Passive Wireless Sensor Technology Workshop

(Part of the June 2012 ISA Communications Division Symposium)

June 6-7, 2012

Hyatt Regency, La Jolla, CA

Chairman: NASA/George Studor, Johnson Space Center george.f.studor@nasa.gov
Sponsor: ISA Comm Division/Ian Verhappen iverhappen@industrialautomationnetworks.com
DOE/ORNL/Peter Fuhr fuhrpl@ornl.gov

Purpose: To bring Passive Wireless Sensor-Tag(PWST) technology developers, manufacturers and potential industry end-users together to understand the larger market drivers that will drive costs down and applications up. We will also discuss logical next steps.

Objectives:

1. **Understand various PWST technologies, actual & potential uses, and maturity.**
2. **Assess the future applications/advantages/limitations in various industries.**
3. **Assess what is needed for high volume production, standardization & communication.**
4. **Precipitate individual and group "next step" thinking to further develop/apply PWSTs.**
5. **Accumulate contacts for potential partnering activities(start at 2011 PWST W-shop Summary)**

Who Should Attend:

- **Industries and Government programs that could use a lot of cheap wireless sensors**
- **Sensor System, Surface Acoustic Wave(SAW) and Passive Wireless Sensor Developers**
- **Academic Institutions and Researchers**
- **Investors**

Registration Website:
http://www.isa.org/Template.cfm?Section=Conferences_and_Exhibitions1&template=/Conference/ConferenceDescription.cfm&ConferenceID=5012

Registration Form: Fax in
http://www.isa.org/Content/Microsites530/Computer_Tech__Division/Home528/2012SymposiaRegistrationForm.pdf

2011 PWST Workshop Website (Brochure, Workshop Summary Presentation and Individual Presentations):
http://www.isa.org/MSTemplate.cfm?Section=Passive_Wireless_Sensor_Workshop&Site=Computer_Tech__Division&Template=/ContentManagement/MSContentDisplay.cfm&ContentID=87544

2012 PWST Workshop Description

The workshop will explore the current state of technology of passive wireless sensor tags (PWST) and their practical applications. As a quick background, a PWST has no battery, no expensive electronics at the sensor site and (of course) no need for a wired connection between the sensor and the data acquisition system. In a manner somewhat similar to a classic passive RFID tag, the PWST responds to a wireless interrogation signal from a reader, but unlike RFID it provides real-time sensor data along with its unique tag id, stored information and range. PWSTs can be manufactured in high volume – even incorporating direct write fabrication - resulting in an inexpensive device. With its considerable read-range (separation distance between reader and device), compatibility with extreme environments, small size, autonomy of sensor installation, and "no onboard power" capabilities, PWSTs have a wider application arena than traditional wireless sensors. The workshop will explore these and other motivations for using PWSTs in a variety of fields, present and demonstrate current technologies, explore current and future applications of PWSTs in various industries (commercial buildings, industrial settings, transportation, aerospace, etc.). A key component of this two-day PWST Workshop is to facilitate discussions between end users and developers/suppliers on application areas of mutual interest.

2012 PWST Workshop Team

Ian Verhappen

Yokagawa Canada
ISA Comm Div Chair
Calgary, Alberta

Dr. Peter Fuhr

Oak Ridge National Labs
ISA Comm Div Future Chair
Knoxville, TN

George Studor

NASA/JSC/StructuralEng
PWST Workshop Chairman
Minneapolis, MN

2012 Passive Wireless Sensor Technology Workshop
Introduction
Talking Points - George Studor

- **Passive Wireless Sensors are just one of the options in the "Tool Box" for reducing dependency on wired connectivity and adding functionality without wires or cables.**
- **PWS Technologies address common needs of NASA, other agencies and other industries.**
- **There are many types of Passive Wireless Sensors to investigate and compare with others.**
- **PWST Functionality, with no wire to the data acquisition system, or battery at the sensor:**
  - **IDs that are uniquely separable from many, perhaps hundreds of other tags.**
  - **Stored Info that can be retrieved and changed with remote/non-contact means.**
  - **Location/Range information**
  - **Real-time Sensor/State information**
- **Cost motivations:**
  - **Initial Purchases - Unique vs Standards**
  - **Integration, Modularity**
  - **Life-cycle Maintenance and End-of-Life**
  - **Sensor Data saves in other areas: operations, systems, anomalies, safety**
- **Added value when embedded during Manufacturing and Fabrication processes.**
- **Power-scavenging, if practical, can add benefits…avoid cost/restrictions of battery charging**
  - **Data Logging, Remote and Hazardous Operations, Event Monitoring/Reporting**
  - **Secure Communications, Longer Range Communications**
  - **Continuous Operations and Transmissions – if the scavenge source is consistent**
- **What will we be doing at this workshop?**
  - **Internalize the vision and the fundamentals of the technology**
  - **Learn about some of the specific technologies and the providers**
  - **Learn about some of the Industry needs**
  - **Learn about some next-step areas - new devices, manufacturing, communication…**
  - **Meet the Presenter opportunities during the breaks, lunch, dinner or ad-hoc.**
  - **Discuss Key Forward Planning topics/suggestions with the organizers**
  - **Plan to meet again and distribute workshop results on-line**
- **Workshop Premise:**
  - **Our organizations need to be able to take advantage of new technology…how?**
  - **Others are developing and using technology related to or the same as we want.**
  - **There is a lot of important development going on that we should know about.**
  - **We need more efficient ways to keep up with new technology.**
  - **Technology developers need to know what problems need solving.**
  - **"Out of the Box" thinking needs to move from gadget to System Engineering level.**
  - **Combined Business Cases in multiple industries may enable larger scale production.**
  - **Need to cross the walls between Industries, Government organizations and countries**
  - **Communication is the key - let's work at it!**

2012 Passive Wireless Sensor Technology Workshop - Day 1

June 6th

8:00am	NASA/JSC/Structures SHM	George Studor	- "Passive Wireless Sensor Technology & 2012 Workshop Plan"
8:30am	GE Global Research	Daniel Sexton	- "ISA107.4: Wireless Sensors for Turbine Instrumentation Working Group"
9:00am	United Tech Research Center	Sanjay Bajekal	- "Wireless for Aerospace Applications"
9:30am	NAWCWD China Lake	Rob Pritchard	- "Naval Applications of PWST from the End-user's Perspective"

10:00am Break - Meet the Presenters

10:30am	BP	Dave Lafferty	- "Passive Sensor Needs at BP"
11:00am	Shell	Ron Cramer	- "Oil and Gas Integrity Monitoring"
11:30am	DOT/FHWA	Fred Faridazar	- "Wireless Sensors for Structural Monitoring During Extreme Events"

12:00 - 1:00 Lunch - Meet the Presenters

1:00pm	Rockwell Automation	Cliff Whitehead	- "Machine-to-Machine Interfaces in Factory Automation"
1:30pm	Arkansas Power & Electric	John Fraley	- "High Temperature Wireless Sensor Systems"
2:00pm	Yokogawa	Penny Chen	- "PWST Needs at Yokogawa"

2:30pm Break - Meet the Presenters

3:00pm	Savannah River Nuclear Solutions	- Mike Mets	- "PWST/RFID Technology for Material Control and Accountability at the Savannah River Site"
3:30pm	On-Ramp Wireless	Jake Rasweiler	- "Ultra-Link High Capacity, Long Range, Low Power Technology/Applications"
4:00pm	VTI Instruments	Chris Gibson	- "Integrating Passive Wireless Sensors with Existing Data Acquisition Systems"
4:30pm	AVSI Project AFE73 -WAIC	Radek Zakrzewski	- "Protected Spectrum for Wireless Avionics Intra-Communications"

5:00pm Meet the Presenters

2012 Passive Wireless Sensor Technology Workshop - Day 2

June 7th:

8:00am	Syntonics	Bruce Montgomery	- "Passive Wireless Sensing in a High-Multipath, High-Doppler Environment"
8:30am	Albido Corp	Fred Gnadinger	- "Wireless Passive Strain Sensors Based on Surface Acoustic Wave (SAW) Principles"
9:00am	Environetix	Mauricio Pereira da Cunha	- "Harsh Environment Wireless Sensor System for Monitoring Static & Rotating Components in Turbine Engines and Other Industrial Applications"
9:30am	nScrypt	Mike Newton	- "Passive Direct-Write Sensors"

10:00am Break - Meet the Presenters

10:30am	RF SAW	Paul Hartmann	- "Advances in SAW Devices for Sensing and RFID Applications"
11:00am	ASRDC	Jackie Hines	- "PWST SAW - Sensor System"
11:30am	Univ of Central Florida	Don Malocha	- "SAW PWST: 915 Mhz Sensor System and Demonstrations"

12:00 - 1:00pm Lunch - Meet the Presenters

1:00pm	Carinthian Tech Research	Heimo Mueller	- "SAW Sensors: Explore New Measurement Horizons"
1:30pm	Vectron/Sengenuuity	Sabah Sabah	- "Vectron Wireless Temperature Monitoring Solutions"
2:00pm	MIT/Auto-ID LAbs	Isaac Ehrenberg	- "RFID Tag Antenna-Based Sensing"

2:30pm Break - Meet the Presenters

3:00pm	Tag Array	Kourosh Pahlavan	- "Passive UWB: Long Range, Low Cost and Precise Location"
3:30pm	MaXentric	Don Kimball	- "60 GHz Comm, RFID Moving to PWST"
4:00pm	Wireless Sensor Technologies	John Conkle	- "Wireless Sensors for Gas Turbine Engines"
4:30pm	Aerojet	Scott Hyde	- "A System Engineering Simulation Tool and Data Base Proposal for Optimizing Application of Wireless Sensors"

5:00pm Closing, Discussion, Conclusions George Studor

8:00AM, June 6 - Day 1		
Session 1 Presentation 1	**George Studor**	**Project Engineer**
NASA/Johnson Space Center, Houston, TX		**george.f.studor@nasa.gov**
http://www.nasa.gov/centers/johnson/home/index.html		**763-208-9283**
"Passive Wireless Sensor Technology and the 2012 PWST Plan"		**281-415-3987c**

Abstract:

Application of Wireless Technology to Aerospace Vehicles can have a number of advantages, but the perception the vulnerability of a single wireless link thwarts system engineering and accurate reliability analyses. Three elements to Fly-by-Wireless are essential: 1) A tool-box of alternatives to standard wiring and sensing, 2) Architectural provisions to all the alternatives to be applied, 3) Management direction and motivations to drive a change in the state-of-the-art. Although smart wireless sensor nodes and networks are coming into maturity, the cost per measurement point is still high and functionality somewhat limited - leaving mainly the applications that have extreme cost, schedule or physical difficulty. Passive Wireless Sensors have the potential to provide extremely useful function, performance benefit to Aerospace Vehicles and their Ground Operations and Test Facilities. By leveraging similar benefits in other industries with much higher volume applications, aerospace can have a mutually beneficial relationship with them - bridging technical gaps and industry bridging cost needs. The topic will address this FBW vision consistent with the PWST workshop goals and content.

Background:

Mr. George Studor is a senior project engineer for technology applications in the Strategic Opportunities and Partnership Development Office of the Johnson Space Center. Through innovative use of relationships outside NASA, he is making significant progress towards technology partnerships with external organizations, industries and universities. He is currently leading the Wireless Avionics Community of Practice for the Office of the Chief Engineer. In the past 15 years, he has championed numerous successful wireless flight instrumentation projects for dual-purpose technology - operational use demonstrations on Space Shuttle and International Space Station. Applying the lessons learned, he has promoted changes to future vehicle architectures to enable reduced wires and connectors through a comprehensive approach called "Fly-by-Wireless".

8:30AM, June 6 - Day 1

Session 1 Presentation 2 **Daniel Sexton** **Project Engineer**
GE Global Research, Niskayuna, NY **sextonda@ge.com**
http://ge.geglobalresearch.com/ **518-387-4121**

"ISA107.4: Wireless Sensors for Turbine Instrumentation Working Group"

Abstract:

ISA107 is a committee formed to develop standards and guidelines for the testing and measurement of gas turbine engines. The ISA107.4 subcommittee was formed to explore how wireless technologies and techniques can be applied can be applied to gas turbine engine testing. This talk will give an overview of the ISA107.4 subcommittee and provide a description of the kinds of applications passive wireless sensing can play key role in this challenging application. An evolving set of requirements will be presented along with a discussion of how emerging passive wireless technologies might fill this critical need and what are some of the gaps and research topics still need to be addressed.

Background:

As a project engineer working for GE's Global Research department, Mr. Sexton has been leading and participating in research projects in wireless communications, wireless sensor system development, magnetic resonance imaging electronics and system design, and advanced control system architectures. He is the chair of ISA107.4; Wireless for gas turbine instrumentation and Co-Chair of ISA100.11a; Wireless sensor networks for industrial applications. Mr. Sexton has 20 years of experience with GE working in the areas of industrial automation and controls and 12 years of experience working for GE Global Research where he has done applied research in industrial wireless communications, wireless sensing for harsh environments and high performance RF signal processing and systems for Magnetic Resonance Imaging. He holds over 25 granted US patents in both the communications and automation technologies. He holds a Bachelors (1978) and Masters degree(1982) in Electrical Engineering from Virginia Tech and is a member of IEEE.

9:00AM, June 6 - Day 1

Session 1 Presentation 3 **Sanjay Bajekal** **Discipline Lead for Communication**
United Technologies Research Center, East Hartford, CT **Systems and Architectures**
http://www.utrc.utc.com/pages/our_company.html **BajekaS@utrc.utc.com**
"Wireless for Aerospace Applications" **860-610-7700**

Abstract:

Measureable benefits of structural health monitoring in aerospace applications have been realized over the last few decades. This has created a call for more and better sensing that feeds the seemingly insatiable appetite of algorithms for real-time data. Wireless technology for communications has encouraged the perception that pervasive sensing in an airframe is a matter of choosing an appropriate peel and stick sensor technology. This work outlines critical decisions that need to be made prior to deploying wireless technology. Some of the items that will be covered include printed circuits and antenna technologies for conformal sensors, cost and efficiency of self powered sensors, and the role of passive sensing at a system level, followed by a discussion about the state-of-art and remaining technical challenges.

Background:

Mr. Bajekal is the Discipline Leader for Communications Systems and Architectures at the United Technologies Research Center with a focus on wireless and hybrid communications technologies since December 2008. Mr. Bajekal has over 25 years of experience in technology and product development ranging from sub to over 10 GHz RF including active noise cancellation techniques at high frequencies. He holds six patents and has co-authored of several publications. Employers prior to UTRC include Quellan (now Intersil) and Lucent Technologies (AT&T Bell Laboratories). He has Bachelor's and Master's degrees in Electrical Engineering and a MBA.

9:30AM, June 6 - Day 1

Session 1 Presentation 4 **Robert Pritchard** **Senior Scientist**
NAVAIR Energetics Research Div.,NAWC, China Lake, CA **Robert.w.pritchard@navy.mil**
http://www.navair.navy.mil/nawcwd/ **760-939-7504**

"Naval Applications of PWST from the End-user's Perspective"

Abstract:

Rob will discuss how PWST could be utilized, primarily in the area of Condition-based Maintenance and Health Management of munitions and what are some of the concerns or "road-blocks" the "end-users" see as a whole on using such systems in the Navy's Fleet Operations.

Background:

Mr. Robert W. Pritchard has been working at NAWCWD, China Lake for the past 27 years as a mechanical engineer, primarily in the area of polymeric behavior of energetic materials. He is the Senior Scientist for the NAVAIR Energetics Research Division; Code 474000D at China Lake in the area of mechanical properties and aging surveillance of energetic materials, and system design/polymeric mechanics of solid propulsion systems. His current emphasis is in the development and integration of health management systems for tactical-based missiles. Before that, for fourteen years he was the supervisor for the Product Quality Branch at China Lake providing state-of-the-art chemical, thermal, safety and physical property analyses to assess the quality assurance/quality control, safe handling, and operational characteristics of energetic materials and their ingredients in support of new weapons development for the Navy. In addition, he has participated on a number of international government's technical interchanges in the hopes of making our alliances stronger through NATO/AGARD committees/working groups, The Technical Cooperation Program key technical Area working groups and Data Exchange Agreements in the areas of inventory health management and structural assessments of munitions, as well as polymeric structures. Lastly, for over 20 years he has been an active participant in JANNAF Structures and Mechanical Behavior Subcommittee (SMBS) as a technical steering group member, co-representative for the Navy and recently been assigned as the committee's chairman, in the betterment of developing sound weaponry for our warfighters. In April 2012, he led the JANNAF Wireless Sensors Workshop and is a key organizer for future workshop directions.

10:30AM, June 6 - Day 1

Session 2 Presentation 1 **David Lafferty** **Technology Advisor**
BP Chief Technology Office, Houston, TX **david.lafferty@bp.com**
www.bp.com **281-504-8852**

"Passive Sensor Needs at BP"

Abstract:

The Oil And Gas business has a wide range of challenging sensor needs where wireless passive senor tags may help. We operate in very hostile environments where traditional active sensor tags have not worked well. We will explore why BP feels passive tags are important and examine some specific use cases where passive sensors may be successfully applied.

Background:

Since joining BP's Information Technology and Services (IT&S) Chief Technology Office in 2004, Dave Lafferty has spearheaded a wide range of innovative projects including: (1) Established and maintains a "Business Partnership" between CTO and the Alaska business unit resulting in the introduction of many innovations, (2) Developing the "Digital Umbrella" concept as a template for industrial wireless backhaul within BP, (3) Enhancing safety and operations using 3D virtual environments – including the award winning Virtual Hazard Monitor. (4) Transforming the Location Intelligence concept into the various business solutions including the Alaska Pipeline Renewal Compliance tool. (5) Award-winning Wireless Measurements systems using "motes" resulting in reducing industrial instrumentation cost an order of magnitude. (6) Numerous integrity management systems including leak detection and corrosion measurements including the North Slope wireless corrosion project and the cross segment real-time corrosion measurement program, (7) Predictive Analytics for both equipment health and supply chain optimization, (8) Geo-fencing projects including perimeter defense for the North American refineries and a Pipeline Intruder Detection System, (9) Handheld projects including Operator Rounds Mobility with embedded work rules, (10) Representing BP in the creation of the new ISA100 industrial wireless standard. For ten years before joining BP, Dave owned a consulting firm in Anchorage, Alaska providing IT consulting and project management services. Projects included business continuity planning for North Slope drilling operations; re-design of spill response procedures for Valdez, merging of the Alaska IT assets during the ARCO acquisition.

11:00AM, June 6 - Day 1
Session 2 Presentation 2 **Ron Cramer** **Principal Optimization Engineer**
Shell, PACO Americas Houston, TX **Ronald.Cramer@shell.com**
www.shell.com **281-544-4411**
"Oil and Gas Integrity Monitoring"

Abstract:

The Oil and Gas industry is sadly afflicted with a history of catastrophic HSSE incidents e.g. 1988 Piper Alpha North Sea explosion resulted in the death of 167 operators, 2005 Texas City fire and explosion resulted in the deaths of 15 people, 2010 Deepwater Horizon with 11 fatalities and many more. Continuous/comprehensive monitoring of all assets will serve to pre-empt and/or mitigate the effects of such incidents. The purpose of this presentation is to stress the need for development of associated low cost, low power, wireless sensors to achieve the required degree of surveillance.

Background:

Ron Cramer is a Principle Optimization Engineer with Shell Projects and Technology, Houston. Cramer has 34 years experience in multiple Shell E&P operating companies covering Oil/Gas Field Operations, Hydrocarbon Accounting, Maintenance/Materials Management, Instrumentation, Telemetry, SCADA/DCS, ESD/F&G and Information Technology. He also worked for 12 years as a Chemical Engineer for Union Carbide and Polysar in downstream research and process surveillance and optimization areas. Mr. Cramer is a graduate Chemical Engineer, BSc, Strathclyde University and MSc, Waterloo University. Cramer has published and/or presented more than 50 papers regarding oil and gas experiences.

11:30AM, June 6 - Day 1
Session 2 Presentation 3 **Fred Faridazarr** **Highway Research Engineer**
DOT/FHWA McLean, VA **fred.faridazar@dot.gov**
www.fhwa.dot.gov/research/ www.tfhrc.gov **202-493-3076**
"Wireless Sensors for Structural Monitoring during Extreme Events"

Abstract:
The presentation will provide an overview of the Exploratory Advanced Research (EAR) program, the status of development of unique self powered sensor system under the Federal Highway Administration and potential of using wireless sensor system technologies to other aspect of structures such as monitoring structure responses at various extreme events (earthquakes, wind, scour, or other impacts). One the topic that will be covered is the on-going studies of seismic vulnerability assessment of national high priority corridors by using the REDARS (Risks from Earthquake Damage to Roadway Systems) and FAF (Freight Analysis Framework) DYNASMART-P (dynamic network traffic planning tool) programs. REDARS program provides earthquake damage/ loss including repairing cost travel congestions/ time increases, and recovering time/ resilience. The FAF programs estimates an analysis due to bridge/highway structure damages including freight route interruption rerouting time and distance to estimate cost. These programs are used to plan or practice emergency planning on post-extreme events, for seismic retrofitting projects and prioritizing retrofitting needs, etc. Wireless sensor system becoming inexpensive can easily be installed on existing structures or new structures for monitoring of structure during the actual earthquake. The information could be used for validations of these programs as well as improving future structure design and retrofitting of structures.

Background:
Fred Faridazar has served as a Highway Research Engineer at the Federal Highway Administration (FHWA), Turner-Fairbank Highway Research Center, since January 2000. Through his work in the Office of Infrastructure Research Development he has acquired pavement and material related technical experience to complement the bridge and structure design and construction obtained through his prior positions with FHWA. He has very broad experience in highway engineering and management applications. In his current position, he provides effective oversight of research contracts, and also chairs panels that provide technical guidance on pavement research, development, and technology transfer. He is a graduate of University of Maryland. His profession affiliations include members of American Society of Civil Engineers, and American Society for Testing and Materials and severs on several Technical Working Group related to concrete.

1:00PM, June 6 - Day 1
Session 3 Presentation 1 Cliff Whitehead Manager, Business Development
Rockwell Automation Mayfield Heights, OH cjwhiteheadjr@ra.rockwell.com
www.rockwellautomation.com 440-646-3779 216-288-9269c
"Machine-to-Machine Interfaces in Factory Automation"

Abstract:

Factory automation, often referred to as discrete and/or hybrid automation, has functional and technical requirements that place unique demands on control systems. A distinguishing requirement of factory automation systems is the speed with which transactions are processed. This presentation will describe several use cases common in discrete and hybrid manufacturing to generate a discussion about how passive wireless sensing tags and related technologies can help solve the use cases.

Background:

Cliff is responsible for strategy and business development for new and emerging technologies and applications at Rockwell Automation. With over 25 years in the automation business, Cliff has been involved in every aspect of automation as both a user and a vendor. In his current role, Cliff is responsible leading complex cross-business unit futuremapping for adoption and proliferation of internal and external innovations with a critical objective to accelerate technology adoption and product time-to-market. Cliff enjoys bouncing new ideas around and working with small and large groups to achieve innovative solutions to complex problems.

1:30PM, June 6 - Day 1
Session 3 Presentation 2 **John Fraley** **Lead, Wireless Engineer**
Arkansas Power & Electric, Fayetteville, AR **jfraley@APEI.net**
www.apei.net **479-443-5759**
"High Temperature Wireless Sensors Systems"

Abstract:

This presentation will include a brief overview of the company history and capabilities of APEI, Inc., and will then move into a high level discussion of various high temperature telemetry systems. The first system that will be discussed is based off of what can be considered a high temperature active RFID sensor, wherein a reader broadcasts induced power to the sensor/transmitter system, which acquires the sensor data and sends that data back to the reader. The second system that will be discussed is a fully drop in sensor for high temperature operation, which is power via a custom thin film thermal electric generator, and can be used to measure parameters such as vibration, pressure, temperature, and others. Finally, a few concluding remarks will be made about the state of advanced high temperature wireless electronics.

Background:

John received his B.S.E.E. from the University of Arkansas in 2005, and has spent the last six years in the development of extreme environment wireless systems. John has been heavily involved in the circuit, packaging, and system design of high temperature telemetry for several SBIR programs and commercial contracts. John's expertise includes high temperature packaging design, low temperature co-fired ceramic processing, high temperature materials, RF circuit design, as well as wireless telemetry system and circuit design using advanced semiconductor components. John has authored or co-authored over 12 publications, and currently holds two US patents, and has nine US patents pending, covering many aspects of high temperature telemetry systems. John is currently the lead wireless engineer at APEI, Inc., and is a partial owner.

2:00PM, June 6 - Day 1

Session 3 Presentation 3 **Penny Chen** **Princ. Systems Architect, Global Marketing**
Yokagawa Industry Automation, San Jose, CA **penny.chen@us.yokogawa.com**
www.yokagawa.com **408-636-8544**

"PWST Needs at Yokagawa"

Abstract:

Yokogawa has invested in wireless technologies decade ago, and has continue invest in wireless technologies for industrial automation. Recognizing the PWST sensing technology has its very unique characteristics, Yokogawa is in progress to investigate PWST. This presentation will introduce the basic PWST needs at Yokogawa. How PWST could potential become one of the very effective wireless technologies for industrial automation.

Background:

Dr. Penny Chen is a Principal Systems Architect at Yokogawa Industry Automation Global Strategic Technology Marketing Center in US (USMK). She is responsible for technology standardization, marketing strategy focusing on wireless, networking and related security, and exploring new technologies for industry applications. Penny is actively involving in ISA100 (Wireless Systems for Automation) and ISA Wireless Compliance Institute (WCI), and wireless convergence activities. She is currently the Vice-Chairman of WCI, Co-Chair of the ISA100.15 Wireless Backhaul Backbone Network Working Group. Over past thirteen years, Penny focused on wireless networking technologies and security solutions for a variety of wireless technologies include Bluetooth, WiFi, and 2G/2.5G/3G Mobile technologies. Penny received a Ph.D. in Electrical Engineering from Northwestern University.

3:00PM, June 6 - Day 1
Session 4 Presentation 1 **Mike Mets** **Manager, Nuclear Materials**
Savannah River Nuclear Solutions Aiken, SC **Organization & Engineering Support**
www.savannahrivernuclearsolutions.com **michael.mets@srs.gov 803-952-9578**
"PWST/RFID Technology for Material Control & Accountability at the Savannah River Site"

Abstract:

This presentation will cover the nuclear materials storage mission at the Savannah River Site near Aiken, SC. It will include an overview of the storage facility, the current material control and accountability systems, the challenges to implementing wireless technology in the facility and the needs for Passive Wireless Sensor Technology as relevant to the storage mission.

Background:

Mr. Mets is an employee of the Savannah River Nuclear Solutions Company at the Department of Energy's Savannah River Site located near Aiken, South Carolina. In his current position he serves as Manager of the Nuclear Materials Organization and Engineering Support group within the Process Controls and Automation Technology department. He has been employed by the site's prime contractor for 23 and one half years and held several engineering positions. His experience there includes design, construction and start up of the site wide personnel security and accountability system; design, implementation and support of computer control and high speed data acquisition systems for nuclear weapon system component testing and support of various nuclear material storage projects and facilities. Mr. Mets is also a retired Lieutenant Colonel from the United States Air Force Reserves where he held many engineering and leadership positions in computer system management, guided weapon development and air base infrastructure support. He holds a degree in Electrical Engineering from Auburn University, Auburn, Alabama graduating in 1984 and a masters degree in Business Administration from the University of West Florida, Pensacola, Florida graduating in 1988. Mr. Mets resides in Aiken, South Carolina, has been married to Mrs. Mindy Mets for nearly 27 years and the two have raised two sons, one currently in medical school and the other working towards an undergraduate degree in Computer Science.

3:30PM, June 6 - Day 1

Session 4 Presentation 2 **Dr. Ted Myers** **Chief Technology Officer**
Jake Rasweiler **Chief Strategic Officer**
On-Ramp Wireless, San Diego, CA **jake.rasweiler@onrampwireless.com**
www.onrampwireless.com **858-312-8397**

"Ultra-Link High Capacity, Long Range,Low Power Technology/Applications"

Abstract:

The presentation will discuss Ultra-link Processing - a wireless sensor and control communications protocol with high capacity and long range capabilities suitable for smart grid and process automation industries. Ultra-Link Processing(tm) is the first wireless system purpose-built to solve the challenges of device monitoring in metro-scale deployments and other challenging radio environments. The technology addresses problems, such as coverage, capacity, robustness, and coexistence that can limit the large-scale deployment of wireless devices. The fundamental development of the ULP technology fills a massive gap in wireless performance; the void between existing communications platforms of higher data rate licensed spectrum cellular systems and free spectrum short-range wireless radio platforms (e.g., 900 MHz Frequency Hopping Spread Spectrum (FHSS), 802.11, 802.15.4) with mesh networking.

Background:

Dr. Ted Myers(no photo) - Ted is a recognized expert in wireless communication systems and digital signal processing theory. He has a PhD and BS in Electrical Engineering from Virginia Tech and an MS in Electrical Engineering from the University of Maryland at College Park. Ted was a founder of CommASIC, where he developed the WBSP processor and its first application to the 802.11 a/b/g physical layer. Based on this architecture, the resulting chipset was a first-pass success and industry best in cost and power consumption, which led to the acquisition of CommASIC by Freescale Semiconductor. While at Freescale Semiconductor, Ted applied the WBSP processor architecture to various other wireless applications. Earlier in his career he led and/or contributed to numerous other physical layer designs for cellular applications and government satellite systems. Ted is a founder of On-Ramp Wireless and serves on the company's board.

Jake Rasweiller(photo left) - Jake has more than 18 years of engineering, sales and business development experience within the wireless communications industry. Jake is the Chief Strategy Officer for On-Ramp Wireless. Prior to joining On-Ramp Wireless, Jake was the CTO and VP Engineering for Arcadian Networks Senior Director for the New York Area and Northeast Design. He holds degrees in Physics, Electrical Engineering and Management, is a licensed professional engineer and has been awarded two patents.

4:00PM, June 6 - Day 1

Session 4 Presentation 3 **Chris Gibson** **Mgr of Marketing & Business Dev.**
VTI Instruments, Irvine, CA **cgibson@vtiinstruments.com**
www.vtiinstruments.com **949-955-1894**

"Integrating Passive Wireless Sensors with Existing Data Acquisition Systems"

Abstract:

Testing challenges require todays test engineer to have a number of tools available to properly capture test data in increasingly difficult environments. Channel counts are increasing, test times decreasing, and the need to reduce cost puts constant pressure on test engineers to utilize new and better methods. This presentation will discuss some of those challenges as well as some of the technology to allow test engineers the opportunity to utilize passive wireless sensors with existing cabled data acquisition systems.

Background:

Chris currently is a marketing and business development manager for VTI Instruments, working in the Lake Stevens Instrument group in Washington state. He provides sales and marketing support with a primary focus on the Data Acquisition products. Before joining VTI Instruments, Chris worked for Agilent technologies providing the technical support for the Agilent/HP VXI data acquisition products. Prior to joining Agilent, Chris worked in launch vehicle and spacecraft testing for 15 years as a system level test engineer. He has worked for both General Dynamics Space Systems Division and Lockheed Martin Astronautics. Chris's testing responsibilities included high level acoustic testing, modal testing, and pyro-separation and deployment tests, component vibration, and thermal cycling testing for a number of spacecraft and launch vehicle configurations. His test experience includes the Atlas and Titan/Centaur launch vehicles. Chris was also involved with a number of large-scale test programs from NASA including: Mars Global Surveyor, Mars Climate Orbiter, Mars Polar Lander, Stardust, Cassini and International Space Station. Chris is also an active board member of the Western Region Strain Gage Committee.

4:30PM, June 6 - Day 1

Session 4 Presentation 4 **Radek Zakrzewski** **Project Lead/Chairman**
Aerospace Vehicle Systems Institute, Project 73 **Radek.Zakrzewski@goodrich.com**
http://www.avsi.aero/research/current_projects.HTML **802-877-4757**

"Protected Spectrum for Wireless Avionics Intra-Communications"

Abstract:

Wireless Avionics Intra-Communications (WAIC) project is a collaborative industry activity aimed to secure a new world-wide radio frequency allocation for safety-critical wireless systems to be operated on aircraft. Recently, the project reached a major milestone when the 2012 World Radio-communications Conference (WRC) put WAIC on the agenda of the 2015 WRC. This talk will provide an overview of the WAIC effort and its current status, and will discuss prospects for obtaining protected spectrum for wireless avionics.

Background:

Radek Zakrzewski got his PhD degree in Electrical and Computer Engineering from Oregon State University in 1995, specializing in neural net-based optimal control. Since 1997 he has been with Goodrich Corporation, working on signal and data processing, sensor fusion and system optimization applied to aircraft sensing, monitoring, and diagnostic systems. At the 2012 PWST he is representing the Aerospace Vehicle Systems Institute Project 73, which he has been chairing since 2009.

8:00AM, June 7, Day 2

Session 5 Presentation 1 **Bruce Montgomery** **President**
Syntonics, LLC, Columbia, MD **Bruce.Montgomery@syntonicscorp.com**
www.SyntonicsCorp.com **410-884-0500x201** **410-913-2907(m)**

"Passive Wireless Sensing in a High-Multipath, High-Doppler Environment"

Abstract:

Syntonics has investigated the RF issues that arise from measuring strain inside an operating jet engine fan or compressor uing. Passive Wireless Sensing (PaWS™) technology. PaWS measures physical properties such as temperature, strain, pressure, etc. using unpowered surface acoustic wave (SAW) devices and radio frequency (RF) interrogation techniques. In an operating turbine, multiple reflections ("multi-path signal propagation") and Doppler shifting of the RF signals occurs along the many propagation paths, so that the RF signals to/from the sensor are corrupted and/or modulated. This situation presents a challenge for the PaWS system design.

Background:

Bruce G. Montgomery, founder and president of Syntonics LLC, has performed and managed defense and space technology development projects for 40 years. The first half of his career he worked with scientific spacecraft at Caltech's Jet Propulsion Laboratory (JPL) and the Fairchild Space Company (now Orbital Sciences). In 1995, Mr. Montgomery cofounded a technology company and then in 1999 founded Syntonics. He holds a BS, Engineering and Applied Science from the California Institute of Technology (Caltech); an MS, Civil Engineering from the California State University at Los Angeles; and an MBA from the Tepper School at Carnegie-Mellon University. Mr. Montgomery is a Registered Professional Engineer in Maryland, a senior member of the American Institute of Aeronautics and Astronautics (AIAA), a senior member of the Institute of Electrical and Electronics Engineers (IEEE), a member of the International Society of Automation, and was a founding Director of the Maryland Space Business Roundtable.

8:30AM Day 2

Session 5 Presentation 2 **Fred Gnadinger** **President & CEO**
Albdeo Corp, Colorado Springs, CO **fred@gnadinger.com**
www.albedo.com **719-337-4318**

"Wireless Passive Strain Sensors Based on Surface Acoustic Wave (SAW) Principles"

Abstract

Albido Corporation is employing surface acoustic wave (SAW) sensors to measure mechanical strain and transmit the data wirelessly over a distance of several meters. Albido's sensors are passive, accurate, sensitive, radiation hard and low cost. They are powered by an electromagnetic field emanating from a reader system. Multiple sensors can be powered by a single reader system. Albido has developed and patented a scheme to distinguish between strain and temperature. In addition to strain, other physical, chemical and biological parameters can be measured.

Background:

Fred Gnadinger came to Albido from COVA Technologies Inc., a semiconductor technology company he founded in 1996. Dr. Gnadinger was Executive Vice President and COO of Ramtron International Corporation, a public semiconductor company engaged in ferroelectric non-volatile memory products. Prior to Ramtron, Dr. Gnadinger worked for INMOS Corporation, a Semiconductor Company, as Vice- President of product development. Under his leadership INMOS developed a broad range of semiconductor memory devices (SRAM, DRAM and nvRAM) that generated (in the mid 1980's) a total of 150 M$ in annual revenues. Dr. Gnadinger holds 18 US Patents and several foreign patents. He authored more than 30 publications including a book chapter published by Academic Press, New York. He has also given many talks at Scientific Conferences and has been an invited speaker on several other occasions. Dr. Gnadinger received an MSEE degree from the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland and an MSEE and a Ph.D. degree in Electrical Engineering from the University of Kansas.

9:00AM, June 7 - Day 2

Session 5 Presentation 3 **Mauricio Pereira da Cunha** **Vice President & CEO**
Environetix, Orono, ME **www.environetix.com** **mdacunha@environetix.com**
207-581-2384

"Harsh Environment Wireless Sensor System for Monitoring Static & Rotating Components in Turbine Engines and Other Industrial Applications"

Abstract: Turbine engines, power plants, and oil/gas extraction machinery are examples of harsh environment applications which require and will significantly profit from high performance wireless sensor systems. Currently, very few sensor systems exist that can provide reliable operation at temperatures in the 500°C to 1000°C range, pressures up to 750 psi, and in highly reactive, explosive and/or toxic gas environments. In many applications, there is a critical need to monitor moving parts, thus requiring cable-free, wireless operation. For example, wireless sensors are highly desired to observe and control moving objects in high temperature zone furnaces or rotating rotors and blades at high accelerations. Yet, the conditions of harsh environment, high temperatures and pressures, exposure to aggressive gases, and wireless operation place major demands on sensor packaging, signal extraction, transmission, and processing. Environetix, a spin-off company from the University of Maine, has transitioned harsh environment surface acoustic wave sensor technology from a promising technology to the product level. The Environetix EVHT-100 sensor system provides: (i) Passive, battery-free, lightweight, harsh environment wireless microwave acoustic sensors and sensor arrays; (ii) Footprint down to a few mm^2 and around a gram in weight depending on the application; (iii) Stable, medium and long term (>1000 hrs) langasite (LGS) temperature sensor operation in the range 500°C to 1000°C (932°F to 1832°F) and pressure up to 750 psi; (iv) Sensor operation under severe thermal shock conditions (room temperature to >700°C within a few seconds); (v) Proprietary sensor attachment methodology which survives g-forces in excess of 50,000g on rotating parts of turbine engines; (vi) Capabilities of operation using sensor arrays for pressure, strain, and vibration. Environetix has installed harsh environment sensor systems for testing in the power and turbine engine industries, and the technology is available for application in a variety of other harsh environments. Results and capabilities of Environetix technology and products will be presented and discussed.

Background: Dr. Mauricio is Vice-Preseident and CEO of Environetix Technologies Corporation, a spin-off company from his team's research efforts on harsh environment wireless sensors and systems at the University of Maine. Mauricio was a Professor in the Department of Electronic Engineering, Universidade de São Paulo until he joined the Department of Electrical and Computer Engineering at the University of Maine in 2001, where he presently holds the position of Professor. A native of Brazil, now US Citizen, he received his B.S., M.S. in EE at Escola Politécnica, Universidade de São Paulo and PhD in EE McGill University, Montreal, PQ, Canada. His work experience includes the Micro-Electronics lab at the university in São Paulo and Microwave Devices R&D Group at NEC (Nippon Electric Co.) in Brazil, McGill University, and SAWTEK, Orlando, FL. His sabbatical at University of Central Florida included work with Piezotechnology Inc in characterizing new piezoelectric materials, namely langatate, langanite, and langasite, and with bulk and surface acoustic wave devices. Mauricio has over 170 journal and conference publications/presentations, and leads and participates in a variety of applicable professional organizations.

9:30AM, June 7 - Day 2		
Session 5 Presentation 4	**Mike Newton**	**Director of Strategic Technology**
nScrypt Inc., Orlando, FL		**mNewton@nscryptinc.com**
www.nscryptinc.com		**407-275-4720**
"Passive Direct-Write Sensors"		

Abstract: In a recent article by the Economist, they predict that 3D additive manufacturing will be the 3rd industrial revolution. Additionally the convergence of additive manufacturing technology with printed electronics can enabled the development of novel passive sensor functionality integrated as part of a systems structure. This presentation will provide an overview on the technology of direct print additive manufacturing (DPAM) for the development of embedded passive sensing capability as well as an integrated RF front end and antennas providing a communications capability. Traditional electronic packaging for UAV or space systems has the volumetric overhead of mechanical fasteners, harness and connectors. In order to improve the size weight and power requires volumetric efficiencies and the desire for added electronic capability. DPAM is a new paradigm with the potential of eliminating traditional packaging with material and integrated 3D device technology that ultimately are part of the system structure.

Background:

C. Mike Newton has over 30 years experience in the areas of advanced microelectronics and Microsystems technologies. He has built and managed a number of fabrication and research labs serving both commercial and more recently government markets. He has scaled up ceramic thick film and LTCC products for both the commercial and military industries. Currently, he is co-founder and V.P. of Integration Technology for 3D Monolithix Corporation based in El Paso Texas. The company is focused on 3D manufacturing of components subsystems and platforms serving the Military and commercial UAV industry. He has served as Director of Strategic Technology at nScrypt is developing transition opportunities into the 3D structural and printed electronics market space for functional device fabrication. Prior to joining nScrypt, he served as Chief Technologist – Microsystems with the Microelectronic Core Technology Group at Harris Corporation. In this position, he led strategic technology pursuits into the DoD and more specifically into DARPA. He currently has 42 patents in microelectronics, sensors, MEMS and antenna technologies. He has written and presented on the topic of printed electronics and is the General Chair of the 3D and conformable Printed Electronics Workshop sponsored by the International Microelectronics and Packaging Society (IMAPS). He has also served as an IMAPS Regional Director, Florida Chapter President and currently the Executive Council Vice President of Technology.

10:30AM, June 7 - Day 2

Session 6 Presentation 1 **Paul Hartmann** **Vice President for Engineeering**
RF SAW, Inc. Dallas, TX **phartmann@rfsaw.com**
www.RFSAW.com **469-227-0322**

"Advances in SAW Devices for Sensing and RFID Applications"

Abstract:

RF SAW Inc. has developed Surface Acoustic Wave sensors that overcome the problems of limited ID numbers, restricted reading range, and lack of anti-collision. These issues have limited the widespread deployment of SAW based RFID and temperature measurement systems. Uses of SAW devices for RFID applications have been know since the 1970's. Despite the high speed reading capabilities and harsh environment range that these devices can withstand, the deployment has been limited by the inability to produce a large number of unique RFID codes and to read more than one tag in the read field at one time. This presentation describes recent advances in SAW design for RFID and temperature sensing based on the Global SAW Tag (GST) system that overcomes both of these limitations.

Background:

Paul is Vice President, Engineering for RF SAW, Inc. in Dallas, Texas. Prior to joining RF SAW, Hartmann spent 13 years as the founding Vice President of Engineering and CTO of Applied Digital Access in San Diego and 25 years at Collins Radio/Rockwell International in Richardson, Texas. His technical career has focused on the design of microwave communications systems, embedded network monitoring systems, and RF system design and integration. Hartmann is a Senior Life Member of the IEEE and was the founding chair of the IEEE Technical Committee on RFID (CRFID) and the current Past Chair of that committee. He has served as the vice chair of the founding organizing committee for the IEEE International Conference on RFID in 2007 and has been a member of the steering committee for this series of conferences now in its sixth year. He has also served on the Board of Governors of the Communication Society and was the Technical Program Chair of IEEE Globecom 1989. Hartmann holds a B.S.E.E. from the University of Texas at Austin and an M.S. in Management and Administrative Science from the University of Texas at Dallas.

11:00AM, June 7 - Day 2
Session 6 Presentation 2 **Jackie Hines** **President**
ASRDC Corp, Arnold, MD **jhines@asrdcorp.com**
www.asrdcorp.com **410-544-4664**
"PWST SAW-Sensor Systems"

Abstract:

This presentation describes the development, operating principles, and experimental operation of sixteen uniquely identifiable, wirelessly interrogable, passive surface acoustic wave (SAW) humidity sensors, and a prototype wireless interrogation system capable of reading the set of sensors and interpreting individual sensor responses. Recent advances in coding and sensor diversity techniques that enable better code anti-collision are described, including a set of 32 individually identifiable temperature sensors, and a set of 100 sensor-tags. A set of sixteen SAW sensors were produced, using a combination of discrete frequency coding (DFC) and time diversity, that can operate simultaneously in groups of 8 or more while retaining the ability to individually identify and read each sensor. Nanostructured polyvinyl pyrrolidone/ lithium chloride doped titanium dioxide sensing layers developed in collaboration with researchers from Temple University were utilized to produce sensors that demonstrate large, rapid, reversible quantitative responses to humidity exposure in laboratory conditions. The transceiver implemented a novel differential time integrating correlator-based interrogation system architecture. The system operates in a manual mode for sensor selection, and utilizes a PC-based LabView user interface for data acquisition and system control. This system was shown to be capable of reading the humidity sensors wired and wirelessly over short range under laboratory conditions and was successfully demonstrated at Kennedy Space Center in Nov, 2011.

Background:
Jackie Hines received her BS from Cornell and a M.S. & Ph.D in from the University of Central Florida. Jackie served on active duty in the U.S. Navy from 1984 though 1988 as an instructor at the U.S. Naval Nuclear Power School in Orlando FL and in the Reserves achieved the rank of Lt. Commander. At Sawtech, Jackie established and managed a SAW-based chemical sensor with ARPA and DOE support which was demonstrated at DOE's Savannah River Site in June 1998. It was capable of detecting, identifying, and quantifying volatile organic chemical vapors alone and in mixtures of up to two vapors plus water. Jackie served as Sawtech's Manager of Research and Development for over 10 years until she left to found her own consulting company in 2000. In August of 2005, having served as PI on two NASA contracts, Jackie founded Applied Sensor Research & Development Corporation to commercialize passive wireless acoustic wave sensor technologies. Located outside Annapolis MD, ASR&D is an application engineering and contract research firm specializing in innovative chemical, biological, and physical acoustic wave sensor technologies for government and industrial clients. Jackie has been active in a wide range of professional activities, and currently serves as President of the Administrative Committee (ADCOM) of the IEEE Ultrasonics, Ferroelectrics, and Frequency Control Society (UFFC-S).

11:30AM, June 7 - Day 2

Session 6 Presentation 3 **Don Malocha** **Professor**
University of Central Florida, Orlando, FL **malocha@mail.ucf.edu**
http://caat.engr.ucf.edu **407-823-2414**

"SAW PWST: 915 Mhz Sensor System and Demonstrations"

Abstract - Wireless ubiquitous sensing is the goal for space vehicles and exploration, for industrial, commercial and home building monitoring and control, and for transportation vehicles and infrastructure monitoring. One of the primary hurdles for acceptance of the wireless SAW sensor devices into a wide variety of applications is the transceiver, also often referred generically as a "reader". The ideal reader would be device-signal format independent, low cost, small, rugged, and have 10-100 meter range. This paper will discuss theoretical and practical applications of a coherent correlator transceiver (CCT) system approach for SAW RFID sensors, with the vision toward low cost sensing. For high volume applications, it appears achievable to meet the ultimate system goals and costs with RF device integration. As with most technologies, the sensor device and system volumes will drive the cost down, and it seems reasonable to expect a similar product cycle as with SAW filters. Theoretical predictions of range, SNR, and correlation properties will be shown for differing system parameters, such as bandwidth, power, coherent integration, and ADC parameters. A comparison of SAW device resonant, CDMA and OFC type signal formats will be given and an approach for signal detection and extraction discussed. Recent measurement results for a 915 MHZ, 64 MHz bandwidth, CCT system using OFC SAW temperature sensors, gas sensors, and ranging will be given and compared to predictions. Results demonstrate the implementation of the system architecture and it seems practical that either low power short range, or high power long range, sensing is achievable.

Background:

Donald C. Malocha is a Pegasus-Professor in the Electrical and Computer Engineering Dept., University of Central Florida (UCF), Orlando. Don received a joint BS in EE & CS, an MS in EE, and Ph.D. in EE from the University of Illinois, Urbana. He was member of the technical staff (MTS) at Texas Instruments Corporate Research Laboratory, Mgr. of Advanced Product Development, Sawtek, and an MTS at Motorola. He has been a Visiting Scholar at the Swiss Federal Institute of Technology, Zurich (ETH), Switzerland, and the University of Linz, Austria. He is a member emeritus of the Electronics Industries Association (EIA) and was a member of the Board of Directors of Piezo Technology, Inc. until merged as Mtron-PTI. He has and does have active leadership roles in IEEE-UFFC. He serves on the Technical Program Committees (TPC) of several major Techical forums. He has over 200 technical publications, 12 patents awarded, and several pending and has numerous awards to his credit. Don is a Fellow of the Institute of Electrical & Electronics Engineers (IEEE). His current research interests include solid–state devices, surface acoustic wave (SAW) and bulk acoustic wave (BAW) technology, sensors and wireless radio frequency identification systems. He is advisor for 37-MS and 19-PhD current or former students.

1:00PM, June 7 - Day 2		
Session 7 Presentation 1	**Heimo Mueller**	**Senior Account Manager, R&D**
Carinthian Technology Research, Villach, Austria		**heimo.mueller@CTR.at**
http://www.ctr.at/en/r-d-technologies.html		**43 (0)4242 56300 213**
"SAW Sensors: Explore New Measurement Horizons"		

Abstract:

A little piece of piezocrystal with some metal structure on it is going to expand the scope of standard semi-conductor sensors. Being passive, wireless and designed for harsh environment SAW sensors can already be used up to 400°C (752°F) for measuring temperature, pressure, force or strain. In the near future these sensors will be able to stand temperatures up to 600°C (1112°F) and comply to 433MHz standards. The latest results of ongoing R&D projects did proof the feasibility of a 1000°C (1832°F) SAW sensor. Different applications from the steel-, automotive-, energy- and food-industry will be shown and new results from R&D projects will be presented.

Background:

Mr. Heimo Mueller received his M.Sc. in Electro & Biomedical Engineering from the University of Technology in Graz, Austria. Prior to joining CTR in 2003 he worked as an International Sales Manager, Network Distribution Manager and Senior Product Manager for international high-tech companies, producing complex equipment for the medical industry as well as the pharmaceutical industry. As a Senior Account Manager at CTR, Mr. Mueller focuses on setting up R&D projects in the field of wireless SAW sensors with national and international partners as well as promoting the existing CTR SAW sensors for applications in all kinds of heavy industries.

1:30PM, June 7 - Day 2		**Marketing Mgr & Systems Technical Dir**
Session 7 Presentation 2	**Sabah Sabah**	**Wireless SAW Sensor Systems**
Vectron Inc, Hudson, NH		**ssabah@vectron.com**
www.vectron.com; www.sengenuity.com		**(603) 577-6751**

"Vectron Wireless Temperature Monitoring Solutions"

Abstract:

The Surface Acoustic Wave (SAW) propagation mode is characterized by velocities typically five orders of magnitude below electro-magnetic waves with amplitudes in the order of nanometers and wavelengths in micrometers. Basically as the acoustic wave propagates through or on the surface of the crystal substrate, any changes to the characteristic of the propagation path affect the velocity of the wave. Changes in velocity can be monitored by measuring the frequency or phase characteristics of the sensor and can be correlated to the corresponding physical quantity being measured. The key advantages of using Surface Acoustic Wave (SAW) components as the basis for a temperature sensor are the **wireless** and **passive** operational attributes which means that no cables or external power supplies (nor battery) are needed to operate the sensor. By connecting a small antenna to the Surface Acoustic Wave (SAW) device's InterDigital Transducer (IDT), the sensor can be powered remotely by the energy of a radio wave pulse emitted by a transceiver. SAW passive temperature monitoring solutions open up many new application areas. It offers many advantages compared to traditional thermometers and temperature monitoring solutions. The fact that the system is battery-less and wireless significantly decreases the environmental impact of battery replacement as well as reducing the total operating cost and enhances ease of use.

Background:

Dr. Sabah Sabah is the Product Marketing Manager and Technical Director at Vectron International. He is responsible for providing strategic and technical leadership to advance the wireless passive SAW physical sensors.Dr. Sabah, for many years, has led the research activities as principle scientist at Vectron International; he is the author and coauthor of many publications and is the inventor and co-inventor of numerous patentsDr. Sabah joined VECTRON International in 1999 as senior Surface Acoustic Wave (SAW) RF design engineer. He has in-depth experience in developing Waveguide, Micro-strip and SAW based RF passive components and sensors. His research interests are microwave, SAW, BAW, MEMS and FBAR resonators, passive wireless sensors, energy harvesting, FEM modeling and small antennas. Dr. Sabah received his PhD. and Diploma (Dipl. Ing. / Msc.) in electrical engineering from the Technical University of Berlin, Germany in 1995 and 1999 respectively.

2:00PM, June 7 - Day 2

Session 7 Presentation 3 **Isaac Ehrenberg** **Research Assistant**
MIT Auto-ID Labs, Cambridge, Mass **yitzi@MIT.EDU** **201-390-6168**
http://web.mit.edu/rahul_b/www **Rahul Bhattacharyya** **rahul1782@gmail.com**
"RFID Tag Antenna-Based Systems" **617-997-9803**

Abstract:

Large-scale deployment of sensors could greater improve many areas such as infrastructure condition monitoring and supply chain management. However, many of today's wireless sensor technologies are still too expensive to meet this need. Radio Frequency IDentification (RFID) offers good potential for the development of pervasive sensors. This talk will introduce the concept/RFID Tag Antenna-Based Sensing (RFID TABS). This approach builds upon current developments in RFID technology, utilizing simple, low cost RFID tags to design sensors that not only confirm the presence of objects, but report and store the state of important assets.

Background:

Isaac grew up in suburban New Jersey, and has studied physics and mechanical engineering, earning a master's degree in 2009 from the Massachusetts Institute of Technology, where he is currently a PhD candidate. Isaac is a research assistant working with the MIT AutoID Lab, under Dr. Rahul Bhattacharyya, where he focuses on RFID applications and improving RFID antenna performance in harsh environments.

3:00PM, June 7 - Day 2

Session 8 Presentation 1 **Kourosh Pahlavan** **CEO & CTO**
TagArray, Palo Alto, CA **kourosh@tagarray.com**
www.tagarray.com **650-251-4400 x 202**

"Passive UWB: Long Range, Low Cost and Precise Location"

Abstract:

Ultra Wideband radio has outstanding characteristics among which low power, high bandwidth, immunity to multipath fading, simplicity and extreme signal acuity are directly advantageous to wireless sensing. We have been able to create and patent a passive UWB radio that scavenges its power from incident RF waves coming from as far as 10 meters away and transmits its data to as far as 100 meters away. The peak power dissipation for the whole chip, including memory, logic and transceiver stage is 2uW. The low power makes it possible for the chip to run on many sources of ambient energy at extremely low cost and small size. The single largest benefit of this technology is that these passive tags can be located with 2-3 inches of accuracy within a range of 100 meters. Currently, we have engineering samples and a complete end to end solution in a demo station set up for location determination in our Palo Alto office.

Background:

Kourosh Pahlavan holds a PhD in CS from Royal Institute of Technology(KTH), Sweden. He has been a research professor at KTH, Director of Research at Ericsson Research, Co-founder and CTO at RedJade, Chief Architect at Leap Wireless International, CTO at Inter-4 and is currently CEO and CTO at TagArray Inc. His areas of interest are ultra low power transceivers and communication protocols, Computer Vision and Robotics, as well as Product Design.

3:30PM, June 7 - Day 2
Session 8 Presentation 2

Don Kimball — **Chief Technology Officer**
MaXentric LaJolla, CA — **dkimball@maxentric.com**
www.maxentric.com — **858-272-8800**

"60 GHz Comm, RFID Moving to PWST"

Abstract:

V-band (60 GHz) has physical characteristics that makes it an excellent candidate for wireless communication and PWST. In this talk we will go over these characteristics and show implementation of a communication (ViFi) and PWST (VERA) systems. ViFI is a wireless system that utilizes the advantages of a V-band (60 GHz) technology while addressing the previously listed challenges. Our technology incorporates different techniques to utilize the 60GHz band, such as dynamic beam-forming, ad-hoc networking as well as spatial transmit and receive diversity created by the presence of multiple antennas configured for a particular application scenario. VERA, V-band Enhanced RFID, is label based and chip-less solution that is based on resonant fiber arrays The core concept utilized by VERA is to create a unique Radio-Frequency fingerprint through distinct configurations of numerous thin and narrow metal strips embedded on a substrate material such as paper, wood, or plastic.

Background:

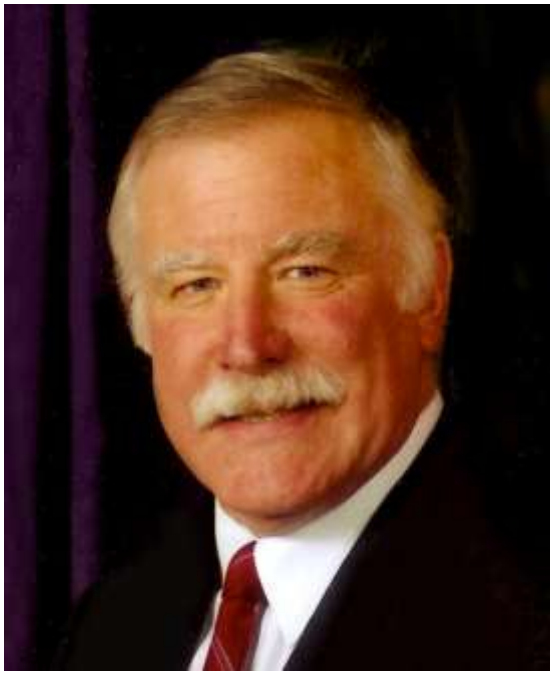
Chief Technology Officer (CTO) at MaXentric Technologies, LLC, Donald Kimball is responsible for establishing MaXentric's technical vision and leading all aspects of the company's technology development. He has over twenty-five years of experience in the design and development of wireless communication systems and technical research in advanced communication schemes. Mr. Kimball has been involved in research and development of wireless communication systems including design of wireless communication transmitters and receivers at the physical layer. His main area of expertise is in High Efficiency Power Amplifiers, Linearization Schemes, Power Management, and Electromagnetic Compatibility. Currently, he is involved in the design and creation of high efficiency high linearity wide band power amplifiers and advanced modulation techniques.

In the recent past, he was a researcher and lab manager for the University of California San Diego (UCSD) at the California Institute for Information Technology and Telecommunications (Calit2). At UCSD he developed research platforms that established UCSD as a world leader in high efficiency microwave communication radios. Prior to his appointment at UCSD, Donald worked at Ericsson Wireless Communications, Qualcomm Inc., Data Products Corporation, and Data General Corporation. During this time Donald worked on Electromagnetic Compatibility in severe environments, and TEMPEST compliance for secure computing systems. Mr. Kimball has a Bachelor and a Master's of Science Degree in Electrical Engineering with emphasis on radar and communications from The Ohio State University. He holds 8 United States Patents in the area of microwave power amplifiers with 3 additional patents pending. Donald is also the author of over 39 peer reviewed technical papers.

4:00PM, June 7 - Day 2		
Session 8 Presentation 2	**John Conkle**	**President**
Wireless Sensor Technologies, Encinitas, CA		**jrconkle@att.net**
"Wireless Sensors for Gas Turbine Engines"		**(408) 234-3741**

Abstract:

Gas turbine engines present a particularly challenging environment for sensors. Consider temperatures that can exceed 1200C, accelerations up to 50,000 G's, and rotating components that make the use of wired sensors difficult since slip rings are inherently noisy and unreliable and only a limited number of sensors can be accommodated. A class of wireless sensors have been developed that address the operational environment using passive, RFID-like sensors that can be deposited on turbine blades or other surfaces and offer long term, reliable operation. This RF circuitry is" printed" on the surface similar to the processes used to make integrated circuits such that their mass and size are sufficiently small that they do not alter the vibrational modes of the blade on which they are mounted. They are totally passive, requiring no external power to operate. They operate by receiving an interrogating signal, modulating it with the parameter value being monitored, and re-transmitting the modulated return signal to a receiver/signal processor for measured parameter estimation. This presentation details the operation of these sensors for temperature measurement. It describes their design and fabrication and details several applications for their use.



Background:

John Conkle is a founder and the President of Wireless Sensor Technologies, LLC (WST). Mr. Conkle is an experienced technology leader possessing a broad range of executive, senior management, and technical skills and experience in information and wireless companies. He has an extensive background in starting and growing technology businesses. During the past twenty-five years Mr. Conkle has focused on wireless systems and products having developed manpack equipment for the military for signal intercept and geolocation, cellular distribution systems to allow wireless reception in tunnels and large buildings, and mobile communications systems for training range applications. At WST, Mr. Conkle is developing temperature and pressure sensors for harsh operational environments like the gas turbine engine, and energy harvesting-powered wireless networks for condition monitoring applications.

4:30PM, June 7 - Day 2

Session 8 Presentation 3 **Scott Hyde** **Marketing Mgr for Strategic Propulsion**
Aerojet, Clearfield, UT **www.aerojet.com** **Scott.Hyde@Aerojet.com**
801-774-2474
801-745-7449

"A System Engineering Simulation Tool and Data Base Proposal for Optimizing the Application of Wireless Sensors"

Abstract:

The world is continually becoming more and more integrated. Technology advancement persists at a rapid pace. However, it remains difficult to insert new technology into established systems. The emerging market of machine-to-machine (M2M) communications has documented some of these obstacles as follows; 1) Communication congestion from too much data or too little bandwidth, 2) System inflexibility because change is expensive and time consuming and 3) Initial system acquisition costs slow market growth. Creating robust multi-mode system simulation capabilities will allow developers to address these issues efficiently in a low cost virtual environment. Simulations can assist developers to explore trade space and performance of competing hardware before having to invest in the hardware itself. Once a system is physically in place and functioning, simulation could identify effects of replacing obsolete hardware as well as the impact of changing requirements. One of the barriers to being able to perform virtual system trade study simulations is not having ready access to sensor data. The Chemical Propulsion Information Analysis Center (CPIAC) has recognized the need for a combined Government, Industry, and Academia sensor database and has initiated it creation. Once sensor data is populated into the database it will facilitate development of systems engineering tools that allow users to perform detailed sensor system simulations and remove many of the current entry barriers.

Background

Richard (Scott) Hyde is Marketing Manager for Strategic Propulsion at Aerojet Corporation in Clearfield, Utah. Scott has had a passion for Integrated Vehicle Health Management technologies and has contributed to their development and implementation throughout his aerospace career. He has spent 25 years working on improving the management of solid rocket motor systems, working for companies like Thiokol and ATK in positions like: Manager Integrated Vehicle Health Management Department, Technical Programs Manager, Chief Engineer, Minuteman Programs, and Structural Analyst, Trident D5, Minuteman and Small ICBM Programs.