modeling tools can be employed to efficiently produce implementations of wireless communication systems. The architecture and programming methodology for realizing digital IF processing functions and a sphere detector-based MIMO decoder for spatial multiplexing MIMO systems will be reviewed in detail. An overview of the algorithmic and micro-architecture design considerations for producing area efficient FPGA realizations of these functions will be provided.

**Friday, 4 December, Morning**

**Session 1.6: Cognitive Radio, Chair: Wolfgang Koenig**  
Regency A

- 8:30 "Dynamic Cellular Cognitive System," **Ying Wang, Qinqin Chen, Charles Bostian**, *Virginia Tech*
- 8:50 "Functional Architecture for Efficient Control of Cognitive Radio Systems," **Klaus Nolte**, *Alcatel-Lucent*
- 9:10 "Cognitive Radio Systems: market assessment of selected value propositions," **Pierre Carbonne**, *IDATE Consulting Firm*
- 9:30 "Developing an Ontology for the Cognitive Radio: Issues and Decisions," **Shujun Li, Mieczyslaw Kokar, David P. Brady**, *Northeastern University*
- 9:50 "CROSS - A Distributed and Modular Cognitive Radio Framework," **Benjamin Hilburn, Timothy R. Newman, Tamal Bose**, *Virginia Tech, Warren Rodgers, Georgia Tech*
- 10:10 "A Design-and-Test Methodology for Cognitive Radio," **Greg Jue**, *Agilent Technologies*

**Session 2.6A: Location Based Technologies, Chair: Mayan Moudgill**  
Regency B

- 8:30 "A Low Power Software Defined Radio Networked Architecture for Digital Camera Image GeoTagging," **Rollin Cogburn, Alison Brown, Bruce Johnson, Yan Lu, Peter Brown**, *NAVSYS Corporation*

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Friday, 4 December, Morning (continued)

8:50 "Software GPS in SB3500 Processor," John Glossner, Daniel S Iancu, Hua Ye, Yuri Pogudin, Mayan Moudgill, Andrei Iancu, Sandbridge Technologies; Jarmo Takala, Helena Lep-päkoski, Tampere University of Technology; Vasile Surducan, Emanoi Surducan, National Institute of Research for Isotopic and Molecular Technologies

Session 2.6B: Infrastructure, Chair: Nadeem Bukhari Regency B

9:30 "MASTR V: A Software Defined Base Station for Public Safety," Rekha Menon, Pete Grissom, Richard Taylor, Harris Corporation

9:50 "Implementing a Base Station Using the SDR Platform for Coexistence of Heterogeneous Wireless Systems," Shenghui Liao, Lichun Bao, University of California, Irvine

10:10 "10W & 25W GaN HEMT Power Amplifiers with 2 GHz Bandwidth," Karthik Krishnamurthy, James Martin, David Aichele, RF Micro Devices

Session 3.6: High Speed ADCs for SDR, Chair: Mohammed Ismail Regency C

8:30 "On Time-Interleaved Analog-to-Digital Converter for Wide-band Reconfigurable Radios," Michael Soudan, University of Ireland

8:50 Jan Craninckx, Vito Giannini, Pieter Crombez, Julien Ryckaert, IMEC, "Energy Efficient Analog-to-Digital Converters for Software-Defined Radio"

9:10 Ana Rusu, Orhan Hazar, Angeliki Leonida, Julian Garcia, Saul Rodriguez, Royal Institute of Technology KTH; Mohammed Ismail, Ohio State University, "A Continuous-Time Complex Bandpass Sigma-Delta ADC for Software Defined Radio"

Session 4.6: SDR Forum Projects Overview Regency D

Join us for this informative session providing insight into projects currently underway within the SDR Forum, and learn about some new projects about to get started. Workgroups presenting during this session will include:

- \* Public Safety Special Interest Group - Chair: Fred Frantz of L3 Communications, Vice Chair: Rick Taylor of Harris
- \* SATCOM Special Interest Group - Chair: Bob Schutz of Via-SAT
- \* Regulatory Committee - Chair: Peter Tenhula of Shared Spectrum Company, Vice Chair: Paul Kolodzy of Kolodzy Consulting
- \* Cognitive Radio Work Group - Chair: James Neel of Cognitive Radio Technologies, Vice Chair: Ihsan Akbar of Harris Corporation

- \* Commercial Baseband Processing Work Group - Chair: John Glossner of Sandbridge Technologies
- \* Modeling Language for Mobility Work Group - Chair: Mitch Kokar of Vistology, Vice Chair: Vincent Kovarik of Harris
- \* RF Technologies Task Group - Chair: Robert Normoyle of DRS Defense Solutions
- \* SCA Work Group - Chair: Claude Belisle of CRC
- \* Test and Measurement Work Group - Chair: Bob Cutler of Agilent, Vice Chair: Neal Mellen of TDK
- \* Transceiver System Interface Task Group - Chair: Eric Nicollet of Thales Communications

Tutorial: "SCA-Based Education and Rapid Prototyping using OSSIE: A Hands-On Tutorial," Carl Dietrich, Virginia Tech Regency E

This tutorial introduces easy-to-use, open-source tools for rapid prototyping and interactive control of SCA-based SDR waveform applications, and provides hands-on experience developing waveform applications and components with an SCA-based software radio framework and tools suitable for education, research, and rapid prototyping. Based on experience with similar workshops, it is anticipated that many participants will be able to develop SCA receiver applications and use them with RF hardware to receive radio signals within the workshop time frame. The session begins with a brief overview of software defined radio including basic concepts, education, research topics, and the Software Communications Architecture (SCA). OSSIE, Virginia Tech's open source implementation based on the SCA, is introduced through hands-on activities developed by the Naval Postgraduate School and Virginia Tech. Lab materials as well as the OSSIE core framework and associated rapid development and application software are provided to participants and are also available for free download.

Tutorial: "Multirate Signal Processing in Communication Systems," fred harris, San Diego State University Regency F

Most of us know how to design multirate Digital filters to accomplish bandwidth and sample rate changes. The traditional structures that accomplish this task are the polyphase FIR filter, the dyadic half-band filter, and the cascade Integrator and comb filter. Computationally efficient resampling filters can also be formed from recursive all-pass subfilters operating in the conventional polyphase structure. These subfilters, exhibit unity magnitude response, are adjusted to have phase shifts that add constructively in the defined pass band and destructively in the stopband. The computational burden of these filters is one-fourth to one-sixth of standard resampling filters. Linear phase recursive filters can also be built in class of filters. This presentation will review multirate filters in the standard FIR configuration as well as the IIR configurations. This presentation will illustrate a number of traditional signal-conditioning problems solved with the FIR and IIR solutions.

Friday, 4 December, Morning

# ABOUT THE SDR FORUM

The **SDR Forum** is an international industry association dedicated to supporting the development and deployment of software defined and cognitive radio systems. Our **global membership** is comprised of decision makers, planners, policy makers, technical leaders, suppliers, manufacturers and educators.

Become a member and gain insight to emerging technologies. Access key technical documents, industry reports and market surveys. **Network. Collaborate. Participate** in committees, workgroups and workshops to define market requirements, establish the regulatory landscape, and develop specifications for SDR technologies.

**Want to know more, get involved?** To participate in the Forum's advocacy, opportunity development, commercialization and education activities in the defense, public safety, space, and commercial communications markets, contact the Forum's CEO at Lee.Pucker@SDRForum.org.

**Want to become a member?** Visit the SDR Forum's web site:

[www.sdrforum.org](http://www.sdrforum.org)

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