

Advance Program

Tuesday, 12 September 2006

8:00 AM - 9:45 AM

Session TuA: **OPENING**
Session Co-Chairs: Mark W. Beranek, *Naval Air Systems Command, Patuxent River, MD, USA*
 Michael J. Hayduk, *US Air Force Research Laboratory, Rome, NY, USA*

8:00 AM - 8:15 AM **OPENING REMARKS**

TuA1 8:15 AM - 8:45 AM (Invited)

Challenges to the Air Transport Industry for Implementing Fiber Optics, D. Martinec, *ARINC, Annapolis, MD, USA*

The air transport industry recognizes the benefits that may be realized from the use of fiber optics by aircraft systems. However, numerous challenges have been recognized and the means to resolve them are being developed in order to take advantage of this evolving technology.

TuA2 8:45 AM - 9:15 AM (Invited)

A Perspective on Reliability of Military Avionics Fiber Optic Networks, A. Avak, *Naval Air Warfare Center Aircraft Division, Patuxent River, MD, USA*

How reliability of military avionics is measured can affect how the hardware is designed. Keeping these measurements in mind can produce better fiber optic systems for the soldiers and sailors who use them.

TuA3 9:15 AM - 9:45 AM (Invited)

The Practical Side of Technology Transfer, J. Mazurowski, *Pennsylvania State University, Freeport, PA, USA*

Technology transfer is the application of new ideas into products. There are several applicable metrics used to guide decisions about readiness. It is important to involve stakeholders from the technology side and the application side.

9:45 AM – 10:15 AM **COFFEE BREAK**

10:15 AM - 12:15 PM

Session TuB: **ARCHITECTURES**
Session Co-Chairs: Drew Glista, *Liteboard Technology, Annandale, VA, USA*
 Rick C. Stevens, *Lockheed Martin, Eagan, MN, USA*

TuB1 10:15 AM - 10:45 AM (Invited)

Activities of the Joint Fiber Optic Working Group (JFOWG), M. J. Hackert and O. Muja, *Naval Air Systems Command, Patuxent River, MD, USA*

The Joint Fiber Optic Working Group (JFOWG) provides the US military services utilizing optical fiber for aerospace networking with a forum for identification and resolution of transition issues. This paper discusses its purpose and accomplishments.

TuB2 10:45 AM - 11:15 AM (Invited)

Avionic Architectures Incorporating Optical Fibre Technology, A. Lee and S. D. Rayner, *Westland Helicopters Ltd., Yeovil, Somerset, UK*

Avionics architectures are today facing tough challenges with escalating data-rates and connectivity requirements. This paper investigates the needs of future avionics architectures and how fibre optics will be a key enabling technology.

TuB3 11:15 AM - 11:45 AM (Invited)

Fiber Optic Communication within the F-35 Mission Systems, J. Levis, B. Sutterfield and R. C. Stevens, *Lockheed Martin, Eagan, MN, USA*

The F-35, Joint Strike Fighter (JSF), aircraft is designed with a highly capable and flexible Mission Systems architecture. At the heart of this architecture is a fiber optic interface that provides the necessary bandwidth.

TuB4 11:45 AM - 12:00 PM

WDM for Platforms: From Systems Architectures to Systems-on-Chips, W. P. Krug, *Boeing Company, Seattle, WA, USA*

Switched, digital and RF, point-to-point links from discrete components must evolve into highly integrated, reconfigurable, WDM bus and mesh system architectures that support scalable throughputs and minimum latencies, multicasting, and fault tolerance, across a range of platforms.

TuB5 12:00 PM - 12:15 PM

Air Force Highly Integrated Photonics (HIP) Program, M. Horne, G. J. Whaley, H. Schantz and S. Newcomer, *Lockheed Martin, Eagan, MN, USA*

This presentation will describe the Air Force Highly Integrated Photonics Program (AF HIP) and its objective to integrate on a monolithic device, all of the optical components required to serve as node in an all optical communication network.

12:15 PM – 1:45 PM

LUNCH BREAK

1:45 PM - 3:45 PM

Session TuC: NETWORKING

Session Co-Chairs: Michael J. Hackert, *Naval Air Systems Command, Patuxent River, MD, USA*

William P. Krug, *Boeing Company, Seattle, WA, USA*

TuC1 1:45 PM - 2:15 PM (Invited)

Mixed Analog-Digital WDM Local Area Networks, N. M. Froberg, J. L. Prince, *Photonic Systems, Inc., Billerica, MA, USA*, J. Zhang and T. E. Darcie, *University of Victoria, Victoria, BC, Canada*

This paper discusses potential sources of impairment in mixed analog/digital WDM LANs. Some effects that are negligible in all-digital WDMs networks may be detrimental to analog signals with stringent noise and linearity requirements.

TuC2 2:15 PM - 2:45 PM (Invited)

Advances in WDM LAN Standards Development for Aerospace Applications, S. F. Habiby, *Telcordia Technologies, Inc., Red Bank, NJ, USA*

This paper reviews advances in the development of WDM LAN standards. Focusing on standards for aerospace applications, the paper provides a synopsis of the scope, charter, recent activities and key liaisons of the SAE's WDM LAN working group and it highlights associated WDM technology and standardization challenges.

TuC3 2:45 PM - 3:00 PM

Wavelength Allocation Strategies in Optically Switched Networks for Avionics, C. B. Reardon, J. Profumo and A. George, *University of Florida, Gainesville, FL, USA*

An existing WDM optical switching architecture to be considered for networks on avionics platforms is presented and analyzed. Two strategies for wavelength allocation in this architecture are presented, are compared in simulative experiments. Additional experiments analyze the effects of varying two key architecture parameters with each approach.

TuC4 3:00 PM - 3:15 PM

Routing in an Optical Local Area Network using Wavelength Conversion, C. N. Jessop, B. Jenkins and R. Voigt, *US Naval Academy, Annapolis, MD, USA*

This project investigates the use of all-optical wavelength conversion to perform routing in an optical LAN. With wavelength conversion, a reduction in network latency of over 55% was achieved over optical-electrical-optical conversion for digital signals with a 2 dB power penalty.

TuC5 3:15 PM - 3:30 PM

Physical-layer Modeling and Simulation of WDM Fiber Optic Network Architectures for Aerospace Platforms, B. K. Whitlock, *RSoft Design Group, Inc., Milpitas, CA, USA*, H. N. Poulsen, *University of California - Santa Barbara, Santa Barbara, CA, USA*, D. H. Richards, *RSoft Design Group, Inc., Ossining, NY, USA* and D. J. Blumenthal, *University of California - Santa Barbara, Santa Barbara, CA, USA*

We report on architectural requirements for an avionics WDM network, a proposed reference architecture, metrics required from modeling and simulation, and physical-layer simulation studies of this reference architecture.

TuC6 3:30 PM - 3:45 PM

Development of Pulse Position Modulation/Optical CDMA (PPM/O-CDMA) for Gb/s Fiber Optic Networking, A. J. Mendez, *Mendez R&D Associates, El Segundo, CA, USA*, V. J. Hernandez, *Lawrence Livermore National Laboratory, Livermore, CA, USA*, R. M. Gagliardi, *University of Southern California, Los Angeles, CA, USA*, C. V. Bennett and W. J. Lennon, *Lawrence Livermore National Laboratory, Livermore, CA, USA*

PPM has the advantage that bit decisions are based on comparison tests rather than threshold tests. The O-CDMA overlay permits multiple asynchronous users. We demonstrate PPM/O-CDMA for a Gb/s technology demonstrator based on 2D codes.

5:00 PM – 7:00 PM

WELCOME RECEPTION

Wednesday, 13 September 2006

8:30 AM - 9:45 AM

Session WA:

SUPPORTABILITY

Session Co-Chairs:

Michael J. Hackert, *Naval Air Systems Command, Patuxent River, MD, USA*

Daniel N. Harres, *Boeing Company, St. Louis, MO, USA*

WA1 8:30 AM - 8:45 AM

On Aircraft Repair - Fact or Fiction?, A. Voizey, *AVOptics Ltd., Yeovil, Somerset, UK* and J. S. Cotterill, *AIRBUS UK, Filton, Bristol, UK*

As fibre optic applications on aircraft become more prevalent so does the requirement for supporting repair and maintenance techniques. This paper looks at the techniques that can make on-aircraft repair a reality.

WA2 8:45 AM - 9:00 AM

The Sidelighter: A New Dead-Zone Free Distance to Fault Fiber Optic Cable Measurement System, A. Paoella, *Artisan Laboratories Corporation, Chalfont, PA, USA*

Artisan Laboratories Corporation has developed a "dead-zone free" high resolution fiber optic measurement system called the Sidelighter that has 10 cm resolution; optical dynamic range of >40 dB and dead-zone free operation.

WA3 9:00 AM - 9:15 AM

Incoherent Optical Frequency Domain Interferometry for Avionics, M. Dagenais, A. N. Chryssis and S. Sahand, *University of Maryland, College Park, MD, USA*

Incoherent frequency domain reflectometry is a particularly well-suited technique for built-in test related to fiber flaw detection in avionic fiber networks. A large optical dynamical range is demonstrated and a spatial resolution of 10 cm is obtained.

WA4 9:15 AM - 9:30 AM

Correlation based Approach to Fiber Reflectometry using Commercial Off-the-Shelf Components, L. A. Johansson, M. L. Masanovic and J. S. Barton, *Freedom Photonics, LLC, Goleta, CA, USA*,

A concept demonstration of a code-correlation OTDR reflectometer is performed with improved sensitivity and <1cm resolution. It is shown that this approach can exceed conventional OTDR techniques in performance and eliminate dead-zones in the measurement, while being based upon commercially available optical component technology.

WA5 9:30 AM - 9:45 AM

Optical Frequency Domain Reflectometry for Single- and Multi-Mode Avionics Fiber-Optics Applications, B. J. Soller, *Luna Technologies, Blacksburg, VA, USA*

In this talk, we will introduce a commercially available optical frequency domain reflectometry (OFDR) technique and its applications in avionics fiber-optics. We will provide multiple measurement examples within the avionics field not currently supported by conventional test tools or methods including high-resolution fault detection and distributed fiber sensing.

9:45 AM – 10:15 AM

COFFEE BREAK

10:15 AM - 12:00 PM

Session WB:

ANALOG/RF

Session Co-Chairs:

E.W. Jacobs, *SPAWAR Systems Center, San Diego, CA, USA*

Gregory Abbas, *EOSpace Incorporated, Redmond, WA, USA*

WB1 10:15 AM - 10:45 AM (Invited)

Optical Routing and Multicasting of Multiservice RF over Fiber Signals, R. V. Penty, X. Qian and I. H. White, *University of Cambridge, Cambridge, UK*

This talk will describe multiservice radio over fiber switch architectures for the routing and distribution of analog signals such as terrestrial digital TV and wireless LAN. Using a 3x3 SOA-based switch, we demonstrate routing with a switching guard-band of only 500ns.

WB2 10:45 AM - 11:15 AM (Invited)

Coherent Optical Techniques for High Dynamic Range Photonic Links, T. R. Clark and M. Dennis, *Johns Hopkins University, Laurel, MD, USA*

We explore the application of coherent optical techniques to high dynamic range analog signal transport, review the advantages and disadvantages, and present recent progress toward the experimental realization of a coherent optical phase-encoded analog link.

WB3 11:15 AM - 11:30 AM

Optical Amplification in Avionic Analog Photonic Links, V. J. Urick and F. Bucholtz, *US Naval Research Laboratory, Washington, DC, USA*

The performance capabilities of short-length analog photonic links employing optical amplification are detailed. It is shown that performance near the shot-noise limit is achievable in links employing compressed erbium-doped fiber amplifiers.

WB4 11:30 AM - 11:45 AM

10 Gb/s Coherent System Deploying Stable, Low Linewidth Phase Locked Loop, D. Becker, C. Wree, D. Mohr and A. Joshi, *Discovery Semiconductors, Inc., Ewing, NJ, USA*

We demonstrate a coherent heterodyne receiver module with -31 dBm sensitivity for unpreamplified 10 Gb/s on/off keying. An automatic frequency control loop was implemented for field deployability and operational simplicity and reliability.

WB5 11:45 AM - 12:00 PM

Tunable Narrow Band Filters for RF Photonics, B. E. Little, W. Chen, S. T. Chu, W. Chen, J. V. Hryniewicz, D. Gill, O. King, F. Johnson, R. Davidson, K. Donovan and J. Gibson, *Nomadics, Little Optics Division, Annapolis Junction, MD, USA*

We demonstrate compact, narrowband and tunable high-order microring resonator filters suitable for RF photonic applications. Sixth-order filters having bandwidths of 1.5 GHz, out-of-band optical rejection ratios > 60 dB, and on-chip losses < 2 dB are highlighted.

12:00 PM – 1:30 PM

LUNCH BREAK

1:30 PM - 3:45 PM

Session WC: TRANSCEIVERS

Session Co-Chairs: Rebecca J. Bussjager, *US Air Force Research Laboratory, Rome, NY, USA*
Praveen Anumolu, *Northrop Grumman Corporation, Bethpage, NY, USA*

WC1 1:30 PM - 2:00 PM (Invited)

Gigabit Fiber Optic Transceiver Technology Evolution for Avionics, E. Y. Chan, *Boeing Company, Seattle, WA, USA*, M. W. Beranek, *Naval Air Systems Command, Patuxent River, MD, USA* and D. N. Harres, *Boeing Company, St. Louis, MO, USA*

This paper reviews the evolution of gigabit fiber optic transceiver towards incorporating self-diagnostics functions. Recent progress on incorporating high-resolution OTDR capability in SFF gigabit fiber optic transceiver for avionics cable plant systems will be presented.

WC2 2:00 PM - 2:30 PM (Invited)

Qualification and Screening Results of COTS Transceivers for Avionics Applications, P. Risner and L. Zweidinger, *Harris Corporation, Melbourne, FL, USA*

Selection of COTS transceivers for use in military avionics applications requires performance and environmental evaluations. This paper presents the results of performance and environmental testing performed on COTS transceivers from two manufacturers.

WC3 2:30 PM - 3:00 PM (Invited)

Integrated Optical Circuits Utilizing Surface Mount Photonics Technology, H. A. Blauvelt and A. M. Benzoni, *Xponent Photonics, Monrovia, CA, USA*

This paper describes optical circuits based on Surface Mount Photonics (SMP). SMP utilizes many elements of semiconductor device manufacturing, including CMOS foundries, wafer scale testing, flip chip bonding, and low cost non-hermetic plastic packaging.

WC4 3:00 PM - 3:30 PM (Invited)

Low Noise High Power Ultra-Stable SS Laser for 1550nm Wavelength Band, L. S. Watkins, C. L. Ghosh, R. Gandham, S. Leffler, R. Vanleeuwen, Q. Wang and B. Xu, *Princeton Optronics, Mercerville, NJ, USA*

Low noise lasers are required for a range of signal processing and communications systems. We are investigating optical pumped Yb:Er glass laser to achieve high power with low noise and stable frequency. We are also developing an ultra-stable ULE glass locker. Results to date are 200mW, ~7kHz linewidth and SMSR >70dB.

WC5 3:30 PM - 3:45 PM

Integration of Fiber Optic Cable Diagnostics within Aerospace Transceivers, C. B. Kuznia, *Ultra Communications Inc, San Marcos, CA, USA*

We describe an approach to implementing built-in-test (BIT) functionality within multi-Gbps multimode fiber optic transceivers in short-reach applications (< 50 meters).

Thursday, 14 September 2006

8:30 AM - 9:45 AM

Session THA: PHOTONIC COMPONENTS

Session Co-Chairs: Neal Bambha, *US Army Research Lab, Adelphi, MD, USA*
Vincent J. Urlick, *US Naval Research Laboratory, Washington, DC, USA*

ThA1 8:30 AM - 8:45 AM

Highly Integrated, Lossless Bus Interface Modules for Avionic Fiber Optic Communications Networks, A. J. Bruce, S. V. Frolov and J. Shmulovich, *Inplane Photonics, South Plainfield, NJ, USA*

We will describe the enabling technology, integration and performance of a new LBIC module developed under the AFRL Highly Integrated Photonics program. The module supports lossless WDM through traffic while simultaneously enabling channel selectable drops. The LBIC represents the highest level of monolithic photonic integration achieved to date.

ThA2 8:45 AM - 9:00 AM

Recent Advances of All-Fiber Tunable Filter and Its Applications to Reconfigurable WDM Add/Drop Module and Tunable Receiver, S. Yin, J. Lee, Q. Chen, Q. Zhang, K. Reichard, J. Mazurowski, D. Ditto, *Pennsylvania State University, University Park, PA, USA* and M. J. Hackert, *Naval Air Systems Command, Patuxent River, MD, USA*

The recent advances on all-fiber tunable filters and their applications are presented, including (1) the precise four-layer model, (2) nanocomposite electro-optic polymer, (3) super wide tuning range (>200 nm), and (4) application to reconfigurable WDM add/drop module and tunable receiver.

ThA3 9:00 AM - 9:15 AM

Packaged Diamond-Shaped Ring-Laser-Diode Switch, R. J. Bussjager, R. Erdmann, V. Kovanis, B. McKeon, S. Johns, *US Air Force Research Laboratory, Rome, NY, USA*, A. Morrow, M. Green, *BinOptics Corp., Ithaca, NY, USA*, N. Stoffel, S. Tan, *Infotonics Technology Center, Canandaigua, NY, USA*, W. Bacon and B. Beaman, *Kodak, Rochester, NY, USA*

The development of a unique semiconductor ring laser (SCRL) is described. It is packaged and characterized with injection locked time-varying input signals. Applications are discussed.

ThA4 9:15 AM - 9:30 AM

Monolithically Integrated Compact High-Speed Wideband Wavelength Tunable Filter Chip, J. Ma, *OptoNet, Evanston, IL, USA*, Y. Huang and S.-T. Ho, *Northwestern University, Evanston, IL, USA*

We present a novel design of integrated high tuning speed InP based tunable filter. We fabricated and demonstrated <500 nanosecond tuning speed with ~3mm x1mm chip size.

ThA5 9:30 AM - 9:45 AM

Compact Optical Programmable Delay Lines with Fast Thermo-Optic Switching and Output Power Balancing, B. E. Little, S. T. Chu, W. Chen, W. Chen, J. V. Hryniewicz, D. Gill, O. King, F. Johnson, R. Davidson, K. Donovan and J. Gibson, *Nomadics, Little Optics Division, Annapolis Junction, MD, USA*

We demonstrate compact 8-bit programmable delay lines having an integrated VOA for output power balancing. Delays from picoseconds to several nanoseconds are feasible on a 1 cm-sq solid state chip. Thermo-optic switches with 45 usec switching are incorporated.

9:45 AM – 10:15 AM COFFEE BREAK

10:15 AM - 12:15 PM	
Session THB:	CABLE PLANT
Session Co-Chairs:	William Stewart, <i>Lockheed Martin, Fort Worth, TX, USA</i> Greg Abernathy, <i>L-3 Photonics, Alpharetta, GA, USA</i>

ThB1 10:15 AM - 10:45 AM (Invited)

Next Generation Military Fiber Optic Connectors, G. Brown and C. Good, *Naval Surface Warfare Center, Dahlgren, VA, USA*

A short summary of the Navy's Next Generation Fiber Optic Connector (NGCon) development is presented. Primary motivations, requirements, the resulting design, and the current status are discussed.

ThB2 10:45 AM - 11:15 AM (Invited)

Progress on the SAE Aerospace Standard for Beginning of Life Fiber Optic Cable Assembly Inspection and Testing, D. A. Parker, *Tempo Research, Camarillo, CA, USA*

Status of SAE AS3C3 Aerospace Standard 5675 JELLI (Jumpers, End face, Link-Loss, Inspection). The standard is being written to provide both manufacturers and receiving customers with beginning of life inspection and testing for commonality of results.

ThB3 11:15 AM - 11:30 AM

Evaluation of Next Generation Avionic Fibre Optic Cables, G. Proudley, H. J. White, and N. Aldridge, *BAE Systems, Filton, Bristol, UK*

This paper discusses the performance of new aerospace fibre optic cable designs with a target operating temperature of -55 to +125C. Prototype cables are assessed and compared in a number of mechanical and optical tests.

ThB4 11:30 AM - 11:45 AM

High Temperature Fiber Optical Cable (150 C) Design Verification Test Protocol, M. Messer, *Tensolite Company, Saint Augustine, FL, USA* and S. Rehman, *FiberLogix Ltd, Watford, Herts., UK*

Proposed testing protocol for design verification of 150 C rated Fiber optic cable.

ThB5 11:45 AM - 12:00 PM

Microbending of Optical Fiber Cables in Aerospace Environments, D. A. Hardy, *W. L. Gores & Associates, Newark, DE, USA*

Aerospace applications often dictate the use of cable materials that may be used reliably over broad temperature ranges. Differences in thermal expansion coefficients may result in microbending of the optical fiber with temperature cycling. Qualified cable designs that mitigate these effects are discussed.

ThB6 12:00 PM - 12:15 PM

Fiber Optic Cable Assembly Specification Checklist for Avionics Applications, B. G. McDermott, M. W. Beranek and M. J. Hackert,
Naval Air Systems Command, Patuxent River, MD, USA

An aerospace fiber optic cable assembly checklist standard will facilitate unambiguous specification, qualification, and manufacturing quality assurance of avionics fiber optic cable assemblies. Optical fiber, fiber optic termini, fiber optic connectors, and fiber optic cable characteristics are embedded in the cable assembly checklist.

END OF PROGRAM