OFC/NFOEC 2012 Archive

Technical Conference: March 4-8, 2012

Exposition: March 6-10, 2012

Los Angeles Convention Center, Los Angeles, CA, USA

The optical communications industry's leading event wrapped up last week in Los Angeles with increased attendance, a larger show floor and plenty of buzz and enthusiasm surrounding the innovations presented in the technical sessions.

Nearly 800 technical presentations covered topics such as an elastic optical network for enabling terabit speeds, a graphene-based optical modulator, a record-speed wireless data bridge, and optical interconnects for enabling future computers. The popular post-deadline paper session, which saw a spike of 25% more submissions this year, featured the most timely breakthroughs in the research field – including a record 405 Terabit/s transmission speed demonstrated by a team of researchers in Japan.

OFC/NFOEC's most well-attended program, the Plenary and Awards Session, featured three high-level speakers on three unique topics. Isao Sugino, R&D director in Japan's Ministry of Internal Affairs and Communications gave a comprehensive overview the devastation caused to the telecommunication networks in Japan after the March 2011 earthquake and tsunami, as well as a look at what Japan is doing to protect its ICT infrastructure against future disasters. Greg Papadopoulos, venture partner with New Enterprise Associates and former CTO of Sun Microsystems, spoke on exa-scale computing and what it means for the optics industry. Google's Vice President of Access Networks, Milo Medin, spoke on the current "age of abundance" and what that means for bandwidth, network speeds, and consumer demand.

In the exhibition hall, companies presented the latest technologies in 100 and even 400G, optical packet transport, passive optical networks, gigabit Ethernet, coherent systems and more. Building off of last year's 20 percent increase in size, the show floor again expanded by another 10 percent this year—covering more than five football fields' worth of space. Companies were on hand to demonstrate products and discuss the latest in timely industry trends such as optical interconnects for data centers, silicon photonics, WDM, and more.

Exhibit hall attendees heard from a diverse group of company representatives as part of OFC/NFOEC's Market Watch, Service Provider Summit and other panel discussions. Verizon's Stu Elby gave a keynote address on "Cloud Computing as a Service," while other show floor discussion topics included monetization of the network, advanced integrated photonics, lighting up the datacenter, and photonic start-ups.

Overall the number of attendees grew to more than 12,000—the fourth year in a row the event has seen an increase. Rounded out by 560 exhibitors, OFC/NFOEC 2012 showed that the optical

communications field is on the forefront of growth and innovation worldwide. Join us next year when OFC/NFOEC moves to Anaheim, Calif., March 17-23, 2013.

Download pages from the OFC/NFOEC Program Book!

Abstracts
Agenda of Sessions
Key to Authors and Presiders

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10. Transmission Subsystems and Network Element

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Invited Speakers

Category 1. Optical Network Applications and Services (Invited)

Watch Kathy Tse, AT&T, USA, Discusses Highlights of This Year's Category 1 - Optical Network Applications and Services Technical Program

Bandwidth for Next Generation IP MPLS Backbones, Sherry McCaughan; *AT&T, USA*

Developments on a Submarine Neutrino Sensor-Based Network, Claude Vallee ; *CPPM IN2P3, France*

Optical Network Evolving towards Smart Network in Korea, Hyungjin Park; *Korea Telecomm, S. Korea*

Studies On the Application of OTN in China Telecom, Ruiquan Jing; *China Telecom Beijing Research Inst., China*

The Telefonica International Wholesale Services (TIWS) Network, Guillermo Cañete ; *Telefonica, Spain*

World-wide Networking for LHC Data Processing, Artur Barczyk ; *California Inst. of Tech., USA*

Category 2. Network Technologies and Applications (Invited)

100G OTN Technology and Deployment for Carrier Networks, Fei Zhu; *Huawei Tech., USA*

Advanced ROADM Networks, Mark D. Feuer ; *AT&T Labs, USA*

DSP Aspects for Deployment of 100G-DWDM Systems in Carrier Networks, Masahito Tomizawa; *NTT, Japan*

MPLS-TP: Where are we?, Andrew G. Malis; *Verizon Communications, Inc. , USA*

Next Generation CFP Modules, Chris Cole; *Finisar, USA*

Overview of the Common Electrical Interface (CEI) Specification for Next Generation 25 Gb/s Serial Interfaces, David Stauffer; *IBM, USA*

The Challenge for the Next Generation OTN Based on 400Gbps and Beyond, Yutaka Miyamoto; *NTT, Japan*

Category 3. FTTx Technologies, Deployment and Applications (Invited)

A Perspective from Europe on In-Home Networking, A.M.J. (Ton) Koonen; *Eindhoven Univ. of Technology, The Netherlands*

Enabling Broadband Communication, Deutsche Telekom FTTH Deployment, Frank Escher; *Deutsche Telecom (DT), Germany*

Fiber Deployment in Latin America, Keith Russell; *Alcatel-Lucent, USA*

FTTx in Africa: it's Not Just Technology, Marius Mostert; *MCorp Communications, South Africa*

G-PON Interoperability Since 2006 until Today, Regis Coat; *FT-Orange Group, France*

High Performance, Low Cost, Colorless ONU for WDM-PON, Ryohei Urata; *Google, USA*

In-Home Networking using Optical Fiber, Sergey Ten; *Corning, USA*

Mobile Backhaul for PON: A Case Study, Ed Mallette; *BrightHouseNetworks, USA*

New Avenues of Revenues: Open Access and Infrastructure Virtualization, Thomas Pfeiffer; *Alcatel-Lucent, Germany*

NGPON2- Where are the Standards Going? , Fabrice Bourgart; *FT-Orange Labs, France*

PICs in PONs, David Piehler; *Neophotonics, USA*

Category 5. Fibers and Optical Propagation Effects (Invited)

Advances in Solid Core Photonic Bandgap Fiber Amplifiers, Thomas Alkeskjold; *NKT Photonics, Denmark*

Differential Mode Delay Managed Transmission Line for Wide-band WDM-MIMO System, Taiji Sakamoto; NTT, Japan;

Fiber Luminescent Solar Concentrator Fabrics, Ayman Abouraddy; *CREOL, USA*

Hollow Core Photonic Bandgap fibers for Telecommunications: Opportunities and Potential Issues, Francesco Poletti; *ORC, UK*

Low-loss Mid-IR Microstructured Optical Fibers, Jean-Luc Adam; *Université de Rennes, France*

Partially Self-pumped Fiber Fuse Propagation through a White Tight-buffered Single-mode Optical Fiber, Shin-Ichi Todoroki; *National Inst. for Materials Science, Japan*

Realizing Large Effective Area Fibers, Marianne Bigot-Astruc; Draka Communications, France;

Category 6. Fiber and Waveguide Based Devices: Amplifiers, Lasers, Sensors, and Performance Monitors (Invited)

0.2-dB Gain Excursion AGC-EDFA with a High Speed VOA for 100-Channel Add/Drop Equivalent Operation, Yoichi Oikawa; *TriMatiz, Japan*

Advances in Attosecond Photonics, Amir Nejadmalayeri; *MIT ; USA*

Agile Optical Frequency Synthesis in Dispersion-Engineered Parametric Mixers, Bill Kuo; *Univ. of California San Diego, USA*

Distributed and Multiplexed Optical Sensing by Synthesis of Optical Coherence Function, Kazuo Hotate; *Univ. of Tokyo, Japan*

Everything You Always Wanted to Know About Cascaded Parametric Amplifiers, but Were Afraid to Ask , Colin McKinstrie ; *Bell Labs, Alcatel-Lucent, USA*

Higher Order Mode Erbium-Doped Fiber Amplifiers, Jeff Nicholson; *OFS Labs, USA*

kW Fiber Lasers, Dahv Kliner; *JDSU, USA*

Novel Trends in Performance Monitoring, Fabian Hauske; *Huawei; Germany*

Practical Issues and Some Lessons Learned from Realization of Phase Sensitive Parametric Regenerators, Radan Slavik; *ORC, UK*

Category 7. Optical Devices for Switching, Filtering, and Interconnects (Invited)

CMOS Photonics for Optical Engines and Interconnects, Gianlorenzo Masini; *Luxtera, USA*

Flexible Format Modulator using PLC LN Hybrid Technology, Takashi Goh; *NTT, Japan*

Graphene-based Optical Modulators, Ming Liu; UC Berkeley, USA;

Gridless ROADMS, Tom Strasser; *NISTICA, USA*

Latest Developments of 40G Silicon Photonics Active Devices, Jean-Marc Fedeli; *LETI, France*

Nonlinear Optical Functions in Crystalline and Amorphous Silicon-on-Insulator Nanowires, Roel Baets; *Ghent Univ., Belgium*

Silica-based PLC Transponder Aggregators for Color-less, Direction-less, and Contention-less ROADM,, Toshio Watanabe; *NTT, Japan*

Small Form Factor Thin Film Polymer Modulators for Telecom Applications, Raluca Dinu; *GigOptix, USA*

Category 8. Optoelectronic Devices (Invited)

A Generic Foundry Model for InP-based Photonic ICs, Meint Smit; Eindhoven Univ. of Technology, The Netherlands;
A Silicon Platform for High-Speed Photonics Systems, Ran Ding; Univ. of Washington, USA;

CMOS Photonic Integrated Circuits, Rajeev Ram; *MIT, USA*

Electro-optic Polymer Modulators, Alan Willner; *Univ. of Southern California, USA*

Energy-Efficient High-Speed Short-Cavity VCSELs , Markus-Christian Amann; *Technical Univ. Munich, Germany*

High-Power Near-Ballistic Uni-Traveling Carrier Photodiode with Ultra-Fast Switching Characteristic for Millimeter-Wave over Fiber Wireless Communication, Jin-Wei Shi; *National Central Univ., Taiwan*

Hybrid Silicon Micro-cavity Light Source on Silicon-on-Diamond Substrate, Di Liang; *Hewlett Packard, USA*

Metal-cavity Nano Lasers, Shun Lien Chuang; *Univ. of Illinois, USA*

Nanolasers Grown on Silicon, Constance J. Chang-Hasnain; *UC Berkely, USA*

Photonics-Electronics Convergence: Key Technology for WDM, Kazumi Wada; *Univ. of Tokyo, Japan*

Power-Efficient Transceivers for High-Bandwidth, Short-Reach Interconnects, Clint Schow; *IBM, USA*

Category 9. Digital Transmission Systems (Invited)

8 x 320-Gb/s Transmission over 5600 km Using All-ETDM 80-Gbaud Polarization Multiplexed QPSK Transmitter and Coherent Receiver, Gregory Raybon; Alcatel-Lucent, USA;

Evolution and Status of Forward Error Correction, , Takashi Mizuochi; *Mitsubishi Electric Corporation, Japan*

High-Order QAM Transmission for Spectrally-efficient and High-capacity Transport, Takayuki Kobayashi; *NTT Network Innovation Labs., Japan*

Limitless Range Quantum Communications: Steps Towards a Solid State Quantum Repeater, John Rarity; *Univ. of Bristol, UK*

Optical Communications through Turbulent Media, Sam Dolinar, Bruce Moision, Baris I. Erkmen; *Jet Propulsion Lab., USA*

Parametric Preprocessing in High-Capacity Transmission Links, Stojan Radic; *UCSD, USA*

Polarization Effects in Coherent Systems, Lynn Nelson; *AT&T, USA*

Reconfigurable Coherent Transceivers for Optical Transmission Capacity and Reach Optimization, Doug McGhan; *Ciena, Canada*

Category 10. Transmission Subsystems and Network Elements (Invited)

A 400G/1T High Spectral Efficiency Technology and Some Enabling Subsystems, Maurice O'Sullivan; *Ciena, Canada*

Clock Recovery and Jitter Sources in Coherent Transmission Systems, Han Sun; *Infinera, USA*

Digital Signal Processing for Coherent Systems, Seb Savory; *Univ. College London, UK*

High Sensitivity Modulation Formats, Sethumadhavan Chandrasekhar; *Bell Labs, Alcatel-Lucent, USA*

Optical Networking in Smarter Data Centers: 2015 and Beyond, Casimir DeCusatis; *IBM, USA*

Phase Estimation in Coherent Optical Fiber Communication Systems with Advanced Modulation Formats, Changyuan Yu; *Nat. Univ. of Singapore, Singapore*

Spectral Shaping in Ultra-Dense WDM Systems: Optical vs. Electrical Approaches, Gabriella Bosco; *Politecnico di Torino, Italy*

Techniques in carrier recovery for optical coherent systems, Kuang-Tsan Wu, Infinera, USA;

Category 11. Optical Processing and Analog Subsystems (Invited

All-Optical Processing of Multi-level Phase Shift Keyed Signals , Joseph Kakande; *Univ. of Southhampton, UK*

Applications of Phase-sensitive Parametric Amplification, Peter Andrekson; *Chalmers Univ. of Technology, Sweden*

Broadband Optical Processing Techniques for Ultrabroadband RF, Andrew Weiner; *Purdue Univ., USA*

Low-latency Photonic Packet Switches with a Large Number of Ports, H. J. S. (Harm) Dorren; *Technische Universiteit Eindhoven, the Netherlands*

Nonlinear Optical Signal Processing, Alex Gaeta; *Cornell Univ. USA*

Nonlinear Optics on the Silicon Platform, Wolfgang Freude; *Karlsruhe Inst. of Tech., Germany*

Photonic Generation of Millimeter Waves and its Applications, Tadao Nagatsuma; *Osaka Univ., Japan*

Quantum Information Processing at Telecom Waveband, Prem Kumar; *Northwestern Univ., USA*

Ultrafast Nonlinear Signal Processing in Silicon Waveguides, Leif Oxenløwe; *DTU Fotonik, Denmark*

Ultra-fast Optical Signal Processors Based on Fiber Grating Devices for Applications in Telecommunication Systems, José Azana; *Institut National de la Recherche Scientifique (INRS), Canada*

Wideband Photonic Compressive Sampling , Thomas Clark; *Johns Hopkins Univ. Applied Physics Lab., USA*

Category 12. Core Networks (Invited)

A New Teletraffic Approach for Network Planning and Evolution Prediction, Moshe Zukerman; *City Univ. of Hong Kong, Hong Kong*

Directions of Next Generation Transport Network Development, Andreas Gladisch; *Deutsche Telekom Innovation Labs., Germany*

DWDM Optical Line-side Interoperability, Hans-Jeurgen Schmidtke; *Juniper Networks, USA*

Lambda Switched Future Photonic Network Development, Marco Schiano; *Telecom Italia, Italy*

Physical Impairment Aware Planning of Next Generation WDM Backbone Networks, Thierry Zami; *Alcatel Lucent, France*

Spectrally-efficient Elastic Optical Path Networks Toward 1 Tbps Era, Hidehiko Takara; *NTT Network Innovation Laboratories, Japan*

Traffic Trends: Drivers and Measures of Cost-Effective and Energy-Efficient Technologies and Architectures for Backbone Optical Networks, Steven Korotky; *Alcatel-Lucent USA*

Category 13. Access Networks (Invited)

Watch Naoto Yoshimoto, NTT, Japan, Discusses Category 13 Access Networks

Advanced Optical Monitoring Technologies for Passive Optical Network Architecture and the Future , Nazuki Honda; *NTT Access Network Service Systems Laboratories, Japan*

Economical Solutions of WDM-PON Using Digital Signal Processing, Yukio Horiuchi; *KDDI R&D Laboratories Inc., Japan*

High-Speed Visible Light Communications: State-of-the-Art , Jelena Vucic; *Fraunhofer Inst. for Telecommunications Heinrich-Herz Institut, Germany*

Hybrid DWDM-TDMA PONs for Next Generation Access , Peter Ossieur; *Tyndall Nat. Inst., Univ. College Cork, Ireland*

Novel Cellular Optical Access Network and Convergence with FTTH, Wolfgang Kellerer; *Docomo Communications Laboratories Europe GmbH, Germany*

PICs for Next-generation Optical Access Systems, Michael Wale; *Oclaro Technology Ltd., UK*

Power Efficiency in Passive Optical Networks, Chang-Joon Chae; *National ICT Australia, Australia*

Technology Progress of High-speed Burst-mode 3R Transceiver for PON Applications, Masaki Noda; *Mitsubishi Electric Corp. Information Technology R&D Center, Japan*

Category 14. Optical Networking, Technologies, and Applications for Datacom and Computercom (Invited)

Watch Keren Bergman, Columbia University, USA, Subcommittee Chair discuss *Why Datacom is Now a Part of OFC* and *OFC/NFOEC-The Datacom Solutions You Need*

Cost-effective Transceiver Technologies for High-bandwidth Optical Interconnection in High-end Server Systems, Tanaka Kazuhiro; *Fujitsu Labs., Ltd., Japan*

Design Principles in the Open Compute Project, Eitan Frachtenberg; *Facebook, USA*

Efficiency and Scalability of Multi-plane Optical Interconnection Networks for Computing Platforms and Data Centers, Piero Castoldi; *Scuola Superiore Sant'Anna di Studi Universitari e Perfezionamento (SSSUP), Italy*

Future Computing Architectures Enabled by Optical and Nanophotonic Interconnects, Moray McLaren; *HP, USA*

Large Scale Data Centers and the Evolution to 100G Ethernet, Nick Illyadis; *Broadcom, USA*

Optical Networking for Data Centers Across Wide Area Networks, Joe Berthold; *Ciena, USA*

Optically Interconnected Data Centers, Lei Xu; *NEC Labs America, USA*

Plenary Session

Milo Medin

Vice President, Access Services, Google

Presentation: Bandwidth, Optics and the age of Abundance *(view the presentation slides pdf)*

Abstract: Over the last decade, Internet traffic has grown at a dramatic rate, yet prices for Internet transit have dropped significantly and worldwide Internet access prices have declined or stayed stable, despite increases in speeds and usage. This has empowered the growth of bandwidth-heavy video streaming services and new applications that are challenging traditional services on both quality and available content.

The primary reason that the Internet has been able to scale in capacity and yet have a dramatic reduction in the price/bit of transport is due to the innovation of the optical engineering community in building technologies that allow for much higher data rates to be transmitted across existing fiber optic infrastructure, and be able to add that capacity at lower and lower cost.

While some quarters are now calling for more aggressive usage-based pricing that is based on a paradigm of scarcity, it's important to realize that we have actually been living in an era of abundance, delivered courtesy of the optics community. With new optical and switching technologies coming that continue this trend, it's now possible to see a path forward to gigabit speed access networks like what we in Google are deploying in Kansas City.

View special message from Netflix CEO Reed Hastings to OFC/NFOEC attendees.

Biography: Milo Medin has been part of the Internet development community for more than 25 years. He is currently the vice president of access services at Google, where he oversees the company's Gigabit Fiber to the Home project and other efforts to improve access to the Internet.

Prior to joining Google in 2010, he was founder and CTO of M2Z Networks, a company that sought to deploy a national broadband wireless network system that will expand consumer network access by providing nationwide portable broadband service that was also to help bridge the digital divide.

He was co-founder and the chief technology officer of Excite@Home, where he led the development of the company's national infrastructure, and helped deliver the first large-scale residential broadband access service in partnership with major cable operators.

Earlier, Medin worked at NASA's Ames Research Center, where he managed the primary west coast interconnect for the Internet, and architected and managed the global NASA Science Internet. Before NASA, while enrolled at the University of California (UC), Berkeley, he worked at the Lawrence Livermore National Laboratory, programming high-performance computers in support of various defense programs.

Medin holds a bachelor's in computer science from UC Berkeley. He has participated in a number of public policy forums, including two National Academy of Sciences panels and a

variety of TechNet initiatives, and given testimony in Congress and before the Federal Communications Commission on broadband technology policy. He has received two patents in the field of network access technology.

Greg Papadopoulos, Ph.D.

Venture Partner, New Enterprise Associates

Presentation: How to Design and Build Your Very Own Exascale Computer *(view the presentation slides pdf)*

Abstract: A computer of any real size today is built around from thousands of individual servers, storage arrays and network switches. Mostly, the construction of these systems are left as an Exercise for the User, but that's changing rapidly. Patterns around compute-storage-network virtualization are emerging, and are apt to coalesce, finally, into some coherent view of a interconnect-centered system. Optics will play both a defining and enabling role in this "re-integration," and by 2020 it's likely that any competitive large-scale system will crucially depend upon optical interconnects all the way to the processing chips themselves. In this talk, Papadopoulos will look at the forces that have shaped the way we build very large systems today, and speculate about the future history exascale computers and the industry that creates them.

Read Article: OPN Talks with Greg Papadopoulos

Biography: Greg Papadopoulos, a 20-year veteran of the computer industry, is a venture partner at New Enterprise Associates, a venture capital and growth equity firm. Before that he served as chief technology officer at Sun Microsystems, where he directed the company's $2 billion R&D portfolio. He was associate professor of electrical engineering and computer science at MIT, where he conducted research into scalable systems and was on the founding team of three technology companies: PictureTel (videoconferencing), Ergo Computing (PCs) and Exa Corporation (fluid dynamics). He was also Senior Architect at Thinking Machines Corporation, where he led the design of the successor of the CM-5 MPP supercomputer. Earlier in his career, he was a development engineer at Hewlett Packard and Honeywell. Papadopoulos serves on the University of California's President's Board on Science and Innovation, and is a trustee for the SETI Institute and the Computer History Museum, both in Mountain View, Calif. He holds a B.A. in systems science from the University of California at San Diego, as well as an M.S. and a Ph.D. in engineering from MIT.

Isao Sugino

Director of the Research and Development Office, Technology Policy Division, Global ICT Strategy Bureau, Ministry of Internal Affairs and Communications, Japan

Presentation: Disaster Recovery and the R&D Policy in Japan's Telecommunication Networks
(view the presentation slides pdf)

Abstract: Communication network infrastructure is an indispensable base for people's lives and social/economic activities. The Great East Japan Earthquake and following tsunami on March 11, 2011 struck people's lives and caused serious communication disruptions in a wide area of Japan's network. While intense efforts have been paid to recovery, this unprecedented disaster has led to serious discussions on exploring ways to make the communication network more resilient to future disasters. This talk will discuss the impacts of the earthquake and the tsunami on Japan's telecommunication networks, its recovery efforts, as well as the action plans and the R&D policy toward building a dependable network infrastructure in the future.

Biography: Isao Sugino has been involved for 20 years in Japan's government administration related to ICT/telecommunications, including radio frequency management, radio licensing, business/technical regulations, and numbering plans. From 2001 to 2004, he performed diplomatic services as the first secretary of the Embassy of Japan in London, and engaged in various negotiations on ICT issues between Japan and the UK. He was also the deputy head of the Japanese delegation for both the Radiocommunication Assembly in 2007 (RA-07) and the World Telecommunication Standardization Assembly in 2008 (WTSA-08) of the International Telecommunication Union (ITU).

In 2009, he joined the Kyushu Institute of Technology (Kyutech), Japan, as professor at the Network Design Research Center. At Kyutech, he conducted research on policy analyses and

technology management in the areas of ICT/telecommunications and new generation network architecture.

In August 2011, Sugino was appointed to his current position in Japan's Ministry of Internal Affairs and Communications (MIC), where he is responsible for the planning and management of various national R&D projects in ICT fields.

Sugino holds a B. Eng. and M. Eng. respectively from Waseda University, Japan, as well as an M.S. in technology and policy from MIT.

Market Watch Panel Sessions

OFC/NFOEC Exhibit Floor Theater

Market Watch—State of the Industry and Where it is Headed
Hear
Karen Liu, Ovum Inc., USA, Market Watch Chair
Samuel Liu, Juniper, Market Watch Organizer

This three-day series of panel sessions engages the applications and business communities in the field of optical communications. Presentations and panel discussions feature esteemed guest speakers from industry, research and the investment communities.

The program will be located on the exhibit floor, so attendees can easily attend the sessions and tour the exhibit hall. Audience members are encouraged to participate in the question and answer segments that follow the presentations.

Market Watch Chair:
Karen Liu, *Principal Analyst, Components, Ovum Inc, USA*

Market Watch Organizer:
Samuel Liu, *Senior Product Line Manager, Juniper Networks, USA*

Schedule-at-a-Glance

Panel moderators, descriptions, and speakers are being confirmed so check this site often for program updates.

Tuesday 12:00 p.m.-2:00 p.m.	Panel I: State of the Industry Moderator: Karen Liu; *Principal Analyst, Components, Ovum Inc, USA*
Tuesday 3:00 p.m.-5:00 p.m.	Panel II: Market Trend for Passive Optical Networks Moderator: *Alexis Black; President, Source Photonics, USA*
Wednesday 1:00 p.m.-3:00 p.m	Panel III: Impact of Mobile Broadband Moderator: *Ron Kline, Principal Analyst, Network Infrastructure, Ovum, USA*
Thursday 10:15 a.m.- 12:15 p.m	Panel IV: Advanced Integrated Photonics Moderator: *Ted Schmidt; Director, Optical Systems Technology, Juniper, USA*
Thursday 1:00 p.m.- 3:00 p.m.	Panel V: Entering the 100G Era Moderator: *Brandon Collings; CTO, Optical Communications, JDSU, USA*

Watch Two Market Watch Presentations from OFC/NFOEC 2012, Recorded on March 10

Get a taste of why OFC/NFOEC's free show floor programs are the best in the industry.

Megatrends in the Datacenter: Convergence of Networking, Security and Storage Technologies
Jane Li, General Manager, North America Market, *Huawei-Symantec, USA*

Comparison of Links in the Data Center, Scott Kipp, *Brocade, USA*

Panel I: State of the Industry

Tuesday, March 6, 12-2pm

Moderator:

Karen Liu, *Principal Analyst, Components, Ovum Inc, USA*

Karen Liu is a Principal Analyst at Ovum, joining the firm in 2005 through its acquisition of RHK. Recent optical coverage areas include 40G/100G, coherent DSP chips and ROADM architectures. Other coverage includes 4G mobile broadband technology. Prior to becoming an analyst, she architected DWDM networking products and components at Tellabs and IBM. She received a PhD in Applied Physics from Stanford University and a BSE in Mechanical Engineering from Princeton University.

Panel Description:

This interactive panel will focus on the business issues of the optical fiber communication industry. While the field is undergoing rapid technical advance, the business challenges are also knotty problems that require effort and innovation. Over the last decade business models have evolved but concerns over profit margins remain. The issue of margins circles back to how, and how much, the industry can continue to invest in developing new technology.

The panelists have been chosen for their combination of industry and financial analysis experience as well as backgrounds in adjacent industries. The format will consist of questions posed to the panel as a whole; their answers should reflect a variety of opinions and lead to a lively discussion. Attendees are invited to bring their own questions.

The types of issues relevant to this panel are:

- What structure is the industry heading to? Not simply what are the latest

market trends and forecasts, but will more consolidations be needed?

• Will more consolidation help? Is excess capacity still a problem? Or, did the Thailand floods demonstrate that capacity is already concentrated to a risky degree? How significant is the role of contract manufacturing now?

• How does this industry appear to investors? How is VC activity trending? How does private equity look at component vendors and OEMS? What does it mean for a company to be listed on the stock exchanges in different countries?

• Will optical ever be a "normal" industry—and what is "normal" anyway? How does the optical fiber communications industry compare to others? Silicon photonics highlights the benefits of digital CMOS, but perhaps that is not the best comparison. How does this industry compare to other compound semiconductors and analog industries, for example wireless?

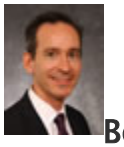
• Is the grass really greener: who has the best role within the industry? Do component vendors earn better margins than OEMS or vice versa? Can system vendors improve margins or are they locked in by industry structure? Does moving up to subsystems help or hurt component vendor margins?

Speakers:

Daniel A. Artusi, *Board Member, Lantiq, USA*

Mr. Artusi has more than 30 years of experience in the semiconductor and communications industries. He is an Operating Executive at Golden Gate Capital and most recently served as President, CEO and board member of Conexant Systems Inc. from 2007 until 2008. Prior to joining Conexant Mr. Artusi was Chairman and Chief Executive Officer of ColdWatt, Inc, from 2005 to 2007. Prior to joining ColdWatt, Inc. in June 2005, Mr. Artusi was President, Chief Executive Officer and board member of Silicon Laboratories Inc., a designer and manufacturer of mixed-signal integrated circuits, having joined the company as COO in 2001. Mr. Artusi held various positions at Motorola, Inc. from 1977 to 2001. From August 1999 to August 2001, Mr. Artusi served as Corporate Vice President and General Manager of Motorola's Networking and Computing Systems Group headquartered in Austin, Texas. Mr. Artusi served as Vice President and General Manager of Motorola's Wireless Infrastructure Division

from May 1997 to August 1999 and as General Manager of Motorola's RF Products Division from April 1996 to May 1997. He was also a board member of Powerwave Technologies Inc. (Nasdaq: PWAV) from 2002 until 2007, Micrel Inc. (Nasdaq: MCRL) from October 2008 to May 2010, QSpeed Semiconductor from June 2008 until December 2010, Atheros Communications from October 2005 until its sale to Qualcomm in May 2011, and Ubiquiti Networks from October 2010 until June 2011. Mr. Artusi currently serves as a board member of Lantiq GmbH, Scintera Networks Inc., Energy Micro AS, and Conexant Systems Inc.

 **Bob Flanagan,** *Managing Director, Head of Technology Hardware Banking at Raymond James & Associates, Inc, USA*

Bob Flanagan manages the technology hardware banking practice of Raymond James & Associates, Inc. Over the course of his two decade career as an investment banker, Mr. Flanagan has worked on a variety of merger advisory and capital raising transactions with leading companies in the telecommunications, semiconductor and photonic technology industries. He holds an MBA from the Stanford Graduate School of Business, and a BA in Economics from UCLA.

 **Simon M. Leopold**, *Communications Equipment Analyst, Managing Director, Morgan Keegan & Co., USA*

Simon M. Leopold joined Morgan Keegan in February 2004 as a communications equipment analyst. Prior to joining the firm, he covered telecommunications equipment stocks at Merrill Lynch for four years and worked in the telecom industry at Telcordia Technologies (a unit of Ericsson) providing services to carriers and equipment vendors for 12 years. Leopold has earned a BS in Electrical Engineering from the University of Michigan Ann Arbor, a Master's of Engineering from Cornell University and an MBA from Rutgers University.

 **Andrew Schmitt,** *Directing Analyst, Optical, Infonetics Research, USA*
Andrew Schmitt is one of the most quoted and respected analysts in the optical network industry. His bold opinions are backed by the prolific and in-depth research he conducts at Infonetics Research, and make him a highly sought-after public speaker and expert. He directs Infonetics' optical research, studying all sides of the market – carriers, equipment manufacturers, and components. He authors service provider surveys and equipment market share and forecast reports on topics ranging from metro and long haul optical, SONET/SDH, WDM, ROADMs, MSPP, and crossconnects to packet optical transport, OTN, 10G, 40G, and 100G+. He is also a consultant to startups, carriers, vendors, and the investment community. Prior to Infonetics, Andrew ran Vitesse Semiconductor's carrier chipset unit, and headed Nyquist Capital, an investment consulting firm focused on the optical sector. He holds multiple patents, and earned his BS in Electrical Engineering at the UCSB.

Panel II: Market Trend for Passive Optical Networks

Tuesday, March 6, 3-5pm

Moderator:

Alexis Black, *President, Source Photonics, USA*

Alexis Black Bjorlin, Ph.D., has served President of Source Photonics since July 2007, and has been on the Board of Directors since 2010. From February 2005 through July 2007, she served as the Chief Sales and Marketing Officer. From March 2003 through February 2005, Dr. Black Bjorlin served as the Vice President, Product Line Management and Corporate Marketing. From June 2002 through February, 2003, she was Director of Product Management for MRV. Prior to this, she served as Chief Optical Architect for Zaffire, Inc, a DWDM Metropolitan Networks company, which was acquired by Centerpoint Broadband Technologies in October 2001. Dr. Black Bjorlin earned a Bachelor of Science degree in Materials Science and Engineering from the Massachusetts Institute of

Technology, and a Ph.D. in Optoelectronics from University of California, Santa Barbara.

Panel Description:

The Passive Optical Networking Market Watch session will cover the dynamics of global PON deployments and future technology and market trends through the view of carriers, networking equipment manufacturers, optical component providers, and integrated circuit developers.

Speakers:

The Splintering of the Traditional PON Deployment Model: An Equipment Vendor Viewpoint

Ed Harstead, *Chief Technology Officer, Wireline Division, Alcatel-Lucent, USA*

The traditional PON deployment of FTTHome from the local CO by a lone incumbent operator has begun to splinter. Residential bandwidth demands, regulatory pressures towards open access, operator economics driving CO consolidation, and new PON applications (e.g. FTTBusiness/FTTBuilding/FTTCellsite) are driving more functionality into PON equipment and more versatility from PON equipment vendors. The relative strengths of these drivers have a high regional variability which must be recognized. These new deployment challenges, how current PON technologies can meet them, how they might be driving next generation PON technologies, and progress in next generation PON standards, will be addressed.

Ed Harstead joined Bell Laboratories in 1983, and his current role at Alcatel-Lucent is Lead Technologist for the Chief Technology Office of the Wireline Division. During the 2000s, Ed was a an R&D-facing and customer-facing Senior Product Line Manager for both Optical and Broadband Access products. In the 1990s, as a systems engineer and systems engineering manager, Ed led R&D efforts in first generation BPON and WDM PON technologies, while taking

the lead role for Lucent in the FSAN standardization forum. He has been awarded four patents, has published over a dozen technical papers, authored the chapter on Optical Access Networks in Optical Fiber Telecommunications IV, and reviews submissions to IEEE on the subject of WDM PON. Ed received the MS Mechanical Engineering and MS Electrical Engineering degrees from Columbia University, New York City, in 1983 and 1987 respectively.

Advances in FTTx Architectures…An Infrastructure Perspective

Atikem Haile-Mariam, *Vice President of Marketing, Opterna, USA*

Recent, large-scale deployment of FTTx networks to homes and Multi-Dwelling Units, (MDUs), in cities have highlighted the importance of having cost effective architectures and networks. While much attention is often given to advances in electronics/"active" devices that power these networks, the overwhelming cost drivers for FTTx networks are actually related to the infrastructure/"passive" portion of the network. This "passive" portion is typically referred to as the network's "Fiber Management System", ("FMS"), and comprises of fiber pedestals, hubs, aerial enclosures, splitters, connectors and associated deployment costs. This talk will focus on advances in FMS, and how these advances have enabled leading carriers to radically reduce the cost to "pass" and "connect" subscribers.

Atikem is the VP of Marketing at Opterna with responsibilities for managing opto-electronic opportunities. From 2003 to 2008, Atikem was a product manager at Finisar with responsibilities for xWDM transceivers. In 2003, Atikem worked with the IFC where he developed an IT services investment blueprint for South East Asia, and led negotiations on several investments. Prior to IFC, Atikem co-founded Ignis Inc., and was also a member of Intel Capital's investment team. While at Intel, he completed investments and was a portfolio-company-board-observer. From 1992 to 1998, Atikem held positions at Corning Inc. including marketing manager of optical fibers for access markets. While at Corning, Atikem was also a member of the IEEE 802.3 committee. Atikem has BS degrees in History and Physics from Knox College, a BS in Engineering from Washington University in St. Louis, and an MBA from the

Darden School at University of Virginia.

WDM PON an Access Solution Today?

Michael Gruhlke, *Business Development Manager, Ericsson, USA*

This presentation will provide an overview of WDM-PON, highlighting its key attributes and values. The solution shows the coexistence to today's traditional TDM-based PON systems and illustrates how WDM-PON addresses the challenges faced by the traditional PON systems. Applications where high and symmetrical bandwidth is required in the Enterprise and backhaul market can be addressed through WDM PON by using the same outside plant infrastructure, side by side to a GPON access network.

Michael Gruhlke is the Business Development Manager for Ericsson representing the WDMPON access platform from LG-Ericsson. For the past five years, Michael has been promoting access solutions within China, India, Russia and North America. Michael has 20+ years of communications experience ranging from microwave, satellite, optical transport and access.

Building Blocks for Next Generation PON

Tim Jenks, *Chairman & CEO, NeoPhotonics Corporation, USA*

Abstract – The FTTx market is defying the economic slowdown and keeps growing at double digit rates. Both GPON and GEPON have become main stream network architectures and 10G PON is starting to enter early volume deployments. Geographically, China has passed Japan as the as the region with the most homes connected, but all regions around the globe are experiencing significant growth, as national broadband strategies accelerate.

This talk will provide an update on the current market status from an FTTx module provider perspective, and include an overview of trends in the areas of embedded network monitoring and the application of PIC technology in access networks. The talk will conclude with an outlook on what is coming beyond the current standards of 10G in terms of network architecture and enabling technologies.

Tim Jenks has been CEO of Neo Photonics (NYSE: NPTN) since joining the

company as a startup in 1998. He has overseen the company's development since that time, including their growth in China and the development of their expanding PON business. Mr. Jenks was previously Vice President and General Manager at Raychem Corporation, a materials and engineering company acquired by Tyco Electronics, where he served in general management and functional positions in the US and Europe. Mr. Jenks is a former naval officer, and holds an MBA from Stanford University, a MS from Massachusetts Institute of Technology and a BS from the U.S. Naval Academy.

Market Trends and Technology Evolution of the PON Modules

David Li, *Chief Techology Officer, Ligent Photonics, USA*

With the growth of broadband access demands, the number of FTTX users has been increasing all over the world and the PON system has been widely deployed as a cost effective optical network. This presentation will review the market trends of the optical modules in the PON system and the technologies on both the optical and electrical components for the EPON, GPON, and 10G-PON applications. Looking forward, the new features in next generation PON appears to be challenging in terms of power consumption, packaging size and cost-effectiveness. The challenges in the new optical components and electronics for the NG PON will also be discussed.

David Li is the Chief Technology Officer of Ligent Photonics (USA) and Vice President in Hisense Broadband Multimedia Technologies. Prior to join Hisense-Ligent in 2002, he held variety positions as associate professor, principal design engineer, technical supervisor, and director in UESTC, CUHK, Texas Center for Superconductivity, Epsilon Lambda Electronics, and Molex. He has been involved in the development and manufacturing of the high-speed electrical, optical modules and subsystems for more than 20 years. David has been participating the IEEE802.3ae/ IEEE802.3ah/ IEEE802.3av and FSAN meetings actively. Following the standard activities, he lead the R&D team developed the innovative EPON ONU/OLT with accurate monitoring functions, GPON ONU/OLT modules, 10G-EPON, NG-PON1, and WDM-PON modules, which have been widely deployed around the world. David received the BS

degree from Shandong University and the MS degree from Beijing University of Aeronautics and Astronautics. He earned the Doctor of Engineering degree from University of Electronic Science and Technology of China and the Ph.D. degree from University of Houston.

Panel III: Impact of Mobile Broadband

Wednesday, March 7, 1-3pm

Moderator:

Ron Kline, *Principal Analyst, Network Infrastructure, Ovum, USA*

Ron Kline is a principal analyst in Ovum's Network Infrastructure group. With over 29 years of industry experience that includes 18 years working for a large North American service provider, Ron has an in-depth knowledge of network technology combined with a strong business-oriented approach to problem solving. He is responsible for the overall direction of Ovum's North American optical networking research, its network infrastructure vendor strategies research, and its mobile backhaul research. Ron specializes in DWDM, bandwidth management, aggregation, and carrier Ethernet technologies used in both wireline and wireless networking applications.

Ron's recent projects include researching North American mobile backhaul networks; developing a carrier Ethernet market analysis; researching global enterprise vertical opportunities for network infrastructure products; sizing the tier 2/3 North American ON market opportunity; analyzing the opportunity for OTN switching and the role of Ethernet transport in metro carrier networks. Ron received a Masters of Science in telecommunications and computing management from Brooklyn Polytechnic University in 1997.

Panel Description:

This panel looks at the relationship between the optical network and all things mobile. Ongoing shifts of mobile networks to support broadband and video have destabilized an already wobbly telecom supply chain. Mobile device suppliers, content providers, and end users increasingly depend on high-

capacity, resilient infrastructure, yet telcos and vendors struggle to make a healthy return on their investments for the infrastructure required to support broadband and video services. How are mobile network operators addressing the explosive growth on their networks? How will ON transport evolve to support operators as they migrate architectures to include small cells and as machine-to-machine connections grow to the billions

Speakers:

Achieving Scalable Mobile Backhaul and Commercial Service Convergence with Packet Optical Transport Technologies

James Anthony, *P-ONP Strategy Planning Fujitsu Network Communications, USA*

As bandwidth needs continue to increase for mobile services, the underlying network infrastructure must scale to meet these requirements while enabling operational and capital expense efficiencies. To cost effectively and profitably meet service and bandwidth scalability requirements, traditional TDM-based technologies are transitioning to Ethernet as the predominant transport solution. As this transition takes place, many of the TDM service attributes, including resiliency, reliability, and manageability, must also translate to the new infrastructure. This presentation will discuss how technology advancements such as Packet Optical Networking Platforms and Connection-Oriented Ethernet enable the transition to packet infrastructure while maintaining network resiliency and providing convergence of mobile backhaul with other commercial services.

James Anthony is the principal solutions architect for packet optical networking at Fujitsu Network Communications. He is responsible for market strategy and business development for packet optical networking technologies and solutions. James' role focuses on defining strategic marketing initiatives and architecting solutions for key Fujitsu technologies. Prior to joining Fujitsu, James was responsible for Carrier Ethernet transport strategy and business development at Nokia Siemens Networks, following their acquisition of Atrica, where he was a product line manager for the Carrier Ethernet product line. He

has also worked in technical leadership roles at Cisco, Alcatel and MCI. James holds a Bachelor of Science in Electrical Engineering from the University of Illinois at Urbana-Champaign.

 **Packet Optical Transport: An Efficient Solution for Wireless Backhaul and Enterprise Services**

Bert Buescher, *Director Product Management and Systems Engineering, Tellabs, USA*

The rapid migration of Wireless Backhaul from TDM to Ethernet has challenged carriers to respond with cost effective transport solutions. The increase in bandwidth and continued need for highly reliable transport are driving the need for new network architectures. From this session, the audience will understand the key drivers for increased bandwidth in backhaul networks and impacts on network architectures. We will present the main benefits of Packet Optical Transport for Wholesale Backhaul as well as other Enterprise Services. Lastly the audience will gain a new perspective of how Wireless Backhaul networks can be leveraged to offer multiple services to improve carrier profitability.

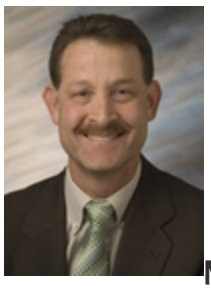
Bert Buescher is director of product management and marketing for Tellabs optical transport solutions. In this role, he is responsible for defining Tellabs strategic direction and market introduction for global optical networking solutions including WDM, SONET/SDH and packet transport. Previously at Tellabs, Buescher held various roles in the office of the CTO, transport strategic planning and digital cross-connect product line management. He has also held positions in research and development and corporate strategy. Buescher has more than 15 years of experience in the telecommunications industry and holds a Bachelor of Science degree in electrical engineering and a Master of Business Administration degree from Purdue University. Tellabs innovates to deliver the mobile Internet and help our customers succeed. That's why 43 of the top 50 global communications service providers choose our mobile, optical, business and services solutions. We help them get ahead by adding revenue, reducing expenses and optimizing networks.

Efficient and Safe Blending of Broadband, Business and Mobile: The Service Separation Approach

Mano Nachum, *Product Line Management Packet Optical Networking, ADTRAN, USA*

The relentless demand for premium, high-bandwidth video and data services—backed by Mobile Network Operators offering supplies of 4G enabled devices—has put a tremendous strain on network infrastructures as service providers look to support the resulting backhaul traffic. The growing needs to stay competitive in the mobile backhaul, business and residential broadband markets have service providers in critical need of an efficient solution that can successfully address both markets. During this session, attendees will learn how to improve competitiveness as they offer high-performance multi-service at the lowest cost of ownership by leveraging the service separation approach. This network architecture eliminates network bottlenecks by leveraging right-sized converged network infrastructure; enabling important service isolation for each individual mobile network operator that may share a single cell site or simultaneously offer residential broadband or business Ethernet, and wholesale backhaul services.

Mano Nachum has 20 years of telecom networking experience working closely with established and emerging service providers globally and various optical and transport solutions. He currently leads the product line management, strategy and market development for ADTRAN's Optical Networking Edge (ONE) solution. Prior to joining ADTRAN, he held various positions with increasing responsibility in R&D, marketing, sales support and market development at ECI Telecom, Lightscape Networks and Tadiran Telecommunications where he was one of the leaders in producing successful market penetration and sales growth. Mr. Nachum holds an MBA from Tel Aviv University's Recanati School of Management and a B.S.E.E from Tel-Aviv University.



Mobile Backhaul – A Platform to Accelerate Metro Transformation

Frank Wiener, *Vice President of Marketing, Cyan Inc. USA*

This video presentation reviews the key LTE requirements which triggered the recent wave of wireless backhaul build-outs and the foundation for a broader metro transformation. It explores how wireless backhaul infrastructures can provide a foundation to support a phased incremental expansion to smaller cell site LTE/WiFi deployments as well as the much broader scope of business Ethernet, broadband backhaul, data center interconnect and wholesale services. It will conclude with a review of the potential of packet-optical transport systems can facilitate the transformation to a software defined metro network to maximize operational flexibility and efficiencies to reduce costs and improve profits. This session will be of interest to a wide audience ranging from network architects and planners to operations and business strategists.

Frank leads marketing for Cyan, which has over 90 service provider customers deploying packet-optical transport and performance assurance solutions world-wide. With 25 years of industry experience, Frank has lead engineering, product management, marketing, sales, business development and general management during his successive tenure with Nortel, AT&T; Paradyne and most recently Calix. Frank has a long history of working with service providers on transport, broadband access and enterprise solutions and has authored 3 industry books ranging from the early days of DSL, to IPTV and network transformation.

Panel IV: Advanced Integrated Photonics

March 8, 10:15am-12:15pm

Moderator:

Ted Schmidt, *Director, Optical Systems Technology, Juniper Networks, USA*

Ted Schmidt has 14 years of experience in the fiberoptic communications industry, spanning network architecture, DWDM system R&D, and high speed (40G and 100G) DWDM transceiver R&D. Dr. Schmidt is currently Director of Optical Systems Technology at Juniper Networks, responsible for development of optical technologies for use in Juniper's switching and routing products. Prior to joining Juniper in 2010, Dr. Schmidt lead optical systems R&D at Opnext Subsystems (formerly StrataLight Communications) for 9 years, delivering the core technologies used in all generations of StrataLight's 40G and 100G products. His interests include high speed optical communications technologies, including advanced modulation formats and the photonics technologies required to achieve commercial viability. Dr. Schmidt holds a Ph.D. in Physics from Oklahoma State University, awarded for his research on the linear and nonlinear optical properties of wide bandgap semiconductor materials and devices. Dr. Schmidt has authored over 50 technical articles and two book chapters on his research interests and is a frequent speaker at technical conferences. He is a Senior Member of the IEEE and a member of the Optical Society of America and American Physical Society.

Panel Description:

This panel will explore how integrated photonics can enable high density optical communications links spanning applications in supercomputing, data centers, inter-office, and core transport networks. Emphasis will be placed on the role of integrated photonics technologies in meeting the density (size and power) requirements of tomorrow's networks

Speakers:

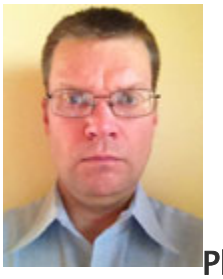
Optical Integration for Data Center Networks

Mitchell Fields, *Director, Advanced Technology Solutions Group, Fiber Optics Products, Avago Technologies, USA*

Photonic integration of components for core transport networks has demonstrated clear advantages in cost/performance and hence has enjoyed

broad adoption and deployment. However, there is minimal photonic integration found in the commercially available and broadly deployed optical components used in high-bandwidth short-reach networks such as data center networks, networks interconnecting high-performance computers, and the interconnect fabric of scalable multichassis routers/switches; the predominant enabling components are VCSEL-based parallel optics. This presentation explores the applications and metrics associated with components for data center networks as well as suggestions where "integration" can have benefits.

Dr. Mitchell Fields is Director, Advanced Technology Solutions Group, Fiber Optics Products, at Avago Technologies. In this role, Mitch works with customers to identify and develop Avago interconnect solutions that enable customers to differentiate their end products. Since joining Avago in 2005, he has also held positions in Strategic Marketing and Applications Engineering. Prior to joining Avago, he worked as an optical engineer and architect at Sycamore Networks (2000 – 2005) and as a staff scientist at MIT Lincoln Laboratory (1997 – 2000). Mitchell has degrees in mathematics and economics from SUNY Binghamton and a Ph.D. in physics from Yale University.



Photonic Integration in Long Haul Transport Networks

Antti Kankkunen, *VP, Product Planning, Infinera Corporation, USA*

The rapid growth of Internet is challenging core transport network architectures. It is increasingly difficult to control network cost, space requirements and power consumption while continuing to rapidly augment network capacity. It will be critical to cost effectively support bandwidths beyond 100Gbps in long-haul optical networks in the near term and it is clear that the most sensible path towards this end is via a multi-carrier approach for N x 100 Gb/s transmission. However implementing it using conventional discrete components leads to complex designs affecting operational reliability.

Photonic integration resolves this simplifying operations while reducing cost, space and power. This presentation provides an update on commercially deployed long haul solutions based on photonic integration along with a discussion on future architectures.

Antti Kankkunen is VP, Product Planning at Infinera Corporation and since 2008 has been responsible for leading the long term product roadmap development at Infinera. Antti has more than 20 years of experience in the communications industry and has worked in both small startup companies and large established equipment providers. He has held senior executive positions with responsibilities covering product planning, product strategy, technology strategy, business development, product marketing, product development and sales. He spent 12 years at Tellabs and among other things held the roles of director of Tellabs 8100 product line and CTO of Tellabs International. Antti graduated from Helsinki University of Technology in 1991 with M.Sc. in Electrical Engineering.

Less is More: Enabling New Applications through Photonic Integration in InP and GaAs and Advanced Packaging Technologies

Yves LeMaitre, *Chief Commercial Officer, Oclaro, USA*

Network operators face the continuous challenge of having to increase bandwidth and network utilization while at the same time reducing costs, aligning expenses with revenue, and minimizing space and power usage. Addressing these challenges requires significant innovation at the module and component level. This talk will discuss how innovation in laser design and packaging is enabling a variety of new applications for 100G networks and what will be required moving forward.

Mr. Yves LeMaitre has served as Oclaro's Chief Commercial Officer since July 2011. He previously served as EVP, Strategy and Corporate Development from

February 2011 to July 2011, EVP and General Manager of our Advanced Photonic Solutions division from April 2009 to January 2011 and prior to that served as our Vice President of Telecommunication Sales and Corporate Marketing since February 2008. Prior to joining Oclaro, Mr. LeMaitre was serving as Chief Marketing Officer at Avanex. Mr. LeMaitre was also President and Chief Executive Officer of Lightconnect. In addition, he worked for Alcatel and its joint venture with Sprint International in a variety of general management, senior marketing and engineering positions in the US, France, the Netherlands and Italy. Mr. LeMaitre earned a master's degree in mathematics and computer science from Nantes University in France. He also holds an engineering degree from Ecole Nationale Superieure des Telecommunications (ENST) in Paris..

Optical Integration – Enabling Next Generation Networks

Atul Srivastava, *Chief Technology Officer, NTT Electronics America, USA*

Lower cost per bit is a key requirement for the deployment of next generation 100G and higher data rate optical transport and CDC ROADM routing equipment. Hybrid PLC-LN modulator technology is attractive for the current 100G PM-QPSK transmission systems and for the future selectable modulation format systems ranging from QPSK to 64-QAM. Likewise, fully integrated receivers consisting of photodiode and TIA arrays and PLC-based dual polarization optical hybrid devices are expected to shrink significantly in size and reduce cost in the future. Moreover, integrated multi-port switches for the CDC ROADM with flexible add/drop capability and integrated optical amplifier arrays will be critical for the dynamic network deployment. This talk will focus on the novel integrated devices enabling the next generation optical networks. It will cover the hybrid components for 100G and higher data rate ROADM networks.

Dr. Atul Srivastava joined NTT Electronics America as Chief Technology Officer in 2011. He has over 30 years of experience in the optical communications R&D starting from AT&T Bell Laboratories and later served as the director of optical amplifier research department. He worked at Bookham (now Oclaro) as the VP of Product Technology after the acquisition of the optical amplifier startup Onetta. He is credited with over 100 publications, and over 12 United States patents. He is editor of a book on "Optically Amplified WDM Networks". He was co-chair of the Technical Program Committee of Optical Fiber Communications Conference (OFC) 2009 and general co-chair of OFC 2011. He is a chair of the SPIE's Photonics West 2012 Technical Program Committee. Dr. Srivastava currently serves as US Technical Advisor for standards activity of International Electro-technical Commission (IEC) SC86C – Fiber Optic Systems and Active Devices, and convener of the Optical Amplifiers and Modules working group. He has been honored with several awards including Bell Laboratories President's Gold Award, and the Trophee du Telephone in Paris. He was elected Fellow of Optical Society of America in 2003. He received the 1905 Award of the IEC in 2009.

Panel V: Entering the 100G Era

Thursday, March 8, 1-3pm

Moderator:

Brandon Collings, *Chief Technology Officer, Optical Communications, JDSU, USA*

Brandon Collings is responsible for defining and driving the strategic technology roadmap for optical communications solutions at JDSU. In addition, his group operates the Optical Networks Research Lab at JDSU which focuses on understanding transmission system issues, network architecture evolution, system and component performance requirements, and product and network test applications to advance JDSU's component and subsystem leadership.

Prior to joining JDSU, Brandon helped lead the development of conventional and ROADM optical system architectures for the equipment vendor start-up Internet

Photonics. He later held the same role at Ciena where he was also responsible for optical system and transceiver performance specification and characterization in addition to providing technical assistance to marketing and customer support activities.

Prior to Internet Photonics, Brandon was a Member of the Technical Staff at Bell Labs, performing research on advanced optical communication network designs and non-linear performance impairments. He holds a Ph.D. from Princeton University where his graduate research, performed in conjunction with Bell Labs, focused on compact ultrafast laser research.

Panel Description:

This Panel will cover the following topics:

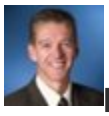
- Status of 100G deployments and lessons learned
- Perspective on the value 100G transmission offers
- Perspective on the migration of 100G into other network segments (metro, regional)
- Status of key enabling technologies and potential evolutionary technologies

Speakers:

100G Transmission Technology: Where are We, and Where Could We Go
Michel Belanger*, Member of Scientific Staff, Ciena, Canada*
Currently, all the technologies required to build a second generation of 100G per wavelength systems are in place, both for the Modem and also the line system.; It turns out that these 100G based transport system can be cost effectively delivered with very little compromises with respect to previous generation 10G and 40G systems. This is caused by significant transmission advances in usage of new modulation schemes, new digital processing capabilities and finally very high gain FEC. Banking on these premises, is there, easy to get, technical improvements that can enable improvements on the

system economic or technical performances before the industry has to deliver a new generation of transport systems.

Michel P. Belanger obtained B.Eng from Ecole Polytechnique in 1979 and a PhD in Electrical Engineering in 1987 from McGill University. He held R&D positions at Ecole Polytechnique in Montreal and at Canadian Marconi. With the National Optics Institute of Canada, he conducted research into the design and application of guided wave optical components and diffractive optical elements. After a brief period at Teleglobe working in submarine system engineering, he joined Northern Telecom (now Ciena Corporation) in 1995 as product manager for DWDM systems. Later, he moved to the optical development group as a member of scientific staff. He is currently leading a group developing deployment strategy for coherent, high capacity, optical systems.

 **Reflections and Predictions on the 100G Market**

Luc Ceuppens, *Vice President of Product Marketing, Platform Systems Division, Juniper Network, USA*

As the first 100G products shipped as early as the 3rd quarter of 2010, we take the opportunity to reflect on the last 18 months and evaluate 100G applications, deployments and challenges. With this knowledge of the past we then offer some predictions of what the future might look like.

Luc Ceuppens is responsible for product marketing, technical marketing and competitive intelligence for the Platform Systems Division at Juniper Networks. He has more than 25 years of international experience in sales and marketing of high-tech products and services gained through senior positions with Solectron Corp, StrataLight Communications, Calient Networks, Level 3 Communications and WorldCom (MFS/UUNET).

 **100G Deployments Year 3: Current and Future Use Cases**

Jean-Paul Faure, *Data Center Connection Product Line Manager, Alcatel-Lucent,*

France

Going into Year 3 of deployments worldwide, 100G has become a widely adopted solution rather than an up-coming market trend. In fact, 100G is currently deployed not only by large tier service providers, but also by smaller ones aiming to decrease operational cost and simplify network management. Critical success factors for commercial 100G solutions will be reviewed. Analyzing typical application cases reveal that most 100G deployments today focus on solving bandwidth exhaust in legacy networks, or are driven by needs for high capacity DCU free greenfield networks. Data Center interconnection at 100Gb/s is another increasing trend, strongly driven today by low latency mirroring that require high transfer capacity. The exponential growth of storage and the increase of cloud computing are fueling Storage Area Networks bandwidth growth and creating new interconnects demands. Consequently, Data Center interconnection will face a tremendous demand for high speed links, while moving from point-to-point to meshed network approach.

Jean-Paul Faure obtained a master degree in physics from university of Paris-XI Orsay, and a PhD. in applied physics from university of Paris-VI in 1998 In 1999, he joined Alcatel Corporate Research Center to work on optical switching technologies and flexible networks. He later joined Alcatel Optics Division contributing to the development of multi-reach transmission platforms and GMPLS applications In 2007, he became Product Line Manager for WDM terrestrial products, with focus on ultra-high bit rate transmission, and was involved in several 100Gb/s market introduction, field trials and customer deployments. He is now acting as Product Line Manager for Data Center interconnection market. Member of Alcatel-Lucent Technical Academy, he received the Bell Labs President's Award in 2010 for its involvement in the 100Gb/s Coherent innovation program and demonstrated business impact. He is author and co-author of 12 patents and several international publications.

Service Provider Concerns for 40G and 100G Deployments

Bob Feuerstein, Principal Architect Transmission, BT Innovate & Design, USA

The technology flow from 2.5G to 10G WDM systems in service provider

networks was a simple and straightforward progression. The evolution to 40G has been slower than first expected, and now 100G is expected to replace and supersede 40G. I will discuss some of the factors that we consider in our evolution planning for beyond 10G WDM systems.

Bob Feuerstein is the Principal Architect for Transmission and Synchronization Systems for BT. He received his PhD in Electrophysics from Polytechnic University, Brooklyn, NY. He then joined the NSF Optoelectronic Computing Systems Center at the University of Colorado. There he researched optical computing, optical communications and helped build the world's first stored program fiber optic computer. He taught classes in optoelectronics and optical communications. He worked in congress for one year after receiving an appointment as the IEEE Congressional Science and Engineering Fellow (1998). He worked at Level 3 Communications as a Senior Architect supporting Level 3's customers and internal optical network design requirements. He joined BT in 2008. He has spoken at dozens of technical and corporate meetings and authored 20+ publications on optical communications, network architecture and design. And he enjoys relaxing on his sailboat, Lightwaves, on Lake Champlain during summer holidays.

A Carrier's Activity for 100G DWDM Development and Deployment

Masahito Tomizawa, *Group Leader, Senior Research Engineer, NTT Network Innovation, Japan*

This presentation covers a carrier's activity for 100G DWDM transmission systems. Development of key technologies and efforts for driving industry are also mentioned. From a viewpoint of a carrier, the highest capacity and the longest distance transmission should be used as much as possible to cover the explosion of traffic, therefore, 100G DWDM is needed to be matured more rapidly or even commoditized, which could be enabled by the healthy supply-chain with assuring some interoperability.

Masahito Tomizawa is a senior research engineer, group leader, at NTT Network Innovation Labs. He received M.S. and Ph.D. in Applied Physics from Waseda

University, Tokyo, in 1992 and 2000, respectively. From 2003 to 2004, he was a visiting scientist at MIT. He has been engaged in high-speed optical transmission systems and their deployments, as well as international standardization in ITU-T, and also international carrier-to-carrier collaboration for several years.

 **How Do We Accelerate Deployment**

Glenn Wellbrock, *Director of Backbone Network Architecture, Verizon Business, USA*

The simple answer to expanding the 100G application space is lowering the cost. But the tough question is how? This presentation focuses on the technical requirements and opportunities for expanding the 100G footprint in an effort to bring the cost down through high volume. There are some tough tradeoffs to make and the only way to be successful in this endeavor is to have the whole industry focused on the same solution as was done on the long-haul application.

Glenn Wellbrock is the Director of Optical Transport Network Architecture and Design at Verizon, where he is responsible for the development of new technologies for both the metro and long haul transport infrastructure.Previous positions include running the advanced technology lab, establishing evaluation criteria, and setting engineering guidelines for all backbone transport equipment as well as various positions within network operations. In addition to his 20+ years at Verizon (1984-2001 & 2004-present), Glenn was responsible for Product Architecture within the USA focused optical networks group at Marconi and Product Planning at Qplus Networks with a specific focus on developing alternative modulation techniques.

Service Provider Summit

The Service Provider Summit is open to all Conference Attendees and Exhibits Pass Plus Attendees!

Join your colleagues for this dynamic program with topics and speakers of interest to CTOs, network architects, network designers and technologists within the service provider and carrier sector. The program includes panel discussions, a keynote presentation, exhibit time and networking time.

The program will be located on the exhibit floor, so attendees can easily attend the sessions and tour the exhibit hall. Audience members are encouraged to participate in the question and answer segments that follow the presentations.

Service Provider Summit Chair:
Karen Liu, *Principal Analyst, Components, Ovum Inc, USA*

Service Provider Summit Organizer:
Steve Plote, *Solution Sales Director, Tellabs, USA*

Moderators, speakers, and panel descriptions are being confirmed so check this site often for program updates.

Wednesday, March 7, 2012

8:30–9:00 a.m.	**Keynote Presentation**
9:00–10:30 a.m.	**Panel I: Towards Layer 1-2-3- Convergence** Moderator: Mark Lum, Co-founder and Market Lead, Layer123, UK
11:00 a.m.–12:30 p.m.	**Panel II: Role of the Network in the Age of Social Media** Moderator: Neil Farquharson, Technology Evangelist, Alcatel-Lucent, USA

Keynote Presentation

Cloud Computing as a Service

Wednesday, March 7, 2012
8:30 a.m. – 9:00 a.m.

Stuart Elby, *Vice President, Network Architecture and Technology & Chief Technologist, Verizon Digital Media Services, Verizon, USA*

Cloud computing technologies enable network service providers the ability to offer IT-style services on top of basic network services. More importantly, cloud computing technologies enable software defined networking (SDN) which may revolutionize the manner which network services are delivered. This presentation will highlight cloud computing services. The application of these same technologies towards software defined networking will also be examined, including several use cases.

Dr. Stuart Elby, Chief Technologist of Verizon Digital Media Services, is responsible for the overall solutions architecture, design and development of VDMS' platform-as-a-service products and the cloud computing infrastructure upon which they are delivered. As VP within the Technology organization, Stuart is responsible for developing Verizon's target network architecture and driving the industry to converge towards this target. He also manages the design and specification of Verizon's core services platforms including VoIP / IMS, video, cloud computing, and Verizon Wireless' open network service delivery platform. Stuart oversees the Verizon Interoperability Forum.

Panel I: Towards Layer 1-2-3 Convergence

Wednesday, March 7

Moderator:

Mark Lum, *Co-Founder Market Lead, Layer123, UK*

Mark Lum is Co-Founder and Market Lead at Layer123, a new venture knowledge exchange company. His expertise is founded in Optical, Carrier Ethernet, Mobile, Metro, FTTx and Storage networks and services, with

experience spanning WDM, OTN, SDH/SONET, ATM, MPLS and Ethernet technologies. Mark studied Natural and Electrical Sciences at Cambridge University and was awarded his MSc in Telecommunication Systems while working in the Harlow R&D labs of ITT-STL, developing the very first multi-Gigabit optical systems. He has a broad industry experience, having worked at Tektronix as market development manager, Nortel Networks as portfolio manager, RHK as market research director and as an independent consulting analyst. Mark has also taken an active role in global standardisation, having led Tektronix' program at ITU and ETSI, contributing as technical editor for several standards and as ITU-T Rapporteur. With many papers published on carrier network evolution, he is a well-known and frequently-requested speaker and chair at industry conferences.

Panel Description:

Service Providers have been travelling the Yellow Brick Road towards Convergence for at least the past decade, if not far longer. The rise of packets, increasing broadband traffic and the explosion of mobile services has not made the techno-economic environment any simpler, and operating costs must be reduced.

Many operators desire to flatten and simplify their hierarchical network architectures, and are carefully examining how fundamental network functions such as aggregation, grooming, restoration and protection are handled. Classically, all traffic is carried by the transport equipment, with the advantage that these functions support all traffic types. In the case of protection, parallel mechanisms at higher layers like IP may duplicate functions or interfere with the service restoration process. Thus, switching at the lowest layer should provide the optimal solution – a classical paradigm that OTN continues.

With new Ethernet transport and MPLS transport capabilities standardised and implemented, are these fundamental network functions now interchangeable between optical and packet transport layers? Can the network be optimised to make a particular layer redundant? What are the benefits and drawbacks of doing so? What is the end game – or target architecture – for carriers? What will

the impact on strategic network investment and planning be over the next decade?

This panel will present and debate different perspectives arising from service requirements, architectures, geographies, regulatory regimes and historical investments – and discuss those differences. What does the future path hold? Can we yet glimpse the Emerald City of Convergence?

Speakers:

Network Convergence: Some Practical Considerations

Bob Feuerstein, *Principal Architect Transmission, BT Innovate & Design, USA*

The god box was first discussed back in the late 1990s; one box that could do it all for a service provider. That turned out to be premature. But now with the new generation of equipment perhaps we are going to really see one. Is it a good box? The devil is in the details as usual. Combining the management systems for three layers, with much new functionality, and making it usable, testable, and affordable is the test carriers will apply before deploying it. The first applications will be niche applications in the network. Once a positive operational experience and attractive financials have been demonstrated, widespread adoption will follow. The issues of regulatory restrictions, competition, training staff, effective design tools, lifecycles of existing technologies, evolving customer requirements, traffic growth and its variability in time and location, all factor into how quickly these new technologies will be deployed.

Bob Feuerstein is the Principal Architect for Transmission and Synchronization Systems for BT. He received his PhD in Electrophysics from Polytechnic University, Brooklyn, NY. He then joined the NSF Optoelectronic Computing Systems Center at the University of Colorado. There he researched optical

computing, optical communications and helped build the world's first stored program fiber optic computer. He taught classes in optoelectronics and optical communications. He worked in congress for one year after receiving an appointment as the IEEE Congressional Science and Engineering Fellow (1998). He worked at Level 3 Communications as a Senior Architect supporting Level 3's customers and internal optical network design requirements. He joined BT in 2008. He has spoken at dozens of technical and corporate meetings and authored 20+ publications on optical communications, network architecture and design. And he enjoys relaxing on his sailboat, Lightwaves, on Lake Champlain during summer holidays.

Drivers for Convergence of Layers 1-2-3

Frank Rühl, *Emerging Technology Manager Fixed Network Technologies, Innovation and Chief Technology Office at Telstra, Australia*

In recent years we have seen a transition from purpose built service-specific networks that were tightly vertically integrated to NGN networks that support reuse and flexibility of horizontal network layers. This has given much needed flexibility and increased speed to market to deliver new services. At the same time network traffic is growing rapidly driven especially by video based traffic types. In order to build sustainable networks businesses supporting the new services and growing traffic, operators must build smarter networks. Varied degrees of convergence of layers 1, 2 and 3 provide ways of delivering more cost effective architectures that can meet this challenge. There is also an intrinsic technological convergence of layers with a range of new emerging technologies. This paper will discuss the drivers for the convergence of network layers and technologies supporting this convergence.

Frank Rühl is the Emerging Technology Manager for Fixed Network Technologies in the Innovation and Chief Technology Office of Telstra. He is

responsible for developing strategies for the future evolution of the Telstra fixed network and the underlying technologies, including Transport, Aggregation, Broadband Access, IP Core Networks and Network Control. He holds a PhD in optical communications from the Australian National University and has been working in optical communications research and its application to telecommunications networks for nearly 30 years. He has been instrumental in the introduction and evolution of optical transport networks in Telstra's network and various major technology evolution studies. He has been an Invited speaker at OFC, COIN and NFOEC international conferences.

Technical Aspects for Layer-converged Platform - NTT Labs Viewpoints

Masahito Tomizawa, *Group Leader, Senior Research Engineer, NTT Network Innovation, Japan*

This presentation overviews layer-converged platform of Packet-Optical Transport Systems (P-OTS) from the viewpoint of a carrier's R&D. Starting from a motivation, next-generation network architecture, protocol-choices, convergence-level, and required functions are discussed. Some example of an efficient bandwidth usage by inter-layer grooming will be introduced. Carrier's hope of clear standards and the market evolution will be addressed.

Masahito Tomizawa is a senior research engineer, group leader, at NTT Network Innovation Labs. He received M.S. and Ph.D. in Applied Physics from Waseda University, Tokyo, in 1992 and 2000,
respectively. From 2003 to 2004, he was a visiting scientist at MIT. He has been engaged in high-speed optical transmission systems and their deployments, as well as international standardization in ITU-T, and also international carrier-to-carrier collaboration for several years.

How Do We Get There

Glenn Wellbrock, *Director of Backbone Network Architecture, Verizon Business, USA*

Network convergence appears achievable today if, and only if, service convergence can be achieved. Router suppliers are developing impressive optical systems and OTN suppliers already have optical systems. The issue is neither appears to have scalable platforms today that can support all IP and TDM service requirements. This presentation will focus on network implications as we aggressively migrate toward all-packet services while still supporting higher rate TDM services.

Glenn Wellbrock is the Director of Optical Transport Network Architecture and Design at Verizon, where he is responsible for the development of new technologies for both the metro and long haul transport infrastructure. Previous positions include running the advanced technology lab, establishing evaluation criteria, and setting engineering guidelines for all backbone transport equipment as well as various positions within network operations. In addition to his 20+ years at Verizon (1984-2001 & 2004-present), Glenn was responsible for Product Architecture within the USA focused optical networks group at Marconi and Product Planning at Qplus Networks with a specific focus on developing alternative modulation techniques.

Panel II: Role of the Network in the Age of Social Media

Wednesday, March 7, 2012

Moderator:

Neil Farquharson, *Technology Evangelist, Alcatel-Lucent, USA*

 Neil Farquharson has been presenting to audiences in a variety of settings for over 25 years; with the most recent seven years being in the telecommunications industry. His appearances include NANOG, APCO and Light Reading among others, and Neil is a frequent guest lecturer at the University of Texas at Dallas School of Management.

His background includes 13 years in the manufacturing industry managing the production of goods as disparate as shielded thermocouples, monocrystalline germanium and confectionary. For the last seven years he has worked as a marketing manager for Alcatel-Lucent focusing on making the high tech world of telecoms more understandable to its staff and customer clients. Neil holds degrees from the University of Glasgow, Scotland, and the University of Texas at Dallas.

Panel Description:

This panel will discuss possible developments in Social Media and how these can be planned for. How will these developments affect investments in the data centers, networks and end-user interfaces? We know that there will be many new application demands; yet without the means to forecast them accurately, how do we plan to architect for them? Does it make sense to let Social Media develop without interference, or is it to our financial advantage to encourage a particular evolutionary path

Speakers:

 **Shamim Akhtar,** *Sr. Director, Network Architecture & Technology, Comcast, USA*

Shamim Akhtar, Senior Director/Network Architecture & Technology at Comcast, is responsible for driving the network technology platform and architecture roadmap for the operator's truly converged national IP backbone, metro, edge and access network. His technology and operations leadership, both inside and outside Comcast, has brought tremendous momentum in the area of vendor-agnostic network scaling to support triple-play residential, MEF-based business services and mobile backhaul services over one converged IP/optical network. He has been a key contributor to the recently founded "100G and beyond" user group in North America along with being a founding member of DOCSIS provisioning of EPON/10G EPON for business-services scalability. In addition, Akhtar has been involved in critical technology acquisition-and-investment decisions in the IP/optical industry with the help of his experience and insight on the length and breadth of network technologies and their operational models. He is an IIT Kharagpur graduate with working knowledge of MSO/Carrier networking in North America, Europe and APAC through his prior experience with Philips, VPISystems and IPI/Ciena.

 **Jan Dawson,** *Chief Telecoms Analyst, Ovum, USA*

Jan Dawson is Ovum's Chief Telecoms Analyst, and is responsible for leading the overall Ovum Telecoms research agenda. In addition, Jan is responsible for the quality of the Ovum Telecoms product, and in both these capacities he works closely with clients to understand their needs and how to ensure that the Ovum Telecoms team meets those needs through their research. Jan also leads

the Collaborative Intelligence initiative on behalf of the Ovum Telecoms group. During his time at Ovum he has been in the field of regulation, where he advised clients on interconnection and regulatory policy, and also acted as a lead author on two reports on DSL business model abd led Ovum's research on wireline carrier strategy globally. Jan has a BA in Politics and Psychology from the University of Manchester, and lives in central New Jersey.

Bikash Koley, *Technical Lead and Manager, Network Architecture and Capacity Planning, Google Inc, USA*

Bikash is currently the Tech Lead and Manager of Network Architecture and Capacity Planning at Google, where he is focused on network infrastructure scaling, optimization and reliability. Prior to Google, Bikash was the CTO of Qstreams Networks, a company he co-founded. Bikash also spent several years at Ciena Corporation in various technical roles developing DWDM and Ethernet technologies. Bikash is a frequent speaker in conferences and industry forums and is an active participant in various networking standard bodies. He received a B.Tech. from IIT, India; and M.S. and Ph.D. from the University of Maryland at College Park, all in Electrical Engineering.

Donn Lee, *Senior Network Engineer, Facebook, USA*

Donn Lee is a Sr. Network Engineer at Facebook. His duties include designing networks, evaluating products, optimizing performance, and performing escalation troubleshooting. Previous to Facebook, Donn worked in Google's Network Architecture group for four years and during tremendous growth of Google's backbone, optical, and datacenter networks. While working as a

Consulting Systems Engineer at Cisco Systems, he worked on large global networks and wrote his book, Enhanced IP Services for Cisco Networks, that is published by Cisco Press. He holds a bachelor's degree in Electrical Engineering from UCLA.

Tom Issenhuth, *Optical Network Architect, Microsoft*

Tom Issenhuth is the optical network architect for Microsoft and is responsible for the architecture and roadmap of Microsoft's optical backbone. Tom's role includes ensuring Microsoft's optical network has the service capabilities, scale, cost structure and global reach to meet Microsoft's fast growing and changing optical transport requirements.

While new to Microsoft Tom has 23 years of optical networking experience including 14 years at Level 3 Communications and 9 years at MFS Telecom and MFS International. While at Level 3 and MFS Tom was responsible for the equipment selection and architecture of numerous intercity, metro and trans-oceanic optical transport networks.

Tom has a bachelor's degree in Electrical Engineering from Iowa State University.

OFC/NFOEC Press Releases

Below is a comprehensive listing of news releases from OFC/NFOEC 2012. Stay tuned for news from OFC/NFOEC 2013. Should you have any questions, please email media@ofcconference.org.

Title	Date
OFC/NFOEC Ends on High Note in Los Angeles	Mar 12, 2012
2012 Corning Student Paper Competition Winner Announced	Mar 06, 2012
Anonymous Donor Agrees to Match Up to $50,000 of Donations to Paul Bonenfant Memorial Scholarship	Mar 02, 2012
Graphene-Based Optical Modulators Poised to Break Speed Limits in Digital Communications	Mar 01, 2012
On the Path to 1 Terabit-Per-Second Networks	Mar 01, 2012
OFC/NFOEC 2012 to Feature Breakthrough Research, Industry-focused Programming at the World's Leading Optical Communications Event	Feb 28, 2012
Record-Speed Wireless Data Bridge Demonstrated: Takes High-Speed Communications the 'Last Mile'	Feb 27, 2012
OFC/NFOEC to Host World-Class Exposition Featuring 500+ Optical Communications Companies and Dynamic Business Programming	Feb 24, 2012
Transforming Computers of the Future with Optical Interconnects	Feb 23, 2012
OSA Foundation Announces 2012 Corning Student Paper Competition Finalists	Feb 17, 2012
OFC/NFOEC Expands Programming to Address Trends in Datacom	Feb 13, 2012
OSA Foundation Launches Paul A. Bonenfant Memorial	Jan 11,

Scholarship Campaign	2012
OFC/NFOEC 2012 Plenary Session to Feature Japanese Government Official's Perspective on Telecom Network Disaster Recovery	Dec 06, 2011
John Bowers Wins 2012 John Tyndall Award	Nov 10, 2011
Tech Industry Veteran Greg Papadopoulos to Keynote OFC/NFOEC 2012 Plenary Session	Oct 27, 2011
Google's Milo Medin to Keynote OFC/NFOEC 2012 Plenary Session	Sep 15, 2011

Exhibitor News

Many prominent industry corporations unveil innovative new products and research at OFC. Below is a comprehensive list of news from OFC/NFOEC 2012 Exhibitors. Stay tuned for news from OFC/NFOEC 2013.

Please contact Angela Stark, OFC/NFOEC's Communications Director, at 202.416.1443 or via email at media@ofcconference.org with any questions.

Company	Title	Date
Anritsu Company	Anritsu Teams with Kotura to Demonstrate 25-28 Gb/s Optical Links Designed to Support 100 Gb/s Network Applications at OFC	Mar 06, 2012
Anritsu Company	Anritsu and Sumitomo Electric to Conduct Joint Demonstration of Optical Module Technology During OFC	Mar 06, 2012

CALIENT Technologies	CALIENT Debuts First High-Density Photonic Switch For Data Centers	Mar 06, 2012
Fraunhofer Institut HHI	Modular Multi-Terabit Turn-Key Solution for Testing your Elastic Optical Network Designs	Mar 06, 2012
OE Solutions	Bringing intelligence to SFP simplifies system design for network operators	Mar 06, 2012
AppliedMicro	AppliedMicro Demonstrates End-to-End OTN: Any Rate, Any Port	Mar 06, 2012
IEEE	IEEE Members Predict Innovations in Optical Fiber at OFC/NFOEC 2012	Mar 06, 2012
Anritsu Company	Anritsu to Display High-Speed Signal Integrity Solutions at OFC	Mar 06, 2012
Source Photonics	Source Photonics expands 40G/100G product family for client side applications	Mar 06, 2012
Source Photonics	Source Photonics Introduces its 10GEPON Symmetric OLT and ONU Solutions	Mar 06, 2012
EMCORE	EMCORE Launches 120 Gbps CXP Active Optical Cable	Mar 06, 2012
Source Photonics	Source Photonics Introduces its 10GEPON Symmetric OLT and ONU Solutions	Mar 06, 2012
Source Photonics	Source Photonics expands 40G/100G product family for client side applications	Mar 06, 2012
Molex	Molex At The Forefront Of High-Speed Interconnect Solutions For Next-Generation High-Performance Systems	Mar 05, 2012

Mindspeed Technologies	Mindspeed Fuels Faster Optical Networking with Complete 10-Gigabit Passive Optical Network Physical Media Device Chipset Solution	Mar 05, 2012
Mindspeed Technologies	Mindspeed Extends GPON and GEPON Leadership with Next-Generation Optical Networking Unit Burst-Mode Driver Solution	Mar 05, 2012
Broadcom Corporation	Broadcom Expands Industry's Broadest Portfolio of 10GbE and 40GbE PHYs	Mar 05, 2012
Broadcom Corporation	Broadcom Announces World's First CMOS 40G Serial Mux/Demux Chipset	Mar 05, 2012
EMCORE	EMCORE Launches micro-ITLA Tunable Laser for Coherent Applications	Mar 05, 2012
EMCORE	EMCORE Introduces 40 and 100 Gbps CFP Optical Transceiver Modules for Ethernet Applications	Mar 05, 2012
ViaSat, Inc.	ViaSat Now Shipping Forward Error Correction (FEC) for 200G	Mar 05, 2012
EMCORE	Enhanced Feature Set of EMCORE Tunable XFP Transceivers Provides Flexibility to Next-Generation Optical Networks	Mar 02, 2012
CALIENT Technologies	CALIENT Announces Slate of New Product Launch Activities at OFC/NFOEC	Mar 01, 2012
CIENA Corporation	Phonoscope Selects Ciena Packet-Optical and Carrier Ethernet Solutions for Next Generation Metro Network	Jan 31, 2012
OE Solutions	OE Solutions Introduces Plastic Optical	Mar 09, 2011

	fiber (POF) Transceiver for Home Networking Applications	
Verizon, EXFO and General Photonics	Verizon, EXFO, and General Photonics Mark First PMD Measurement	Mar 09, 2011
NTT Advanced Technology Corporation	NTT Advanced Technology Introduces New Optical Connector Cleaner, NeoClean EZ	Mar 08, 2011
Tektronix Component Solutions	Tektronix Component Solutions Introduces Instrument-grade Microwave Modules	Mar 08, 2011
Tektronix Component Solutions	Tektronix Component Solutions Announces 30 GHz Leadless Chip Carrier Packaging Platform	Mar 08, 2011
Opnext, Inc.	Opnext Introduces Next Generation 40G DPSK Line-Side Module	Mar 08, 2011
Opnext, Inc.	Opnext Demonstrates 40GBASE-LR4 QSFP+ Transceiver Module at Industry Leading OFC/NFOEC Conference	Mar 08, 2011
Opnext, Inc.	Opnext Demonstrates Tunable TOSA at OFC/NFOEC	Mar 08, 2011
Optelian	Optelian Announces 80-Channel High-Bandwidth Optical Networking Platform	Mar 08, 2011
OE Solutions	OE Solutions Announces Successful Demonstration of 10GbE Single Wavelength Bi-Directional (SWBiDi) XFP	Mar 08, 2011
Semtech Corporation	Semtech Ships First 100G CFP MSA-Compliant Gearbox IC Platform for 100G Optical Networks	Mar 08, 2011

Glimmerglass Networks	Glimmerglass Networks Speaks on Intelligent Optical Signal Management and Network Performance Monitoring at OFC/NFOEC 2011	Mar 08, 2011
Gennum Corporation	Gennum Enables 100Gb/s Networks with 25Gb/s Reference-Free Clock and Data Recovery ICs	Mar 08, 2011
Analog Devices Inc.	Industry's First 11-Gbps and 6-Gbps Integrated Optical Receivers Unveiled At OFC 2011	Mar 08, 2011
VPIsystems	VPItransmissionMaker™ / VPIcomponentMaker™ Version 8.6 - Dramatic Speedup Through Multithreading and GPU-assisted Simulations	Mar 07, 2011
NeoPhotonics Corporation	NeoPhotonics® Photonic Integrated Circuit (PIC) Products Surpass 3 Billion Operating Hours Without A Reported Field Failure	Mar 07, 2011
Sumitomo Electric Device Innovations U.S.A., Inc	Sumitomo Electric and Ixia to Demonstrate 40 GbE CFP Transceiver for Distances up to 40 km at OFC 2011	Mar 07, 2011
Sumitomo Electric Device Innovations U.S.A., Inc	Sumitomo Electric to Showcase 25 Gb/s EML TOSA and PIN ROSA for 100G Base-LR4 at OFC 2011	Mar 07, 2011
OE Solutions	OE Solutions Announces Industry's First Industrial Temperature CWDM/DWDM XFP Transceiver for Metro WDM Networks in Uncontrolled Environments	Mar 07, 2011
Nokia Siemens Networks US LLC (NSN)	Nokia Siemens Networks Delivers Smart Transport at OFC/NFOEC	Mar 07, 2011

Nokia Siemens Networks US LLC (NSN)	UTS Users Enjoy High-speed Data Services	Mar 07, 2011
Opnext, Inc.	Opnext High Speed Technology Leadership Highlighted	Mar 07, 2011
Opnext, Inc.	Opnext Announces Production Release of 40GBASE-LR4 CFP Transceiver	Mar 07, 2011
Semtech Corporation	Semtech 40G MUX/DEMUX Platform Enables JDSU 40G Metro Optical Network Transponder Solutions	Mar 07, 2011
Optelian	Optelian Expands Product Portfolio; Announces Availability of Tunable XFPs	Mar 07, 2011
NeoPhotonics Corporation	NeoPhotonics Chairman to Join Optical Components Panel	Mar 04, 2011
Optical Internetworking Forum	The OIF Looks Beyond 100G at OFC/NFOEC	Mar 04, 2011
Infinera	Infinera to Present on Next-Generation PICs and Systems at OFC	Mar 04, 2011
Infinera	Infinera Presents on First-Ever Terabit PIC at OFC	Mar 04, 2011
Nokia Siemens Networks US LLC (NSN)	Nokia Siemens Networks and Juniper Networks Conduct 100G Interoperability Trial	Mar 04, 2011
JDSU	JDSU to Highlight Key Technology at OFC/NFOEC 2011	Mar 04, 2011
VPIsystems	VPIcomponentMaker Photonics Circuits - New Design Tool for Large-scale Photonic Integrated Circuits	Mar 04, 2011

Oclaro, Inc.	Oclaro Showcases High-Speed Optical Networking Leadership During OFC/NFOEC 2011; Executives Presenting on Three Panels	Mar 04, 2011
Molex	Molex QSFP+ Active Optical Cable (AOC) Assemblies Provide Unmatched Reach at a Fraction of the Power	Mar 03, 2011
Kaiam Corp.	Kaiam Demonstrates 40gb/S Transmitter and Receiver Optical Subassemblies For Lr4 Applications at OFC/NFOEC 2011	Mar 03, 2011
Proximion Fiber Systems AB	Proximion Doubles Production Capacity to Meet Record Demand	Mar 03, 2011
Fibotec Fiberoptics GmbH	Monitoring Band PON-OTDR	Mar 02, 2011
Gould Technology, LLC	Gould Fiber Optics Celebrates Its 25th Anniversary as a Leader in Manufacturing and Supplying Fiber Optic Components and Integrated Assembly Solutions	Mar 02, 2011
TeraXion, Inc.	TeraXion Introduces Coherent Communication Products Portfolio	Mar 02, 2011
EXFO	Strong EXFO Contribution to the Technical Program at OFC/NFOEC 2011	Mar 01, 2011
3M Communication Markets Division	Optelian Partners with Bharat Electronics Ltd. of India	Feb 14, 2011
VPIsystems	MRV Deploys VPILinkConfigurator for Optical Network Design	Feb 14, 2011
IPtronics	IPtronics Releases New 4ch Chip Set	Feb 10, 2011

Telescent Inc	Telescent Inc. Awarded a U.S. Department of Energy SBIR Phase II Research Grant	Feb 08, 2011
Gould Technology, LLC	Gould Fiber Optics: Recipient of U.S. Navy's Life of Type Buy Award to Supply Optical Fiber Splitters in Support of Modernization of the Trident Missile Guidance System	Feb 03, 2011
Light Brigade, Inc., The	Light Brigade to Host CFHP Course at 2011 Optical Fiber Communication Conference	Jan 19, 2011
Telescent Inc	Telescent Awarded a U.S. Department of Energy Research Grant to Develop Massively Scalable Automated Patch-Panels for “Lights-out” Data Centers and Communication Networks	Jan 05, 2011
IPtronics	IPtronics Offers New Low Cost Silicon	Jan 05, 2011
Hittite Microwave Corporation	Three New MMIC Phase Shifters Span 1.2 to 8 GHz	Dec 21, 2010
Seikoh Giken Co., Ltd.	Seikoh Giken Company Introduces FerrulePro™ – The World’s First Benchtop Fiber Cleaner	Dec 07, 2010
Analog Modules, Inc.	OEM Seed Laser Diode Driver Assembly	Aug 19, 2010

Short Courses

General Information

Short Courses cover a broad range of topic areas at a variety of educational levels. The courses are taught by highly regarded industry experts on a number of subjects.

Short Courses are an excellent opportunity to learn about new products, cutting-edge technology and vital information at the forefront of communications. Whether you choose a course designed for beginners or for more advanced instruction, the small size of each class gives you an excellent opportunity for personalized instruction. Short Courses are also an opportunity to earn Continuing Education Units (CEUs) and to meet one of the key requirements to maintaining your PE license.

Continuing Education Units (CEUs)

The CEU is a nationally recognized unit of measure used to quantify continuing education and training activities. Continuing Education Units (CEUs) were created as a way to document noncredit work in specifically developed activities for adult learners in a variety of disciplines. One CEU is defined as "10 contact hours of participation in an organized continuing education experience under responsible sponsorship, capable direction, and qualified instruction.

Registration

Register for a Short Course and you also receive free admission to:

- OFC/NFOEC Exhibition
- Plenary Session
- Workshops
- Market Watch
- Service Provider Summit
- Exhibit Floor Activities

Attendee Testimonials

"I think is one of the best short courses of OFC, this is the second time that I took it and it has a lot of new things. Neal Bergano is an excellent instructor, extremely articulate breaks down difficult comcepts to understandablematters."

*Attendee of **SC102 WDM in Long-Haul Transmission Systems** instructed by Neal S. Bergano*

"Extremely clear and engaging presentation, from a knowledgeable presenter."
*Attendee of **SC114 Passive Optical Networks (PONs) Technologies** instructed by Frank Effenberger*

"Dr. Willner presented very complex topics in a very clear way. He is a gifted and knowledgeable presenter."
*Attendee of **SC141 Combating and Monitoring Data-Degrading Effects in Non-Static WDM Systems** instructed by Alan Willner.*

"John Bowers is a great teacher! I enjoyed the course and highly recommend it."
*Attendee of **SC177 High-Speed Semiconductor Lasers and Modulators** instructed by John Bowers.*

"This is the best short course I attended in a few years. It's absolutely helpful for beginners."
*Attendee of **SC187 Hands-on Basic Fiber Optics for the Absolute Beginner** instructed by Dennis Horwitz*

"The instructor was eloquent and knowledgeable in network planning. Enough time was given for questions - Network demo example at the end of the course was also very helpful. Excellent course!!!"
*Attendee of **SC216 An Introduction to Optical Network Design and Planning** instructed by Jane Simmons*

"Thank you very much for a great course!"
*Attendee of **SC243 Next Generation Transport Networks: The Evolution from Circuits to Packets** instructed by Ori Gerstel*

"Excellent course. Presenter was excellent. The course was very well put together and delivered to wider audiences with diverse expertise."
*Attendee of **SC261 ROADM Technologies and Network Applications** instructed by Thomas Strasser*

"This is a very important course for beginners. The instructor is very skilled and has well organized presentation slides."
*Attendee of **SC289 Basics of Optical Communication Systems and WDM** instructed by Gerd Keiser*

"Really excellent course. Both an optics refresher/primer as well as modeling 101. Very glad I attended."
*Attendee of **SC327 Modeling and Design of Fiber-Optic Communication Systems** instructed by René Jean Essiambre*

"This is a very good course. I can recommend it to everybody who is interested in 40/100G ethernet technologies."
*Attendee of **SC356 40G/100G Ethernet Technologies and Applications** instructed by Ishida Osamu*

"Lisa did an excellent job of covering the basics as well as emerging trends in datameters. The case studies at the end brought home the considerations extremely well!"
*Attendee of **SC358 Data Center Cabling: Transitioning from Copper to Fiber** instructed by Lisa Huff*

Short Courses by Topic

View Short Courses by Date/Time

Category 1. Optical Network Applications and Services
Category 2. Network Technologies and Applications
Category 3. FTTx Technologies, Deployment, and Applications
Category 5. Fibers and Optical Propagation Effects
Category 6. Fiber and Waveguide-Based Devices: Amplifiers, Lasers, Sensors, and Performance Monitors
Category 7. Optical Devices for Switching, Filtering and Interconnects
Category 8. Optoelectronic Devices
Category 9. Digital Transmission Systems
Category 10. Transmission Subsystems and Network Elements

Category 11. Optical Processing and Analog Subsystems
Category 12. Core Networks
Category 13. Access Networks
Category 14. Optical Networking, Technologies, and Applications for Datacom and Computercom
Additional Short Course Category: Industry Best Practices

Category 1. Optical Network Applications and Services

SC102 WDM in Long-Haul Transmission Systems
Neal S. Bergano; TE SubCom, USA

SC171 Introduction to Optical Control Plane Concepts, Technologies and Practices
Greg Bernstein; Grotto Networking, USA

SC176 Metro Network: The Transition to Ethernet
Loudon Blair; CIENA Corp., USA

Sold Out SC203 40/100 Gb/s Transmission Systems, Design and Design Trade-offs
Benny Mikkelsen[1], Martin Birk[2]; [1]Acacia Communications, USA, [2]AT&T Labs, USA

SC243 Next Generation Transport Networks: The Evolution from Circuits to Packets
Ori A. Gerstel; Cisco Systems, USA

SC261 ROADM Technologies and Network Applications
Thomas Strasser; Nistica Inc., USA

SC264 Introduction to Ethernet Technologies
Jeffrey Cox; Juniper Networks, USA

SC327 Modeling and Design of Fiber-Optic Communication Systems
René-Jean Essiambre; Bell Labs, Alcatel-Lucent, USA

SC328 New Developments in Optical Transport Networking (OTN)
Stephen Trowbridge; Alcatel-Lucent, USA

SC356 40G/100G Ethernet Technologies and Applications
Osamu Ishida; NTT, Japan

New Course! SC371 Multi-Layer Control Plane Technologies - Managing Hybrid Networks
Lou Berger, Labn Consulting, USA; Wes Doonan, Adva Optical, USA

Category 2. Network Technologies and Applications

SC101 Hands-on Workshop on Fiber Optic Measurements and Component Testing
Caroline Connolly[1], Chris Heisler[1], Joseph Bos[2], Michelle Collier[3], [1]OptoTest Corp., USA, [2]Luna Technologies, USA, [3]AFL Telecommunications, USA

SC176 Metro Network: The Transition to Ethernet
Loudon Blair; CIENA Corp., USA

SC178 Test and Measurement of High-Speed Communications Signals
Greg LeCheminant; Agilent Technologies, USA

SC185 Hands-on Polishing, Inspection and Testing of Connectors
Jerry Renville[1], Steve Baldo[2], Neal Wagman[3]; [1]Light Brigade Inc., USA, [2]Seikoh Giken Co. Ltd., USA, [3]Norland Products, USA.

SC187 Hands-on Basic Fiber Optics for the Absolute Beginner
Dennis Horwitz; Micronor Inc., USA

Sold Out SC203 40/100 Gb/s Transmission Systems, Design and Design Trade-offs
Benny Mikkelsen[1], Martin Birk[2]; [1]Acacia Communications, USA, [2]AT&T Labs, USA

SC210 Hands-on Polarization-Related Measurements Workshop
Daniel Peterson[1], Tasshi Dennis[2], Brian Teipen[3], Christine Tremblay[4]; [1]Verizon, USA, [2]NIST, USA, [3]ADVA Optical Networking, USA, [4]École de technologie supérieure, Université du Québec, Canada.

SC264 **Introduction to Ethernet Technologies**
Jeffrey Cox; Juniper Networks, USA

SC266 **Quantum Cryptography and Quantum Information**
Richard Hughes[1], Thomas Chapuran[2]; [1]Los Alamos Natl. Lab, USA, [2]Telcordia, USA

Sold Out SC291 **Hands-on Fiber Optics for Engineers Designing for Military, Aerospace, Shipboard and Industrial Harsh Environmental Applications**
Dennis Horwitz; Micronor Inc., USA

New Course! SC312 **Parametric Optical Processing and Systems**
Stojan Radic; UCSD, USA

SC314 **Hands-on Fiber Characterization for the Engineering of Long Haul and Metro Deployments**
Daniel Peterson[1], Christine Tremblay[2]; [1]Verizon, USA, [2]École de technologie supérieure, Université. du Québec, Canada

SC347 **Reliability and Qualification of Fiber-Optic Components**
David Maack; Corning, USA.

SC360 **Hands-On Fiber Optic Terminations and Measurements with Emphasis on MTP Connectorized Ribbon Fiber**
Caroline Connolly[1], Loïc Cherel[2], Tony Nicholson[3], Mike Hughes[4], [1]OptoTest Corp., USA, [2]Data-Pixel SAS, France, [3]Connected Fibers, USA, [4]Conec Ltd., USA

New Course! SC384 **Background Concepts of Optical Communication Systems**
Alan Willner; Univ. of Southern California, USA

Category 3. FTTx Technologies, Deployment, and Applications

SC101 **Hands-on Workshop on Fiber Optic Measurements and Component Testing**
Caroline Connolly[1], Chris Heisler[1], Joseph Bos[2], Michelle Collier[3], [1]OptoTest Corp., USA, [2]Luna Technologies, USA, [3]AFL Telecommunications, USA

SC114 **Passive Optical Networks (PONs) Technologies**
Frank J. Effenberger; Huawei Technologies, USA

SC187 **Hands-on Basic Fiber Optics for the Absolute Beginner**
Dennis Horwitz; Micronor Inc., USA

SC264 **Introduction to Ethernet Technologies**
Jeffrey Cox; Juniper Networks, USA

SC267 **Silicon Microphotonics: Technology Elements and the Roadmap to Implementation**
Lionel Kimerling; MIT, USA

SC347 **Reliability and Qualification of Fiber-Optic Components**
David Maack; Corning, USA.

Category 5. Fibers and Optical Propagation Effect

SC208 **Optical Fiber Design for Telecommunications and Specialty Applications**
David J. DiGiovanni; OFS Labs, USA.

SC210 **Hands-on Polarization-Related Measurements Workshop**
Daniel Peterson[1], Tasshi Dennis[2], Brian Teipen[3], Christine Tremblay[4]; [1]Verizon, USA, [2]NIST, USA, [3]ADVA Optical Networking, USA, [4]École de technologie supérieure, Université du Québec, Canada.

SC288 **Fundamentals of Polarization, PDL, and PMD**
Nicholas Frigo Ph.D; US Naval Academy, USA

SC289 **Basics of Optical Communication Systems and WDM**
Gerd Keiser[1],[2]; [1]PhotonicsComm Solutions Inc., USA, [2]Natl. Taiwan Univ. of Science and Technology, Taiwan

SC360 **Hands-On Fiber Optic Terminations and Measurements with Emphasis on MTP Connectorized Ribbon Fiber**

Caroline Connolly[1], Loïc Cherel[2], Tony Nicholson[3], Mike Hughes[4], [1]OptoTest Corp., USA, [2]Data-Pixel SAS, France, [3]Connected Fibers, USA, [4]Conec Ltd., USA

New Course! SC373 Specialty Fiber Splicing and Interconnection
Andrew Yablon; Interfiber Analysis, USA

Category 6. Fiber and Waveguide-Based Devices: Amplifiers, Lasers, Sensors, and Performance Monitors

SC208 Optical Fiber Design for Telecommunications and Specialty Applications
David J. DiGiovanni; OFS Labs, USA.

SC267 Silicon Microphotonics: Technology Elements and the Roadmap to Implementation
Lionel Kimerling; MIT, USA

New Course! SC384 Background Concepts of Optical Communication Systems
Alan Willner; Univ. of Southern California, USA

Category 7. Optical Devices for Switching, Filtering, and Interconnects

SC265 Passive Optical Components and Filtering Technologies
Bruce Nyman[1], Christi Madsen[2]; [1]TE SubCom, USA, [2]Texas A&M Univ., USA

New Course! SC384 Background Concepts of Optical Communication Systems
Alan Willner; Univ. of Southern California, USA

Category 8. Optoelectronic Devices

SC177 High-Speed Semiconductor Lasers and Modulators
John Bowers; Univ. of California at Santa Barbara, USA

SC178 **Test and Measurement of High-Speed Communications Signals**
Greg LeCheminant; Agilent Technologies, USA

SC182 **Biomedical Optical Diagnostics and Sensing**
Thomas Huser; Univ. of California at Davis, USA

SC289 **Basics of Optical Communication Systems and WDM**
Gerd Keiser[1],[2]; [1]PhotonicsComm Solutions Inc., USA, [2]Natl. Taiwan Univ. of Science and Technology, Taiwan

SC325 **Highly Integrated Monolithic Photonic Integrated Circuits**
Christopher R. Doerr Ph.D; *Acacia Communications, Inc., USA*

Category 9. Digital Transmission Systems

SC102 **WDM in Long-Haul Transmission Systems**
Neal S. Bergano; TE SubCom, USA

Sold Out SC203 **40/100 Gb/s Transmission Systems, Design and Design Trade-offs**
Benny Mikkelsen[1], Martin Birk[2]; [1]Acacia Communications, USA, [2]AT&T Labs, USA

SC289 **Basics of Optical Communication Systems and WDM**
Gerd Keiser[1],[2]; [1]PhotonicsComm Solutions Inc., USA, [2]Natl. Taiwan Univ. of Science and Technology, Taiwan

SC314 **Hands-on Fiber Characterization for the Engineering of Long Haul and Metro Deployments**
Daniel Peterson[1], Christine Tremblay[2]; [1]Verizon, USA, [2]École de technologie supérieure, Université. du Québec, Canada

SC327 **Modeling and Design of Fiber-Optic Communication Systems**
René-Jean Essiambre; Bell Labs, Alcatel-Lucent, USA

Sold Out SC342 **Digital Coherent Optical Systems**
Maurice O'Sullivan; Ciena, Canada

New Course! SC369 Test and Measurement of Complex Modulated Optical Signals
Bernd Nebendahl & Oliver Funke, Agilent Technologies, Germany

New Course! SC370 FEC Technology in Optical Communications
Takashi Mizuochi and Yoshikuni Miyata; Mitsubishi Electric, Japan

New Course! SC372 Energy-Efficiency Networking
Rod S. Tucker, and Kerry Hinton, Univ. Melbourne, Australia

New Course! SC384 Background Concepts of Optical Communication Systems
Alan Willner; Univ. of Southern California, USA

Category 10. Transmission Subsystems and Network Elements

SC101 Hands-on Workshop on Fiber Optic Measurements and Component Testing
Caroline Connolly[1], Chris Heisler[1], Joseph Bos[2], Michelle Collier[3], [1]OptoTest Corp., USA, [2]Luna Technologies, USA, [3]AFL Telecommunications, USA

SC105 Modulation Formats and Receiver Concepts for Optical Transmission Systems
Peter Winzer, Chandrasekhar Sethumadhavan, Xiang Liu; Bell Labs, Alcatel-Lucent, USA.

SC141 (course has been changed to SC384)
Alan Willner; Univ. of Southern California, USA.

SC178 Test and Measurement of High-Speed Communications Signals
Greg LeCheminant; Agilent Technologies, USA

SC205 Integrated Electronic Circuits and Signal Processing for Fiber Optics
Y. K. Chen, Noriaki Kaneda; Bell Labs, Alcatel Lucent, USA.

SC239 Short-Reach Optical Interconnects
Steve Joiner; Finisar, USA

SC259 **Electronic and Optical Impairment Mitigation**
Chris Fludger[1], Seb Savory[2]; [1]CoreOptics GmbH, Germany, [2]Univ. College London, United Kingdom.

SC289 **Basics of Optical Communication Systems and WDM**
Gerd Keiser[1],[2]; [1]PhotonicsComm Solutions Inc., USA, [2]Natl. Taiwan Univ. of Science and Technology, Taiwan

SC341 **OFDM for Optical Communications**
Sander L. Jansen; Nokia Siemens Networks, Germany

SC360 **Hands-On Fiber Optic Terminations and Measurements with Emphasis on MTP Connectorized Ribbon Fiber**
Caroline Connolly[1], Loïc Cherel[2], Tony Nicholson[3], Mike Hughes[4], [1]OptoTest Corp., USA, [2]Data-Pixel SAS, France, [3]Connected Fibers, USA, [4]Conec Ltd., USA

New Course! SC384 **Background Concepts of Optical Communication Systems**
Alan Willner; Univ. of Southern California, USA

Category 11. Optical Processing and Analog Subsystems

SC160 **Microwave Photonics**
Keith Williams; Naval Research Lab, USA.

SC217 **Hybrid Fiber Radio – The Application of Photonic Links in Wireless Communications**
Dalma Novak, PhD; Pharad, LLC, USA

New Course! SC384 **Background Concepts of Optical Communication Systems**
Alan Willner; Univ. of Southern California, USA

Category 12. Core Networks

SC171 **Introduction to Optical Control Plane Concepts, Technologies and Practices**
Greg Bernstein; Grotto Networking, USA

SC216 **An Introduction to Optical Network Design and Planning**
Jane M. Simmons; Monarch Network Architects, USA

SC243 **Next Generation Transport Networks: The Evolution from Circuits to Packets**
Ori A. Gerstel; Cisco Systems, USA

SC261 **ROADM Technologies and Network Applications**
Thomas Strasser; Nistica Inc., USA

SC264 **Introduction to Ethernet Technologies**
Jeffrey Cox; Juniper Networks, USA

SC327 **Modeling and Design of Fiber-Optic Communication Systems**
René-Jean Essiambre; Bell Labs, Alcatel-Lucent, USA

SC328 **New Developments in Optical Transport Networking (OTN)**
Stephen Trowbridge; Alcatel-Lucent, USA

New Course! SC372 **Energy-Efficiency Networking**
Rod S. Tucker, and Kerry Hinton, Univ. Melbourne, Australia

New Course! SC384 **Background Concepts of Optical Communication Systems**
Alan Willner; Univ. of Southern California, USA

Category 13. Access Networks

SC114 **Passive Optical Networks (PONs) Technologies**
Frank J. Effenberger; Huawei Technologies, USA

SC217 **Hybrid Fiber Radio – The Application of Photonic Links in Wireless Communications**
Dalma Novak, PhD; Pharad, LLC, USA

SC264 **Introduction to Ethernet Technologies**
Jeffrey Cox; Juniper Networks, USA

SC267 **Silicon Microphotonics: Technology Elements and the Roadmap to Implementation**
Lionel Kimerling; MIT, USA

New Course! SC372 **Energy-Efficiency Networking**
Rod S. Tucker, and Kerry Hinton, Univ. Melbourne, Australia

New Course! SC384 **Background Concepts of Optical Communication Systems**
Alan Willner; Univ. of Southern California, USA

Category 14. Optical Networking, Technologies, and Applications for Datacom and Computercom

SC187 **Hands-on Basic Fiber Optics for the Absolute Beginner**
Dennis Horwitz; Micronor Inc., USA

SC267 **Silicon Microphotonics: Technology Elements and the Roadmap to Implementation**
Lionel Kimerling; MIT, USA

Sold Out SC291 **Hands-on Fiber Optics for Engineers Designing for Military, Aerospace, Shipboard and Industrial Harsh Environmental Applications**
Dennis Horwitz; Micronor Inc., USA

SC356 **40G/100G Ethernet Technologies and Applications**
Osamu Ishida; NTT, Japan

SC357 **Computercom Interconnects: Circuits and Equalization Methods for Short Reach Power-Efficient Optical and Electrical Links**
Alexander Rylyakov, IBM T.J. Watson Research Center, USA

SC358 **Data Center Cabling: Transitioning from Copper to Fiber**
Lisa Huff; DataCenterStocks.com, USA, [2]Discerning Analytics, LLC, USA

SC359 **Datacenter Networking 101**
Cedric Lam and Hong Liu; Google Inc., USA

New Course! SC371 **Multi-Layer Control Plane Technologies - Managing Hybrid Networks**
Lou Berger, Labn Consulting, USA; Wes Doonan, Adva Optical, USA

New Course! SC374 **Cloud Computing and Dynamic Networks**
George Clapp, USA; Douglas Freimuth, IBM Research, USA

Additional Short Course Category: Industry Best Practices

SC347 **Reliability and Qualification of Fiber-Optic Components**
David Maack; Corning, USA.

Short Courses by Time

View schedule by topic category

Sunday, March 4

Time	Code	Title
9:00 AM - 12:00 PM	SC171	Introduction to Optical Control Plane Concepts, Technologies and Practices

9:00 AM – 12:00 PM	SC177	High-Speed Semiconductor Lasers and Modulators
9:00 AM – 12:00 PM	SC265	Passive Optical Components and Filtering Technologies
9:00 AM – 12:00 PM	SC289	Basics of Optical Communication Systems and WDM
9:00 AM – 12:00 PM	SC328	New Developments in Optical Transport Networking (OTN)
9:00 AM – 12:00 PM	SC359	Datacenter Networking 101
9:00 AM – 12:00 PM	SC141	(course has been changed to SC384)
9:00 AM – 12:00 PM	SC384	New Course! Background Concepts of Optical Communication Systems
9:00 AM – 1:00 PM	SC288	Fundamentals of Polarization, PDL, and PMD
9:00 AM – 1:00 PM	SC105	Modulation Formats and Receiver Concepts for Optical Transmission Systems
9:00 AM – 1:00 PM	SC182	Biomedical Optical Diagnostics and Sensing

9:00 AM – 4:30 PM	SC264	Introduction to Ethernet Technologies
1:00 PM – 4:00 PM	SC267	Silicon Microphotonics: Technology Elements and the Roadmap to Implementation
1:00 PM – 4:00 PM	SC341	OFDM for Optical Communications
1:00 PM – 4:00 PM	SC357	Computercom Interconnects: Circuits and Equalization Methods for Short Reach Power-Efficient Optical and Electrical Links
1:00 PM – 4:00 PM	SC325	Highly Integrated Monolithic Photonic Integrated Circuits
1:00 PM – 4:00 PM	SC203	Sold Out 40/100 Gb/s Transmission Systems, Design and Design Trade-offs
1:00 PM – 4:00 PM	SC216	An Introduction to Optical Network Design and Planning
5:00 PM – 8:00 PM	SC217	Hybrid Fiber Radio – The Application of Photonic Links in Wireless Communications
5:00 PM – 8:00 PM	SC243	Next Generation Transport Networks: The Evolution from Circuits to Packets

5:00 PM – 8:00 PM	SC259	Electronic and Optical Impairment Mitigation
5:00 PM – 8:00 PM	SC261	ROADM Technologies and Network Applications
5:00 PM – 8:00 PM	SC114	Passive Optical Networks (PONs) Technologies
5:00 PM – 8:00 PM	SC371	New Course! Multi-Layer Control Plane Technologies – Managing Hybrid Networks
5:00 PM – 8:00 PM	SC372	New Course! Energy-Efficiency Networking

Monday, March 5

Time	Code	Title
8:30 AM – 12:30 PM	SC101	Hands-on Workshop on Fiber Optic Measurements and Component Testing
8:30 AM – 12:30 PM	SC102	WDM in Long-Haul Transmission Systems

8:30 AM – 12:30 PM	SC160	Microwave Photonics
8:30 AM – 12:30 PM	SC178	Test and Measurement of High-Speed Communications Signals
8:30 AM – 12:30 PM	SC210	Hands-on Polarization-Related Measurements Workshop
8:30 AM – 12:30 PM	SC239	Short-Reach Optical Interconnects
8:30 AM – 12:30 PM	SC342	Sold Out Digital Coherent Optical Systems
9:00 AM – 12:00 PM	SC356	40G/100G Ethernet Technologies and Applications
9:00 AM – 12:00 PM	SC358	Data Center Cabling: Transitioning from Copper to Fiber
9:00 AM – 12:00 PM	SC266	Quantum Cryptography and Quantum Information
9:00 AM – 12:00 PM	SC208	Optical Fiber Design for Telecommunications and Specialty Applications
1:00 PM – 5:30 PM	SC187	Hands-on Basic Fiber Optics for the Absolute Beginner
1:30 PM – 4:30 PM	SC205	Integrated Electronic Circuits and Signal

		Processing for Fiber Optics
1:30 PM – 4:30 PM	SC176	Metro Network: The Transition to Ethernet
1:30 PM – 4:30 PM	SC312	New Course! Parametric Optical Processing and Systems
1:30 PM – 4:30 PM	SC327	Modeling and Design of Fiber-Optic Communication Systems
1:30 PM – 4:30 PM	SC369	New Course! Test and Measurement of Complex Modulated Optical Signals
1:30 PM – 4:30 PM	SC370	New Course! FEC Technology in Optical Communications
1:30 PM – 4:30 PM	SC373	New Course! Specialty Fiber Splicing and Interconnection
1:30 PM – 5:30 PM	SC360	Hands-On Fiber Optic Terminations and Measurements with Emphasis on MTP Connectorized Ribbon Fiber
1:30 PM – 5:30 PM	SC347	Reliability and Qualification of Fiber-Optic Components
1:30 PM – 5:30 PM	SC185	Hands-on Polishing, Inspection and Testing of Connectors

Tuesday, March 6

Time	Code	Title
8:00 AM - 12:30 PM	SC291	Sold Out Hands-on Fiber Optics for Engineers Designing for Military, Aerospace, Shipboard and Industrial Harsh Environmental Applications
8:30 AM - 12:30 PM	SC314	Hands-on Fiber Characterization for the Engineering of Long Haul and Metro Deployments
9:00 AM - 12:00 PM	SC374	New Course! Cloud Computing and Dynamic Networks

Short Course Descriptions

SC171 Introduction to Optical Control Plane Concepts, Technologies and Practices

Sunday, March 4, 2012
9:00 AM - 12:00 PM

Instructor: Greg Bernstein; Grotto Networking, USA

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

The optical control plane is a suite of distributed processing capabilities that allow optical networks to react faster to changing demands and changes in network equipment availability. In addition, the optical control plane automates previously manual tasks reducing errors and making network resource status more readily available for provisioning and planning purposes.

This course introduces optical control plane concepts, technologies, and practices. Three key factors have pushed the deployment of control plane technologies into optical transport networks. First, optical transport networks have grown in capacity (DWDM) and number of elements deployed. Second, to remain competitive carriers need to dynamically allocate expensive or limited optical resources to their customers in a timely manner. Third, element management systems from different equipment vendors tend not to interoperate. These factors and others have led to the emergence of the optical control plane and its deployment in carrier's network as a key supplement to existing management systems.

Key concepts in the optical control plane to be covered include: neighbor discovery, link verification, rapid provisioning, dissemination of reachability information, dissemination of topology and resource status information, and path computation.

We will review the key standards for the optical control plane from the IETF, ITU, and the OIF. Included in this course are the latest emerging standards on wavelength switched optical networks (WSONs) being developed at the IETF. Examples from both TDM-based optical networks and transparent optical networks consisting of ROADMs will be given. Deployment options and additional restoration (beyond linear and ring) functionality will also be discussed.

Benefits:

- Compare and contrast the use of these new control plane based standards with Element Management System (EMS) based approaches.
- List the key organizations involved in determining optical control plane standards or agreements and their relationships.

- Describe the differences and similarities in the control of TDM and transparent optical networks.
- Describe the protocols used in the optical control plane in terms of their heritage and functionality.
- Describe the purpose of neighbor discovery and its relation to network inventory.
- Explain the use of link state route protocols as applied to optical networks.
- Discuss the differences between datagram and optical routing with regard to service impact and standardization.
- Summarize and justify the functionality provided by the basic components of the optical control plane.

Audience:

This course is an introductory course on optical control plane standards. As such it assumes familiarity with SDH/SONET and WDM technology. Its emphasis will be on explaining the various control plane protocols to those with minimal prior experience in the areas of signaling or routing.

Instructor Biography:

Dr. Bernstein is currently Chief Consultant at Grotto Networking and is active in network standardization, network design, network equipment design, and network research for a variety of customers. He has been involved with standards development at the IETF, OIF, ITU-T, and ANSI Committee T1. Previously he was a Senior Director at Ciena Corp. after directing all software development at Lightera Networks (acquired by Ciena) where his team applied signaling and routing techniques to the control of networks of Lightera optical switches (now the Ciena CoreDirector). He is the lead author of the book Optical Network Control: Architecture, Protocols, and Standards, published by Addision-Wesley in 2004, and has written many articles and papers on the control of optical networks. He received his Ph.D., M.S. and B.S. degrees in

electrical engineering and computer science from the University of California at Berkeley.

SC177 High-Speed Semiconductor Lasers and Modulators

Sunday, March 4, 2012
9:00 AM - 12:00 PM

Instructor: John Bowers; Univ. of California at Santa Barbara, USA

Level: Intermediate (prior knowledge of topic is necessary to appreciate course material)

Description:

Amplitude and phase modulation of light for transmission at 10, 40 and 100 Gbit/s is a critical problem for fiber-optic networks. We will review the basic concepts of optical modulators, with emphasis on electroabsorption modulators. The fundamental physics and design of modulators will be reviewed. The microwave characteristics of semiconductor lasers, important for high-speed digital and analog applications, are presented. From the rate equations for electron and photon dynamics in the laser we derive fundamental limits to laser bandwidth. These limits include resonance limits, damping, transport effects and device parasitics. Methods to increase the bandwidth are illustrated with examples from literature, along with results showing the current state of the art. Finally, analog and large-signal modulation issues important for applications in communication systems are covered, including ringing, chirp, intensity noise and distortion.

Benefits:

- Compare different technologies.
- Make informed decisions on the design of optical transmitters and their incorporation into optical networks.
- Explain the performance of high-speed transmitters.

Audience:

Attendees should have some knowledge of semiconductor and device physics. A basic knowledge of laser operation is also needed.

Instructor Biography:

John E. Bowers is Director of the Institute for Energy Efficiency and the Kavli Professor of Nanotechnology in the Departments of Electrical and Computer Engineering and Materials at the University of California at Santa Barbara. He received his master's and doctorate degrees from Stanford University. He previously worked for Bell Labs and Honeywell. He is a member of the National Academy of Engineering and a Fellow of the IEEE, OSA and American Physical Society. He is a recipient of the IEEE/LEOS William Streifer Award and the OSA Holonyak Award. He has published nine book chapters, 500 journal papers, 700 conference papers and has received 52 patents.

SC265 Passive Optical Components and Filtering Technologies

Sunday, March 4, 2012
9:00 AM - 12:00 PM

Instructor: Bruce Nyman[1], Christi Madsen[2]; [1]TE SubCom, USA, [2]Texas A&M Univ., USA

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

Today's WDM networks rely on subsystems, such as ROADMs and erbium-doped fiber amplifiers, and incorporate many types of passive components. For example, a typical optical amplifier will contain an isolator, a pump and signal multiplexer, optical taps, and a gain flattening filter. In this Short Course, we will discuss the passive components found in a typical WDM system. For each one, students will be able to identify the system requirements on device performance and assess the technology options for meeting those requirements. While passive devices may be simple in function, choosing and specifying them can be challenging. Performance issues such

as insertion loss, return loss, polarization-dependent loss, polarization mode dispersion, and chromatic dispersion are important, as are temperature and wavelength dependencies. Component fabrication techniques, including fused fiber, dielectric filters, planar waveguide, and fiber Bragg gratings are surveyed, with an emphasis on their relative strengths and weaknesses. For effective specification and system design, accurate measurements are critical. An understanding of the various measurement methods and issues will be provided. A fundamental understanding of optical filters will be addressed in the course. We take a signal processing approach, which allows us to compare the properties of such diverse filters as waveguide grating routers, Fabry-Perot etalons, ring resonators, and thin-film filters. The source of chromatic dispersion in filters and its relationship to their magnitude response will be discussed. Optical filter applications will be presented, including signal conditioning applications such as tunable dispersion compensation, as well as optical sensing applications.

Benefits:

- Identify the device requirements and technology options of the passive components in a WDM system.
- Compare filter choices for applications, such as chromatic dispersion compensation and monitoring.
- Define specifications for passive components to meet system requirements.
- Understand the various measurement methods and important parameters.
- Explain the basic commonality and differences between optical filter types.
- Identify the trade-offs to obtain a more idealized, dispersionless, boxlike spectral response.

Audience:

This course is for those who need an introduction into the various types of optical components and filters used in WDM systems, including practitioners and technical managers responsible for system design, integration, and testing, as well as those who need to deliver and verify components for WDM systems.

Instructor Biography:

 Bruce Nyman is currently with TE SubCom where he develops next-generation undersea systems. From 2005 to 2009 he was with Princeton Lightwave as Vice President of System Solutions. Previously, he developed optical amplifiers and measurement equipment at JDS Uniphase and optically amplified undersea systems at Bell Labs. He received his doctorate from Columbia University and is a fellow of the IEEE.

 Christi Madsen is a professor at Texas A&M University, focusing on photonic processing for optical communications and sensing. Previously, she was a Distinguished MTS with Bell Labs. She is an OSA Fellow, coauthored *Optical Filter Design and Analysis: A Signal Processing Approach*, holds 30 patents, and has published numerous papers.

SC289 Basics of Optical Communication Systems and WDM

Sunday, March 4, 2012
9:00 AM - 12:00 PM

Instructor: Gerd Keiser[1],[2]; [1]PhotonicsComm Solutions Inc., USA, [2]Natl. Taiwan Univ. of Science and Technology, Taiwan

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

The course covers the functions and operational characteristics of available optical fibers, transceivers, and specialized passive and active components needed for designing modern optical fiber communication links. It explains distortion effects on lightwave signals, defines bit error rate and receiver sensitivity, and identifies measurement equipment and procedures used to verify system operating characteristics. The course also defines wavelength division multiplexing (WDM) concepts, components and applications. The topics include characteristics of wavelength multiplexers, optical amplifier uses in WDM links, WDM link design examples, and implementation of WDM-based metro and FTTP networks.

Benefits:

- Describe the functions and operations of key components in fiber optic links.
- Summarize technology trade-offs for implementing different types of fiber optic systems.
- Compare different component types for optical fiber link designs.
- Explain signal distortion effects due to dispersion and nonlinear processes.
- Discuss wavelength division multiplexing (WDM) concepts and components.
- Describe WDM applications to long-haul, metro, and FTTP networks.

Audience:

This course is intended for engineers who are new entrants to the fiber optic communications field, component and product design and test engineers, technical trainers, technical sales and marketing personnel, consultants, telecommunications managers, and anyone who needs an introductory knowledge of optical fiber communications.

Instructor Biography:

Gerd Keiser was involved with telecommunication technologies at Honeywell, GTE, General Dynamics and PhotonicsComm Solutions. Currently he is a Chair Professor at the National Taiwan University of Science and Technology. He is an IEEE Fellow, a member of OSA and SPIE, an associate editor of Optical Fiber Technology, and the author of four books. His professional experience and research interests are in the general areas of optical networking technology and biophotonics.

SC328 New Developments in Optical Transport Networking (OTN)

Sunday, March 4, 2012
9:00 AM - 12:00 PM

Instructor: Stephen Trowbridge; Alcatel-Lucent, USA

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

This course provides an introduction to revised ITU-T Recommendation G.709/Y.1331, Interfaces for the Optical Transport Network (OTN), focusing on new interfaces and capabilities for OTN in the first major revision of the standard since 2003. As DWDM networks have evolved, they have provided a common convergence layer for SONET/SDH, IP, and Ethernet traffic. The latest version of the standard helps move from a combination of point-to-point DWDM line systems and metro ROADM networks to a full, end-to-end managed network. The OTN hierarchy has been extended "at both ends," adding a new lower tier (ODU0) optimized for the transport of 1000GBASE-X (Gigabit Ethernet), and a new upper tier (ODU4) optimized for the transport of the new 100GBASE-R (100 Gigabit Ethernet) recently specified by the IEEE P802.3ba project. Mapping is specified for the new 40GBASE-R (40 Gigabit Ethernet) signal into existing 40G transport using the currently deployed ODU3. OTN is being deployed by many operators for their next generation network builds. This course will cover the

basic concepts of G.709, with specific emphasis on the recently added interfaces and capabilities. You will learn how IP, Ethernet, and SONET/SDH traffic can be carried by an international standard based digital wrapper solution. You will develop an appreciation for the flexibility provided in the latest OTN standards to transport a wide variety of client signals and to efficiently manage bandwidth.

Benefits:

- Understand the concepts that form the basis for an OTN based on G.709.
- Learn about the new interfaces provided in the latest revision of the standard.
- Apply the capabilities of the OTN standards to manage client signals and wavelengths.
- Understand the mapping mechanisms used by OTN to transport major client signals.
- Utilize the new flexibility of the latest standard for efficient bandwidth management.
- Know where to look to find more information about G.709.

Audience:

This course is intended for anyone who designs, operates, or supports metro and/or long haul optical networks and who need to understand the new interfaces and capabilities in ITU-T Recommendation G.709 and how they can be used.

Instructor Biography:

Dr. Stephen J. Trowbridge is a Consulting Member of Technical Staff (CMTS) at Alcatel-Lucent. He received his B.S. (EE&CS), M.S. (CS), and Ph.D. (CS) from the University of Colorado, Boulder. He joined Bell Laboratories-AT&T (now Alcatel-Lucent) in September 1977. He has been active in optical networking standardization since 1995. He is vice-chair of ITU-T TSAG, chairman of ITU-T Working Party 3/15 (responsible for OTN standards including G.709), chairman of the ATIS COAST-OHI working group, and a was a member of the IEEE P802.3ba editorial team.

SC359 Datacenter Networking 101

Sunday, March 4, 2012
9:00 AM - 12:00 PM

Instructor: Cedric Lam and Hong Liu; Google Inc., USA

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

This introductory course starts with a review of the network transformations resulted from the rise of Internet computing applications. We then review the architectural structures of warehouse-scale computers (WSCs) and the networking technologies used to implement WSC datacenters. This course covers both intra-datacenter and inter-datacenter networks, the challenges facing datacenter operators in the next 3 to 4 years, the need for energy efficient datacenter networking technologies, and the desirable optical networking technologies to sustain the growth of Internet computing applications.

Benefits:

- Define warehouse-scale computer (WSC) and describe its structure
- Describe the engineering principles and philosophies behind scalable mega-datacenter infrastructures
- Compare different datacenter cluster topologies and switching technologies.
- Compare the differences and similarities between traditional telecommunication networks and booming data-communication networks

- Identify the challenges for intra-datacenter and inter-datacenter communications
- Select suitable optoelectronic interconnect technologies
- Explain the roles of optics in transmission, multiplexing and switching
- Identify designs to realize energy efficient data networks

Audience:

This course is beneficial to optoelectronic engineers, fiber optic transceiver designers and optical transmission engineers who would like to understand the requirements of datacenter networking. It also benefits network engineers with the knowledge of high-speed optical communication technologies used to realize various datacenter network applications. For network planners and architects, this course provides outlooks in optical network technology developments in the next 3 to 4 years.

Instructor Biography:

Cedric F. Lam is currently Optical Network Architect at Google. Before joining Google, he worked at OpVista Inc. as chief system architect, responsible for the development of an ultra-dense WDM transport system with integrated ROADM functionality. Prior to OpVista, Cedric was senior technical staff member at AT&T Labs-Research. His research covers broadband optical transport and access networks architectures, optical signal modulation and transmission, passive optical network, HFC, etc. His current focus is in FTTH and optical networking technologies for data center applications. Cedric received B.Eng. in Electrical and Electronic Engineering from the University of Hong Kong with First Class Honors and PhD. in Electrical Engineering from UCLA.

Hong Liu is a Member of Technical Staff at Google Platform Advanced Technology, where she is involved in the system architecture and interconnection for large-scale computing platforms. Her research interests include interconnection networks, high

speed signaling, photonic integrated circuit, and optical metro design. Prior to joining Google, Hong was a Member of Technical Staff at Juniper Networks, where she was principally involved in the architecture and design of high-end physical interface cards, network routers, and multi-chassis switches, including Juniper's flagship core router T640, edge routers M7i/M10i/M120, world's first OC768 line card and world's very first switch-matrix TX640. Hong received her Ph.D. in Electrical Engineering from Stanford University.

SC141 (course has been changed to SC384)

Sunday, March 4, 2012
9:00 AM - 12:00 PM

Instructor: Alan Willner; Univ. of Southern California, USA.

Alan Willner (Ph.D., Columbia) worked at AT&T Bell Labs and Bellcore and is the Sample Professor of Engineering at the University of Southern California. He received the NSF Presidential Faculty Fellows Award from the White House, Packard Foundation Fellowship, NSF Young Investigator Award, OSA Forman Eng. Excellence Award, IEEE PS Eng. Achievement Award, Fulbright Foundation Senior Scholars Award, USC University-Wide Outstanding Teacher Award, Eddy Best Technical Paper Award from Pennwell, and Armstrong Memorial Prize. He is an Int'l Fellow of the UK Royal Academy of Eng., and Fellow of IEEE, OSA & SPIE. He was president of IEEE Photonics Society; OSA Science and Engineering Council Co-Chair; Editor-in-Chief of Optics Letters, Journal of Lightwave Technology and IEEE JSTQE; CLEO General Co-chair; OSA Photonics Division Chair; and OFC steering/program committee member.

SC384 Background Concepts of Optical Communication Systems

SC288 Fundamentals of Polarization, PDL, and PMD

Sunday, March 4, 2012
9:00 AM - 1:00 PM

Instructor: Nicholas Frigo Ph.D; US Naval Academy, USA

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

Polarization, as one of the fundamental characteristics of light, can be used to discriminate between different optical signals: polarization states have been used to couple (combine) or decouple (split, or filter) light in a variety of applications ranging from sunglasses to optical signal processing. High-speed, long-haul transmission systems have ushered in an era in which imperfections of the optical medium itself, the fiber, can introduce an unintentional coupling between signals and polarization states, and these effects form the basis for this short course. We review the descriptions of polarization, show the relationships between linear, circular, and elliptical polarization states, and introduce the common formalisms that describe these states, showing relationships between the Jones vector, Poincare sphere, and Stokes representations. "Imperfect" transmission effects that depend on the state of polarization, namely birefringence (polarization-dependent speed) and PDL (polarization-dependent loss) are then described using the various formalisms, emphasizing visual and intuitive descriptions already introduced. These descriptions permit analysis of optical propagation in conventional and specialty fibers (such as PMF, polarization-maintaining fiber), impairments such as perturbations and splices, the principles behind (and effects of) polarizers and polarization-controllers, and realizations of polarization-measuring devices. After a brief review of phase and group velocity we consider concatenated birefringent systems and introduce polarization mode dispersion (PMD). In this section we describe how PMD impairs optical transmission systems, as well as approaches to its compensation and mitigation. Throughout the course, graphic representations are emphasized as much as possible to reinforce physical intuition.

Benefits:

- Describe the major representations of polarization states
- Perform simple calculations of polarization evolution in birefringent fiber.
- Transform between different representations for birefringence
- Explain the mechanisms underlying PMF and estimate splice tolerances
- Discuss polarization-dependent loss sources and effects
- Explain the physical origin of PMD
- Describe the dominant effects of PMD on transmission systems

Audience:

The course is intended for engineers, technicians, and managers who would like to have a more deeply grounded understanding of polarization effects in devices or systems. The participant should have a basic understanding of waves and the use of complex numbers to describe their phases. An elementary understanding of how matrices multiply column vectors is necessary to follow the Jones formalism, and is highly recommended.

Instructor Biography:

Nicholas Frigo received a bachelor's degree from Claremont-McKenna College, and a Ph.D degree from Cornell University, both in Physics. He has worked at the Naval Research Laboratory, at Litton Industries, at AT&T Bell Laboratories, and at AT&T Research in optical propagation and polarization effects in fibers, fiber optic sensors, and optical networks. Since 2005 he has been teaching in the Physics Department at the US Naval Academy in Annapolis, MD.

SC105 Modulation Formats and Receiver Concepts for Optical Transmission Systems

Sunday, March 4, 2012
9:00 AM - 1:00 PM

Instructor: Peter Winzer, Chandrasekhar Sethumadhavan, Xiang Liu; Bell Labs, Alcatel-Lucent, USA.

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

The ever-increasing traffic demands in carrier networks, driven by emerging data-centric services and applications, have led to intense research and development in the area of high-capacity (several 10Tbit/s), high-speed (beyond 100 Gb/s per wavelength) optical transport networks. In order to enable such high capacities and speeds over appreciable transmission distances (>1000 km) in carrier networks, spectrally efficient yet impairment-tolerant transmission technologies have moved into the focus of optical communications research and have led to considerable innovation in modulation and detection strategies. This course gives an overview of modulation formats and multiplexing techniques for optical networking applications, both from a conceptually fundamental and from a state-of-the-art technological point of view. The discussed modulation formats include intensity modulation, phase modulation, and quadrature amplitude modulation; multiplexing techniques include wavelength division multiplexing, polarization-multiplexing, subcarrier multiplexing, and orthogonal frequency division multiplexing (OFDM), and also introduce spatial multiplexing as the next research frontier. The course also covers optical receiver design and optimization principles, both for direct-detection and coherent (intradyne) receivers, including a discussion of the underlying digital electronic signal processing and coding techniques. Finally, the course highlights the interplay of modulation format, receiver design, and the wide variety of transmission impairments found in optically routed long-haul networks and points to latest research trends in optical modulation and multiplexing.

Benefits:

- Identify key objectives of high-capacity and high-speed optically routed network design.

- Describe the concepts behind optical modulation formats and multiplexing techniques.
- Generate advanced optical modulation formats using state-of-the-art opto-electronic components.
- Summarize the concepts behind optical receiver design, including direct and coherent detection as well as related digital signal processing techniques. Recognize the interplay between modulation format, receiver design,and transmission impairments.
- Get an insight into future trends regarding advanced modulation and multiplexing techniques and receiver concepts.

Audience:

This advanced-level course is intended for a diverse audience including lightwave system researchers and engineers as well as opto-electronic subsystem designers. Some basic knowledge of optical modulation and detection technologies will help in better understanding the course but is not a prerequisite. Past attendees will find substantial updates to this augmented edition of the course, especially in the areas of multi-carrier modulation and digital signal processing, and may find it useful to attend again.

Instructor Biography:

 Peter J. Winzer received his doctorate in electrical engineering/communications engineering from the Vienna University of Technology, Vienna, Austria, in 1998. His academic work, largely supported by the European Space Agency (ESA), was related to the analysis and modeling of space-borne Doppler wind lidar and highly sensitive free-space optical communication systems.

In this context, he specialized in optical modulation formats and high-sensitivity receivers using coherent and direct detection. He continued to pursue this field of

research after joining Bell Labs in 2000, where he focused on Raman amplification, optical modulation formats, advanced receiver concepts, and digital signal processing techniques for 10, 40, and 100-Gb/s fiber-optic communication systems. Dr. Winzer is a member of the OSA and a Fellow of the IEEE.

 Sethumadhavan Chandrasekhar received a doctorate in physics from the University of Bombay, Bombay, India, in 1985. He joined Bell Labs, Lucent Technologies (formerly AT&T Bell Labs), Holmdel, New Jersey, in 1986. He has worked on III-V compound semiconductor devices such as photodetectors, heterojunction phototransistors, bipolar transitors (HBTs) and high-speed optoelectronic integrated circuits (OEICs), advanced receive-side digital signal processing, novel modulation formats, and high-speed DWDM optical networking systems. His current activities include ROADMs, mesh optical networking, and hybrid DWDM 10G/40G/100G transmission. He is a Fellow of the IEEE.

 Xiang Liu is a Distinguished Member of Technical Staff at Bell Labs, Alcatel-Lucent. He received his Ph.D. degree in applied physics from Cornell University. Since joining Bell Labs in 2000, Xiang has been primarily working on high-speed optical communication technologies including advanced modulation formats, coherent detection schemes, and fiber nonlinearity mitigation. Dr. Liu has authored/coauthored more than 200 journal and conference papers, and holds over 35 US patents. He is a Fellow of the OSA and an Associated Editor of Optics Express.

SC264 Introduction to Ethernet Technologies

Sunday, March 4, 2012
9:00 AM - 4:30 PM

Instructor: Jeffrey Cox; Juniper Networks, USA

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

This course will begin by covering the history of Ethernet in the IEEE 802.3 standards and its evolution through present-day implementations. All major commercially successful variants will be reviewed at the physical layer, including coax (thin and thick-wire), twisted-pair, fiber (multi and single-mode), 10/100Mb and 1/10/40/100Gb implementations. Discussion topics will include media, topologies, framing, coding and media access control. The material will then introduce the data-link layer by covering learning bridges, spanning-tree, VLANs, trunking and flow-control. This information will be leveraged to illustrate how larger "switched" Ethernet networks are sometimes built. Issues related to scaling switched networks and "when to route" will be addressed ("Layer 2" vs. "Layer 3" networks). Extending Ethernet beyond the LAN into metropolitan and long haul networks will be explored. Different transport, protection and restoration mechanisms will be examined including Ethernet over SONET, GFP, DWDM and "native" transport. Finally, we will cover techniques for building extremely large-scale Ethernet-based networks that integrate Layer 2 switching, Layer 3 routing and optical transport.

Benefits:

- Define Ethernet's place in the IEEE 802 standards.
- Identify the various Ethernet frame types.
- Explain how Learning Bridges function including the Spanning Tree protocol.
- Describe VLANs, Trunking and Flow Control.
- Describe Ethernet's various physical-layer implementations.
- Describe the various options for transporting Ethernet beyond the LAN environment.
- Discuss issues relating to protection and restoration in Ethernet environments.

Audience:

This course provides introductory-level information on Ethernet technologies and their related protocols. Individuals attending this course must understand basic networking/computing terminology and concepts. The material will delve into the “bits and bytes” of Ethernet protocols and is aimed at anyone who wishes to understand Ethernet, how it works, and its applications. No prior knowledge of Ethernet is required.

Instructor Biography:

Jeffrey L. Cox has accumulated more than 25 years of experience in designing, deploying and supporting large-scale enterprise and carrier data networks. From 1985 to 1992, he designed and supported a large multi-protocol network infrastructure at Texas A&M University. During the mid 1990s, he built enterprise networks for various large corporations including Texas Instruments. He joined Level (3) Communications in 1998 and was responsible for the global architecture of the company's MPLS backbone and other packet infrastructures. In 2000, he started Celion Networks, building optical DWDM transport equipment targeted at transporting enterprise data traffic. He also held network architecture and research roles at JPMC and BT. Jeff currently is the Director of Packet-Optical Engineering at Juniper Networks

SC267 Silicon Microphotonics: Technology Elements and the Roadmap to Implementation

Sunday, March 4, 2012

1:00 PM - 4:00 PM

Instructor: Lionel Kimerling; MIT, USA

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

The optical components industry stands at the threshold of a major expansion that will restructure its business processes and sustain its profitability for the next three decades. This growth will establish a cost-effective platform for the partitioning of electronic and photonic functionality to extend the processing power of integrated circuits and the performance of optical communications networks. The traditional dimensional shrink approach to the scaling of microprocessor technology is encountering barriers in materials and power dissipation that dictate more distributed architectures. Before 2015 the performance requirements for this short link interconnection will cross the 10Mb/s.km threshold that dictates optical carrier utilization. This business direction will ignite a major change in leadership of the industry from information transmission (telecom) to information processing (computing, imaging); and it will open significant new markets with high-volume applications. Silicon microphotonics is a platform for the large-scale integration of CMOS electronics with photonic components. This course will evaluate the most promising silicon optical components and the path to electronic-photonic integration. The subjects will be presented in two parts: 1) Context: a review of the recently released Communications Technology Roadmap by the Industry Consortium of the MIT Microphotonics Center; and 2) Technology: case studies in High Index Contrast design for silicon-based waveguide, filter, photodetector, modulator, and laser devices. The objective of the course is to present an overview of the silicon microphotonic platform drivers and barriers in design, fabrication, packaging, and test.

Benefits:

- Identify trends in the optical components industry.
- Explain the power of a standard platform.
- Discuss the benefits of electronic-photonic integration.
- Evaluate the latest silicon photonic devices.
- Summarize the findings of the Communications Technology Roadmap.

Audience:

This course is for executives and technologists in the optical components industry to include planners, engineers, and scientists participating in the optical components technology supply chain.

Instructor Biography:

Lionel Kimerling is the Thomas Lord Professor of Materials Science and Engineering at MIT. He was head of materials physics research at Bell Labs until 1990, when he joined MIT. He is currently Director of the MIT Materials Processing Center and its affiliate, the MIT Microphotonics Center, which he co-founded with 30 faculty members in 1997. Among his industry responsibilities were long-term reliability of semiconductor lasers, development of the first 1MB DRAM chip, and defect diagnostics and control for silicon IC manufacturing. His group's research has focused on silicon microphotonics, environmentally benign IC manufacturing, and solar electricity

SC384 Background Concepts of Optical Communication Systems

Alan Willner; Univ. of Southern California, USA

Level: Beginner (No background or minimal training is necessary to understand course material)

Course Description

Optical communication systems have provided ever-increasing data transmission capacities, and there is a set of core concepts that are fundamental to understanding many of the crucial technical areas. The OFC/NFOEC conference has numerous courses teaching advanced topics that require some basic prior knowledge of these core concepts. The intent of this short course is to provide key background information to enable attendees to subsequently take more advanced courses as well as to enhance the attendee's understanding of technical sessions throughout the conference.

An attendee will obtain an overview of the field that concentrates on a number of specific topics, including:

1. Introduction to optical systems (point-to-point links, reconfigurable networks, line/client, switching techniques)
2. Communications concepts (SNR, ISI, BER, PRBS, eye diagrams, link budget, data standards)
3. Channel multiplexing techniques (time, wavelength, subcarrier, space, polarization)

3. Fiber-based data-degrading effects (loss, chromatic dispersion, polarization-mode dispersion, polarization-dependent loss)
4. Amplifiers (EDFA and Raman, gain flattening, gain transients)
5. Nonlinear effects, dispersion management and fiber types
6. Modulation formats, capacity and data constellations (OOK, PSK, DPSK, QAM, OFDM)
7. Direct and coherent detection schemes
8. Mitigating data impairments: optical (tunable compensators) and electronic (DSP, FEC)
9. Basics of lightwave system modeling

Benefits and Learning Objectives

This course should enable you to:

- Understand basic concepts of an optical communication system.
- Identify different types of modulation and multiplexing formats.
- Compute a simple optical power budget.
- Explain key differences between direct and coherent detection systems.
- Attend more advanced OFC short courses and understand better the conference technical sessions.

Intended Audience

This introductory course is intended for an audience with at least some technical background in engineering, physics or related disciplines, and is ideally suited for engineers who want to learn more about optical fiber communication systems. The audience should gain valuable knowledge enabling them to take more advanced courses as well as understand better the conference technical sessions.

Biography

Alan Willner (Ph.D., Columbia) worked at AT&T Bell Labs and Bellcore, and he is the Sample Chaired Professor of Engineering at USC. He received the Int'l Fellow of U.K. Royal Society of Engineering, NSF Presidential Faculty Fellows Award from White House, Packard Foundation Fellowship, Fulbright Foundation Senior Scholars Award, OSA Forman Eng. Excellence Award, IEEE Photonics Society Eng. Achievement Award and Distinguished Lecturer Award, USC University-Wide Outstanding Teacher Award, and Eddy Best Technical Paper Award from Pennwell. He is an IEEE, OSA, and SPIE Fellow. He

was co-chair of National Academies Committee on Harnessing Light II, president of IEEE Photonics Society, OSA Science and Engineering Council co-chair, *Optics Letters* editor-in-chief, *Journal of Lightwave Technology* editor-in-chief, *IEEE JSTQE* editor-in-chief, CLEO general co-chair, and OFC steering/program committee member.

SC341 OFDM for Optical Communications

Sunday, March 4, 2012
1:00 PM - 4:00 PM

Instructor: Sander L. Jansen; Nokia Siemens Networks, Germany

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

In this short course the ins and outs of optical OFDM for optical transmission systems will be discussed. The course will describe the principles of OFDM and the signal processing that is required for generation and detection. Different forms of OFDM will be described (both analogue and digital) and particularly the modulation and detection techniques for an optical OFDM signal will be explained. In addition, implementation aspects of optical OFDM are addressed: How can optical OFDM be generated and detected experimentally? How can imperfections be compensated for?

In this year course there will be a stronger focus on application scenarios from short distance access networks to ultra long-haul transmission. In addition the course will touch on the requirements and challenges when using OFDM for multi-mode propagation.

The course should enable attendees to get a feel for the different concepts and implementations of optical OFDM and their application scenarios.

Benefits:

- Describe the concept of orthogonal frequency division multiplexing (OFDM) and its implementation.
- List different flavors of optical OFDM and detail the advantages and disadvantages of each method.
- Appreciate the design trade-offs of the cyclic prefix, FFT-size, etc. with respect to for instance the dispersion tolerance and oversampling.
- Explain the multi-input, multi-output (MIMO) technique that is required to equalize a polarization division multiplexed (PDM) signal.
- Describe concepts such as: IQ imbalance mitigation and phase noise compensation.
- Explain the influence of fiber nonlinearity on OFDM and describe methods to increase the nonlinear tolerance of optical OFDM.
- Discuss different applications for optical OFDM: From access to long-haul transmission.

Audience:

This course is intended for engineers, researchers and technical managers who like to gain a better understanding of optical OFDM and its applications. Apart from the theory and concepts behind optical OFDM, the implementation and system design will be discussed in detail as well. Participants should have a basic knowledge in the field of fiber-optic transmission systems; no previous knowledge of OFDM is required. Past attendees of the course will find substantial updates and new information, and they are encouraged to attend again.

Instructor Biography:

Sander L. Jansen received his Ph.D. degree (with highest honors) in EE from the Eindhoven, University of Technology. From 2006 to 2008 he was a research engineer at KDDI R&D Laboratories in Japan and since June 2008 he is with Nokia Siemens Networks in Germany. He is currently responsible for the technical evaluation and selection of optical components and subsystems. Dr. Jansen is an associate editor for

PTL and a committee member of several international conferences. He authored and co-authored 10+ patents and more than 100 refereed papers and conference contributions. Recently Dr. Jansen has been awarded the IEEE young investigator award “for pioneering contributions in optical OFDM for fiber-optic transmission systems”.

SC357 Computercom Interconnects: Circuits and Equalization Methods for Short Reach Power-Efficient Optical and Electrical Links

Sunday, March 4, 2012
1:00 PM - 4:00 PM

Instructor: Alexander Rylyakov, IBM T.J. Watson Research Center, USA

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

We live in a computercom interconnect era, when optics is displacing wireline links at ever shorter distances inside large scale computer and switch/router systems. Each optical link, however, begins and ends with a short electrical link, so both communication channels will co-exist for the foreseeable future. It is extremely important, therefore, to understand the power dissipation, area/density and cost tradeoffs involved in selecting one solution over another.

We will start with outlining the basics of channel properties and communication techniques. We will then review the most common front-end I/O circuit topologies used in both optical and electrical short reach interconnects and compare their overall efficiencies. Typical transmitter and receiver architectures for both electrical and optical links will be presented, with discussion of basic functionality and performance requirements for each of the building blocks. We will outline the similarities as well as the differences between the key front-end components (e.g., VCSEL driver vs line driver, TIA vs receiver amplifier, etc.), and their effect on the overall link performance. The review will also include the discussion of the high-speed digital MUX/DEMUX (serializer/deserializer) circuits and the CDR (clock and data recovery) function. We will also compare the most commonly used SiGe bipolar and CMOS technologies in terms

of performance, power dissipation, area and cost.

Electrical links have to employ heavy-duty equalization techniques due to severe bandwidth limitations of wireline channels, but optical solutions can also benefit from, and often include, some form of equalization, even at short reach. We will discuss several commonly used equalization methods, including feed-forward equalizers (FFE, typically employed in the transmitter pre-emphasis), decision-feedback equalizers (DFE, commonly present in the receiver) and peaking amplifiers (often used on both sides of the link). High-level descriptions of several topologies of FFE transmitters and DFE receivers will be presented, together with a discussion of tradeoffs involved when selecting one over another, or using both.

Benefits:

- Outline overall transceiver architectures of typical wireline and optical short reach links
- Explain functionality and performance requirements of all key front-end I/O building blocks
- Evaluate and compare the efficiencies of wireline and optical short reach interconnects
- Compare SiGe bipolar and CMOS circuits for short reach optical and electrical links
- Understand and compare equalization techniques (FFE, DFE, peaking amplifier)
- Discuss benefits and tradeoffs of equalization
- Make an educated choice between an optical and electrical solution for short reach interconnect

Audience:

This course is for anyone interested in learning the basic transmitter and receiver circuit architectures for both optical and electrical short reach interconnects. The course will help gain the insight into the main tradeoffs involved in choosing between the optical and electrical links, as well as the integrated circuit topologies and technologies used in the transceiver circuits. The overview of advanced equalization

techniques will be also of interest to audience already familiar with the basics of short reach interconnect.

Instructor Biography:

Alexander Rylyakov received the M.S. degree in physics from Moscow Institute of Physics and Technology in 1989 and the Ph.D. degree in physics from State University of New York at Stony Brook in 1997, where he worked on the design and testing of superconductor integrated circuits based on Josephson junctions. In 1999 he joined the IBM T.J. Watson Research Center as a research staff member, working on the design and testing of high-speed digital and mixed-signal communication circuits for optical and channel-limited wireline communications. Many of those circuits, implemented in various generations of CMOS and SiGe bipolar, are now used in IBM products and several of them have established performance records in their respective technologies. Dr. Rylyakov's current research interests are in the areas of digital phase-locked loops for communication and microprocessor clocking, high-speed low power transceivers and equalization for wireline and optical communication, and integrated circuits for silicon photonics. He has published over 70 papers and has received 10 patents.

SC325 Highly Integrated Monolithic Photonic Integrated Circuits

Sunday, March 4, 2012
1:00 PM - 4:00 PM

Instructor: Christopher R. Doerr Ph.D; *Acacia Communications, Inc., USA*

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

This course will discuss monolithic photonic integrated circuits (PICs) in InP, silicon, and related materials for optical communications. The course will start with optical waveguide fundamentals and move toward state-of-the-art devices comprising many elements monolithically integrated. Higher layers of PIC design will be stressed. A significant portion is devoted to PICs for advanced modulation formats and coherent detection.

Benefits:

- Design optical waveguide structures.
- Simulate optical waveguide structures.
- Design complex photonic integrated circuits.
- Simulate photonic integrated circuits.
- Understand some of the device physics.
- Predict future abilities and costs of photonic integrated circuits.
- Debug problems in photonic integrated circuits.

Audience:

This course is intended for anyone who has basic electromagnetics knowledge (e.g., know Maxwell's equations but do not have them memorized) and basic optical communications knowledge (e.g., know what optical fiber is but do not have to know what 16-QAM is) but wants to learn more about photonic integrated circuits.

Instructor Biography:

Christopher R. Doerr earned a bachelor's degree in aeronautical/astronautical engineering and bachelor's, master's, and doctorate degrees in electrical engineering, all from MIT. He attended MIT on an Air Force ROTC scholarship. His doctoral thesis, on constructing a fiber-optic gyroscope with noise below the quantum limit, was supervised by Prof. Hermann Haus. Since coming to Bell Labs in 1995, Doerr's research has focused on integrated devices for optical communication. He was promoted to Distinguished Member of Technical Staff in 2000 and received the OSA Engineering Excellence Award in 2002. Doerr was Editor-in-Chief of IEEE Photonics Technology Letters, and was an elected member of the LEOS Board of Governors. He became an

IEEE Fellow in 2007 and an OSA Fellow in 2009. He received the 2009 IEEE William Striefer Scientific Achievement Award. He is currently an Associate Editor for the Journal of Lightwave Technology. He is married to Neriko Musha and has two children.

SC203 40/100 Gb/s Transmission Systems, Design and Design Trade-offs

Sunday, March 4, 2012
1:00 PM - 4:00 PM

Instructor: Benny Mikkelsen[1], Martin Birk[2]; [1]Acacia Communications, USA, [2]AT&T Labs, USA

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

Commercial mass deployments of 40G have primarily happened in service provider's backbone networks. However, it is expected that 40G deployments will soon move into regional and metro networks imposing a different set of system and cost requirements than backbone applications. At the same time, carriers are already preparing for 100G transport in their backbone networks. This course will cover both 40G metro-regional networks as well as emerging 100G backbone applications.

The first part of this course provides an overview of the drivers and applications of 40G transmission systems in regional and metro networks. It describes the requirements and expectations carriers will have to cost, power consumption, footprint, reliability, optical performance, and interoperability of 40G systems. In the second part, we discuss emerging 100G backbone applications and technologies. In both parts, we present practical design issues of 40/100G line-cards, and we critically review the availability and performance of the key building blocks. In particular, we discuss the technologies needed to implement different modulation formats, and the corresponding trade-off between complexity/cost of line-card implementations and the achievable fiber transmission distance.

Benefits:

- Identify key requirements and drivers for 40/100 Gbit/s applications.
- Describe the availability and performance of 40/100 Gbit/s key building blocks.
- Discuss 40/100 Gbit/s transmission limitations.
- Describe lessons learned from 40/100 Gbit/s field trials.
- Summarize 40/100 Gbit/s standards activities.

Audience:

The course is intended for engineers and technical managers who want an up-to-date overview of 40G/100G transmission systems, including applications, line-card designs, and fiber transmission limitations. It was significantly updated in 2011, and past attendees may find it useful to take the course again. The course requires some understanding of basic optical transmission systems.

Instructor Biography:
Benny Mikkelsen is co-founder and CTO at Acacia Communications, where he is responsible for the design of 100 Gbit/s optical transport products. Before Acacia, he co-founded Mintera and earlier was with Bell Labs, Lucent Technologies, where his research included ultra high-speed optical transmission. He holds master's and doctorate degrees in electrical engineering from the Technical University of Denmark.

Martin Birk received his master's and doctorate degrees from Germany's University of Ulm in 1994 and 1999, respectively. Since 1999, he has been with AT&T Labs-Research in New Jersey, working on high-speed optical transmission at data rates of 40Gbit/s and above.

SC216 An Introduction to Optical Network Design and Planning

Sunday, March 4, 2012
1:00 PM - 4:00 PM

Instructor: Jane M. Simmons; Monarch Network Architects, USA

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

This course is an introduction to optical network design and planning for backbone, regional and metro-core networks. A fundamental aspect of any optical network design is selecting the proper network equipment to maximize flexibility and adaptability for future growth, while minimizing cost. The course will discuss the role of network elements, such as ROADMs, multi-degree ROADMs and optical switches, and describe where each element fits in a network. It will address the benefits of equipment features such as 'colorless' and 'directionless.' Various case studies illustrating technology tradeoffs will be presented.

Routing and wavelength assignment play an important role in the efficiency of networks based on these optical elements. The course will cover the principles of routing and wavelength assignment, including a description of some of the relevant algorithms. The role of regeneration and optical reach in network design will be discussed in some detail. Modeling for real-time planning will also be covered.

Many of the principles of the course will be illustrated through an interactive design session with a commercial optical network design tool.

Benefits:

- Compare O-E-O and optical-bypass technology.
- Compare the architectures of various optical network elements.
- Determine the proper optical equipment for a particular network site, based on nodal degree and traffic patterns.
- Describe the basics of routing traffic, including strategies for diversity and load balancing.
- Describe the basics of wavelength assignment.
- Enumerate some of the networking principles as well as physical effects that determine where regeneration is required in a network.

- Determine the optimal optical reach for a given network and set of traffic demands.
- Compare real-time vs. long-term network planning.

Audience:

This course is intended for network planners and architects in both carriers and system vendors who are involved in planning optical networks and selecting next generation optical equipment. The discussion of networking elements and algorithms should be helpful to vendors who are developing optical systems, as well as to carriers who are modeling network evolution strategies. The course is introductory level, although a basic understanding of networking principles is assumed.

Instructor Biography:

Jane M. Simmons has been involved in the research and development of optical networks for 15 years. She founded Monarch Network Architects, which provides optical network architectural services and design tools. From 1999 to 2002, she was the Executive Engineer of Network Architecture and later the Chief Network Architect of Corvis Corp. She performed the network design and the link engineering for the Broadwing network, the first commercially deployed all-optical backbone network. Through pioneering algorithmic and architectural optimizations, she played a significant role in the adoption of all-optical networking in telecommunications networks. Prior to Corvis, Dr. Simmons worked at Bell Labs/AT&T Labs Research, where she conducted research on backbone, regional, and broadband access networks. She received a B.S., Summa Cum Laude, from Princeton University, and S.M. and Ph.D. degrees from MIT, all in Electrical Engineering. She is a Fellow of the IEEE and is the author of the textbook Optical Network Design and Planning.

SC217 Hybrid Fiber Radio – The Application of Photonic Links in Wireless Communications

Sunday, March 4, 2012
5:00 PM - 8:00 PM

Instructor: Dalma Novak, PhD; Pharad, LLC, USA

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

The use of photonic links for the transport and distribution of radio signals in wireless networks is becoming increasingly pervasive. Applications where such hybrid technology is employed include backhaul solutions for mobile networks; indoor distributed antenna systems; as well as integrated fixed and mobile broadband and ultrabroadband networks capable of providing users with very high bandwidth services.

This short course presents an overview of the application of photonic links in wireless communication networks. The associated system architectures and signal transport technologies that enable the implementation of integrated wireless and wireline (optical) networks will be discussed. The various technical challenges and issues that must be addressed for the successful integration of these networks, which encompass very different requirements and specifications, will also be presented. Topics to be covered include:

- Integrated optical/wireless network architectures
- Requirements and challenges for the development of hybrid fiber radio systems
- Relevant technologies and implementation approaches

Benefits:

- Understand the motivation for the integration of wireless communication systems with optical fiber networks;
- Identify the technical challenges related to the application of photonics and optical networking concepts to wireless communications;

- Understand and compare physical layer technologies that enable the integration of wireless and optical networks;
- Identify technologies that can improve the performance of integrated optical and wireless networks;
- Establish the trade-offs with alternative integrated network architectures

Audience:

This is an intermediate course for people working in telecommunication related areas who wish to broaden their knowledge and learn how optical networks are being integrated with wireless communications or find out the current status of this multidisciplinary field.

Instructor Biography:
Dalma Novak is Vice-President at Pharad, LLC who are developing advanced RF-over-fiber and antenna products. She received her PhD in Electrical Engineering in 1992. From 1992 – 2004 she was a faculty member in the Department of Electrical and Electronic Engineering at The University of Melbourne, Australia. Previously Dr. Novak held positions at Dorsal Networks and Corvis Corporation. Dr. Novak is a Fellow of the IEEE and has published over 250 papers in the area of hybrid fiber radio technologies.

SC243 Next Generation Transport Networks: The Evolution from Circuits to Packets

Sunday, March 4, 2012
5:00 PM - 8:00 PM

Instructor: Ori A. Gerstel; Cisco Systems, USA

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

Transport networking technologies are experiencing one of the most significant evolutionary pressures in recent history. While previous phases in the evolution of the transport layer were driven by operations considerations (SONET/SDH) and bandwidth growth (WDM), the current phase is driven by fundamental shifts in services from circuits to packets. Services like VoIP and VoD have a profound impact on how the network is architected and managed. The challenge is compounded by an order-of-magnitude increase in bandwidth demands from the end-user and by the large number of unknowns, both from a service type perspective and bandwidth sizing and distribution perspective. As a result, service providers and equipment vendors alike are struggling with the best long-term architecture to the new transport layer and with the need for a smooth migration path form their legacy systems to that long-term solution. This course attempts to add clarity to the new requirements for the transport layer and the different technologies that are being considered to address these requirements. The course starts with a review of new services that must be supported by the transport layer, including Metro Ethernet services, storage services, and triple play services (mainly Internet/VOIP/VoD). We then proceed to discuss the current transport technologies, such as legacy IP, Ethernet, SONET/SDH and DWDM, and their drawbacks for the new offered services. Each legacy technology has been extended recently in support of the new demands. In particular, Carrier-class IP, MPLS-TP, Metro Ethernet, PBB-TE, OTN, and automated DWDM systems are being considered. We will clarify the innovation and capabilities that make these technologies more appropriate and how they can be combined into effective network architectures.

Benefits:

- Understand transport technologies from L3 to L0: IP, MPLS, Ethernet, TDM, and WDM.
- Describe new enterprise services: point to point and point to multi-point Ethernet and Storage services.
- Understand triple play services and their requirements: VOIP, digital video and VoD, internet access.
- Understand next-gen SONET and the evolution of OTN.

- Compare MPLS, Ethernet, PBB-TE, MPLS-TP.
- Describe access and core networking from a transport perspective.
- Understand the interplay between the IP layer and the underlying transport technology.

Audience:

This course is intended for the general OFC/NFOEC audience, including network planners, architects, product line managers, and other professionals, as well as researchers working on electrical and optical technologies for the carrier's transport layer.

Instructor Biography:
Ori Gerstel (F'08) is a Principal Engineer at Cisco. His main role is to identify and define architectural capabilities that stem from IP and optical networks integration. Prior to that, he was in charge of Cisco's advanced optical technology team and is the key inventor of some of the advanced capabilities of Cisco's DWDM product. Before joining Cisco in 2002, he was a Senior Systems Architect for Nortel's photonic crossconnect. Before joining Xros/Nortel, Gerstel was the Systems and Software Architect for the Optical Networking Group at Tellabs, where he architected the first commercial mesh DWDM system.

Previously, he performed early optical networking research at IBM Research. He authored more than 70 papers for international conferences and journals and over 20 patents. He served on the program committee of various conferences and journals and is an invited speaker to many panels, tutorials. and courses. Ori holds a Ph.D. from Technion-Israel Institute of Technology, Israel.

SC259 Electronic and Optical Impairment Mitigation

Sunday, March 4, 2012
5:00 PM - 8:00 PM

Instructor: Chris Fludger[1], Seb Savory[2]; [1]CoreOptics GmbH, Germany, [2]Univ. College London, United Kingdom.

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

As the channel bit-rate increases from 10 Gbit/s to 40 and 100 Gbit/s, chromatic dispersion (CD) and polarization mode dispersion (PMD) become visible as limiting properties of optical network links. Next generation transmission equipment needs to be both affordable and tolerant to impairments in the channel. This course compares and contrasts electronic equalization and optical compensation techniques.

The principle of electronic impairment mitigators such as feed-forward and decision feedback equalizers or Maximum-Likelihood Sequence Estimators will be explained, and their performance compared. Electronic compensation using transmitter pre-distortion or coherent detection will also be discussed. These will be contrasted against more traditional optical compensation devices for CD and PMD.

Benefits:

- Explain the requirement for dynamic impairment mitigation devices;
- Explain the major options for electronic equalisers and optical PMD compensators;
- Describe the building blocks and operation of electronic equalizers;
- Explain analogue and digital electronic signal processing;
- Explain the difference between electronic equalizers that operate on the optical field, and those that use the directly detected signal;
- Quantify the performance of the different PMD and CD compensators.
- Discuss the advantages and disadvantages of optical and electronic mitigation.

Audience:

This course is intended for individuals having a basic knowledge of digital lightwave transmission systems. It will be of value for industrial professionals (system designers,

managers) who need to assess the different options of electronic and optical impairment mitigators, as well as for researchers who are new to the field.

Instructor Biography:

 Chris Fludger has received master's and doctorate degrees in electronics engineering from Cambridge University, UK. At Nortel Networks he has worked on electronic signal processing, advanced Modulation techniques and Raman amplification. He is currently working at Cisco Optical (formerly CoreOptics), developing next generation 10G, 40G and 100G optical transceivers.

Seb Savory received master's and doctorate degrees in engineering from Cambridge University, UK, and the MSc(Maths) degree from the Open University, UK. He is a lecturer at University College London, where his research is focused on digital coherent receivers. Previously he was at Nortel, where he worked on PMD compensation, coherent detection and DSP.

SC261 ROADM Technologies and Network Applications

Sunday, March 4, 2012
5:00 PM - 8:00 PM

Instructor: Thomas Strasser; Nistica Inc., USA

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

In the past few years, one of the most promising new optical technologies has been the Reconfigurable Optical Add-Drop Multiplexer (ROADM). This technology is in the

process of transforming worldwide metropolitan transport systems to a more automated and scalable network. Evidence of the commercial traction is seen in requests for proposals (RFPs) from the largest North American carriers, more than a dozen RFPs from service providers worldwide, and deployment of more than $100 million of ROADM technology in 2004. This represents a groundbreaking commercial technology transformation of transparent optical routing displacing electrical grooming equipment for the first time on such a wide scale. Despite the commercial success, substantial confusion has surrounded this technology. This is largely because (a) the ROADM market is poorly defined since it may mean a subsystem or a system, neither of which have market-accepted minimum functionalities; and (b) the lack of a clear market definition has been exploited to promote competing technologies driven by different commercial interests. This course will give a historical perspective of how this technology evolved, the numerous network benefits derived, and how those benefits depend on the functionality of the technology employed. Finally, the course will describe how these technologies are being integrated into WDM systems and what types of networks most fully leverage the new capabilities to provide network value.

Benefits:

- Describe the network level benefits of ROADM systems.
- Define the different ROADM technology approaches competing in the market.
- Summarize the functionality differences between competing ROADM technologies, including which are most likely to succeed in the long term and why.
- Compare the incremental cost of a ROADM to the network level savings it enables.
- Discuss the types of networks that most fully benefit from ROADM technology and why.
- Explain the contradictory statements made about ROADM in trade literature.

Audience:

Anyone interested in more fully understanding the functionalities and benefits of ROADMs, including students, researchers, engineers, managers, and executives

involved in ROADM development, network design, network planning, and network operations.

Instructor Biography:

Thomas A. Strasser received a doctorate from Cornell University designing periodic guided-wave devices and worked for three years at Eastman Kodak Research Labs and seven years at Bell Labs in Murray Hill, New Jersey. At Bell Labs his group invented and developed manufacturing for enabling technologies in the next-generation transmission platforms of AT&T and Lucent Technologies. He served for five years as the chief technologist defining the ROADM-based platform of Photuris and its subsequent acquirer, Mahi Networks. He is currently CTO of an early-stage startup, Nistica Inc., focusing on next-generation optical technologies. Strasser was the OFC/NFOEC 2006 General Co-chair and the OFC 2004 Technical Program Co-chair. He has contributed 40 patents and more than 100 presentations and publications in the field of optics and communication devices.

SC114 Passive Optical Networks (PONs) Technologies

Sunday, March 4, 2012
5:00 PM - 8:00 PM

Instructor: Frank J. Effenberger; Huawei Technologies, USA

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

PON systems have become the preeminent technology for broadband optical access networks. Over 50 million lines of PON-based access have been deployed around the world. However, there are multiple network types deployed today, and proposals for

future systems are even more diverse. For this reason, it is important to understand the architectures and technologies that are used in PON, including their unique capabilities and trade-offs.

At the highest level, this short course reviews the major architectural variants of PON systems, including TDMA, WDMA, OFDMA, and hybrids of these. The commercially important implementations of these technologies will also be described, and their major application areas (FTTHome, FTTbuilding, etc.) will be described. The status of commercial deployments and interoperability of the equipment will be reviewed.

Additionally, the economic drivers for the entire PON value chain will be reviewed, including the factors that triggered deployments of the past, and what may cause evolutionary steps to the next generation. The incorporation of the PON technology into the larger broadband network will also be covered, including the larger network architecture, management, and regulatory framework.

Benefits:

- Understand and discuss the capabilities and advantages of different PON technologies.
- Be able to describe the practical limitations of real-world G-PON and EPON systems for broadband access.
- To know the motivations behind the Full-Service-Access-Network initiative and the related IEEE P802.3 and P1904 projects.
- Understand the commercial issues surrounding fiber access, and how PON works to address these.
- Have an overview of the possible future evolution paths that PON technology may take.

Audience:

This course is intended for engineers, network planners and product designers involved with broadband access and a need to understand passive optical networks.

Instructor Biography:

After completing his doctoral work in 1995, Dr. Effenberger took a position with Bellcore (now Telcordia) where he analyzed all types of access network technologies, focusing on those that employed passive optical networks. He witnessed the early development of the FSAN initiative and the development of the APON standard. In 2000, he moved to Quantum Bridge Communications (now a part of Motorola), where he managed system engineering in their PON division. This work supported the development and standardization of advanced optical access systems based on B-PON and G-PON technologies. In 2006, he became director of FTTx in the advanced technology department of Huawei Technologies, USA. He remains heavily involved in the standards work, and is a leading contributor and editor of the major PON standards in the ITU. He is now the rapporteur of Q2/15, which is the group charged with standardization of all optical access systems. In addition, his work has turned towards more forward-looking fiber access technologies, including ten gigabit PONs (various types). He is also an editor of the FSAN NG_PON2 white paper, which will eventually lead towards future standards.

SC371 Multi-Layer Control Plane Technologies - Managing Hybrid Networks

New Course!

Sunday, March 4, 2012
5:00 PM - 8:00 PM

Instructor: Lou Berger, Labn Consulting, USA; Wes Doonan, Adva Optical, USA

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

Network services and switching technologies have traditionally been deployed and operated along a per-layer approach, where network equipment supports only a single switching technology and management of each set of equipment is independent. More recently there has been a trend to integrate multiple switching technologies into the same network equipment and to integrated operation support tools and technologies. Such hybrid networks incorporate different and distinct classes, or multiple-layers, of transport services and switching. Examples of hybrid-network technologies include integrated packet-optical transport platforms, and OTN equipment that can simultaneously switch at ODUk multiplexing levels. Networks constructed with such network equipment present a unique set of deployment and control challenges. Integration between transport technologies involves adaptation in both data and control planes, and in order to efficiently manage these adaptations, a clear and consistent operational framework is required. In the context of the control plane, multi-layer integration enables opportunities for dynamic cross-layer interactions as well increased resource optimization.

This course will provide participants with an understanding of existing GMPLS-based control plane standards, techniques and mechanisms for operating hybrid networks. This course will review the relevant control plane concepts and standards. Both single-layer and multi-layer perspectives will be presented. The course will also identify specific concepts, tools and mechanisms which can be used by network operators to efficiently and functionally control a hybrid network controlled by a standards-based control plane. Such topics as dynamic forwarding adjacencies, dynamic service activation, virtual links, virtual nodes, and remote path computation will be covered. Use of these technologies in context of emerging network virtualization applications is also outlined. Examples of how these techniques can be deployed within optical hybrid network topologies are also discussed, along with the advantages and consequences of each.

Benefits:

- Identify and describe the primary operational support functions provided by a GMPLS-based control plane in a transport network
- Discuss and compare different control-plane based approaches for the integrated control of a multi-layer transport network.

- Determine how the capabilities of a specific control-plane implementation may be leveraged in a particular transport network.
- Begin the design of multi-layer transport network control systems employing single-layer or multi-layer control plane techniques and mechanisms.
- Initiate designs for the use of new network virtualization capabilities enabled by advanced control plane features.

Audience:

This course is intended for network engineers and network managers who are looking to gain an understanding of how a dynamic control plane can be leveraged in their current and planned transport networks. Much of this course will also be of interest to those looking for a high-level introduction to a GMPLS-based control plane. Basic familiarity with WDM and other transport network technologies is assumed. No familiarity with control plane routing or signaling is required.

Instructor Biography:

Louis Berger is a recognized industry expert in software and protocol control technology for telecommunication switching equipment. He has been designing, building and deploying IP infrastructure and other telecommunications products and technology for the last 25 years. Mr. Berger is currently a principal in LabN Consulting, LLC which he founded in 1999, where he provides consulting services in the areas of IP based control plane, GMPLS and MPLS. Prior to rejoining LabN, Mr. Berger was the Vice President of Protocol Development at Movaz Networks. Earlier Mr. Berger worked for FORE Systems and BBN. Since 1989, Mr. Berger has been an active contributor in the IETF where he has authored several RFCs and Internet-Drafts in the areas of GMPLS, MPLS, MPLS-TP, Quality of Service signaling and Routing. He coined the term GMPLS, pioneered it as a technology, and was the editor of the GMPLS signaling protocol specifications. He currently serves as the IETF CCAMP Working Group co-chair.

Wes Doonan is Senior Director for Control Plane R&D at ADVA Optical Networking. Wes leads the ongoing development and delivery of control plane technologies at ADVA, using IP-based protocols and mechanisms to manage carrier-class transport networks.

He has previously spoken at Internet2 JointTechs events, Supercomputing, TERENA, the MPLS & Ethernet World Congress, ECOC, IEEE HotInterconnects and various CENIC events. Wes has also served as industry advisor to various funded research activities, including the DRAGON, PHOSPHORUS, GEYSERS and OFELIA network research projects. He holds a Bachelor of Science in Electrical and Computer Engineering from Carnegie Mellon University.

SC372 Energy-Efficiency Networking

New Course!

Sunday, March 4, 2012
5:00 PM - 8:00 PM

Instructor: Rod S. Tucker, and Kerry Hinton, Univ. Melbourne, Australia

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

This short course will provide an introduction and overview of energy efficiency in communications networks. The course will look at trends (past and future), challenges and opportunities presented by the evolution to energy-efficient telecommunications. Course components are:

- Growth of ICT and its power consumption
- Sustainability implications of ICT growth
- Modelling network power consumption
    - Sales and inventory based models
    - Network-design-based model
    - Transaction-based model
    - Important parameters: PUE, peak vs average access speed, dimensioning for growth, redundancy, protection and replacement
- Power consumption modelling of networks

- Access networks: Wireless, PON, FTTN, HFC and Point-to-Point
- Edge and Metro networks
- Core networks: Terrestrial and submarine

- Power consumption of equipment
  - IP Routers (edge and core)
  - Switches (Ethernet, MPLS and TDM)
  - Cross connect, add/drop multiplexer
  - Multi-layer switches (GMPLS)
  - Transmission systems
  - OLTs and ONUs
  - Equipment for cloud services
- Equipment power consumption trends
  - Time evolution
  - Traffic load dependence
- Bringing it all together
  - Future trends and directions
  - Identifying leverage points for improvements in energy efficiency
- Improving energy efficiency using:
  - Architectures
  - Protocols
  - Technologies
- What is attainable
  - Lower theoretical limits on power consumption
  - How close can we get to these limits?: Network control, management and monitoring
- Overview of global activities in green networking
  - GreenTouch
  - Carbon Trust
  - GreenGrid
  - GeSI
  - ITU, EU & others

Benefits:

- Compare networks from the perspective of energy efficiency.

- Compute an estimate of the energy efficiency of network equipment, designs and architectures (in Joules/bit).
- Explain the principles of energy efficiency in telecommunications networks
- Identify key factors and leverage points for improving the energy efficiency future networks
- Describe the key determinants of network energy efficiency

Audience:

Telecommunications engineers, managers, policy makers, researchers and educators.

A basic knowledge of telecommunications networks and equipment will be advantageous. Little or no knowledge of energy efficiency issues in telecommunications networks is required.

Instructor Biography:

Rodney S. Tucker (M'76–SM'81–F'89) is a Laureate Professor at the University of Melbourne. He is Director of the University of Melbourne's Centre for Energy-Efficient Telecommunications (CEET). He is a Fellow of the Australian Academy of Science, a Fellow of the Australian Academy of Technological Sciences and Engineering, a Fellow of the Optical Society of America, and a Fellow of the IEEE. He is currently Vice-President, Publications of the IEEE Photonics Society.

Kerry Hinton received a PhD from the University of Newcastle Upon Tyne, U.K., in 1984. He worked at the Telstra Research Laboratories, Australia, for 21 years researching analytical and numerical modelling of optical systems, ASONs and monitoring in all-optical networks. In 2006, he joined the University of Melbourne,

undertaking research into the energy efficiency of the Internet, communications technologies and networks as a member of the Centre for Energy Efficient Telecommunications (CEET).

SC101 Hands-on Workshop on Fiber Optic Measurements and Component Testing

Monday, March 5, 2012
8:30 AM - 12:30 PM

Instructor: Caroline Connolly[1], Chris Heisler[1], Joseph Bos[2], Michelle Collier[3], [1]OptoTest Corp., USA, [2]Luna Technologies, USA, [3]AFL Telecommunications, USA

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

This Short Course focuses on the practical aspects of working with fiber optic components and instrumentation used to make optical performance characterization measurements. Four fully equipped stations are available for hands-on participation.

Rotation 1) Basic Component Testing—test and measurement techniques and latest issues involving single-mode and multimode fiber, cable and connectors including insertion loss, return loss, and visual fault location.

Rotation 2) Launch condition effects on multimode fibers. Launch conditions will be demonstrated and measured via near field, far field, and encircled flux methods. Includes demonstration and hands-on measurements with launch condition analyzer.

Rotation 3) Optical Time Domain Reflectometer (OTDR) and Fiber Link Characterization—understanding the measurements involved in characterizing a fiber link for high speed communications. Includes a demonstration of an OTDR for testing and troubleshooting of networks. By analyzing the backscatter and link length, attenuation and reflections can be analyzed. Anomalies such as connectors, splices,

and breaks can be evaluated. As speeds increase, measurements such as Chromatic and Polarization-Mode Dispersion become necessary.

Rotation 4) Component test and characterization measurements such as CD, PMD, GD, Jones-Matrix Eigenvectors will be measured. Test instruments such as the optical vector analyzer, tunable lasers, and optical power meters are used to measure PDL using the All-States-Method and the Mueller-Stokes-Method. Experiments will help participants visualize polarization-dependent behaviors of fiber optic components.

Industry trends will be related in each rotation such as encircled flux requirements, high density connectivity, phase related measurements important to the design and manufacture of optical components.

Benefits:

- Explain the fundamental optical differences and applications of single-mode fiber (SMF) vs. multimode fiber (MMF), including the different fiber types and fiber sizes.
- Identify the different connector types and understand their specific performance features (i.e., E2000, FC, LC, Mil-Styles, MTP, SC, ST, etc.) plus the various end-face options (i.e. Expanded Beam, UPC and APC).
- Test connectors, cable assemblies, and fiber links for insertion loss (IL) and return loss (RL), while also understanding how these measurements can be affected by wavelength and launch conditions.
- Explain characterization measurements on passive optical components.
- Measure spectral performance attributes using an optical vector analyzer (OVA).
- Measure polarization-dependent loss (PDL) and polarization mode dispersion (PMD) of fiber optic components.
- Test and troubleshoot fiber links and component assemblies using OTDR techniques.
- Measure and understand performance parameters of passive optical network components.

Audience:

This course is valuable to technicians, engineers, and managers interested in measurement and characterization of fiber optic components. Some familiarity with fiber optic test cables and equipment is assumed. Class size is limited to 16.

Instructor Biography:

Caroline Connolly is a Sales Director at OptoTest Corp. and has been involved with fiber optic test and measurements technologies and cable assemblies for more than 12 years. Her experience covers all areas of physical layer optical testing ranging from laboratory to field applications. Before joining OptoTest, she worked in various key sales positions at Rifocs Corp. Connolly holds a bachelor's degree in business management from the University of Phoenix.

Chris Heisler has been in the fiber optics industry for over 4 years. For this duration he has worked at OptoTest Corp. as an Applications and Test Engineer where he has studied and researched fiber optic cable measurements with a focus on launch condition measurements and the various standards governing these measurements. Chris attended California Polytechnics San Luis Obispo where he received a B.S. in electrical engineering and is currently pursuing his master’s degree.

Dawn Gifford, Ph.D., is the Director of Technology Development for Luna Technologies. Since 2002, Dr. Gifford leads a team responsible for research and development of fiber optic measurement and sensing technology and instrumentation. She helped develop Luna’s fiber optic test and measurement instrumentation. Dr. Gifford received her doctorate in optics at the Institute of Optics, University of Rochester, and her bachelor’s degree in physics from Brigham Young University.

Joe Bos has been an optical engineer at Luna Innovations since 2008. During his time

at Luna, he has contributed to various aspects of Luna's optical test and measurement and fiber sensing instruments including research, development, manufacturing test, and customer support. Joe earned his B.S. in physics from Western Michigan University in 2006 and his M.S. in optics from the Institute of Optics at the University of Rochester in 2008. Prior to joining Luna, Joe's research endeavors included thin film coatings, tunable pulsed dye lasers, PIN photodiode characterization and nuclear mass spectrometry.

SC102 WDM in Long-Haul Transmission Systems

Monday, March 5, 2012
8:30 AM - 12:30 PM

Instructor: Neal S. Bergano; TE SubCom, USA

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

Wavelength division multiplexing (WDM) technology used in long-haul transmission systems has steadily progressed over the past few years. Newly installed state-of-the-art transoceanic systems now have terabit/s maximum capacity, while being flexible enough to have an initial deployed capacity at a fraction of the maximum. The steady capacity growth of these long-haul fiber-optic cable systems has resulted from many improvements in WDM transmission techniques and an increased understanding of WDM optical propagation. Important strides have been made in areas of dispersion management, gain equalization, modulation formats, and error correcting codes that have made possible the demonstration of multi-terrabit capacities over transoceanic distances in laboratory experiments. Next-generation systems and future upgrades of existing systems will benefit from these new concepts emerging from system research.

This course will review the important issues regarding the use of WDM in long-haul transmission systems. Included will be an introduction to long-haul undersea transmission systems, the amplified transmission line, dispersion/nonlinear management, transmission formats, measures of system performance, forward error

correction, the importance of polarization effects, experimental techniques and results, a transmission line design example and future trends. Next-generation systems and future upgrades of existing systems will benefit from these new concepts emerging from system research.

Benefits:

- Explain the tradeoffs made in the design of an amplifier chain.
- Summarize the tradeoffs made in the selection of dispersion maps.
- Identify the methods used to measure system performance, such as Q-factor.
- Identify the important polarization effects in long-haul transmission systems.
- Compare the different methods of performing long-haul transmission experiments.
- Discuss circulating loop experiments.
- Discuss the future trends in long-haul transmission systems.
- Gain insight into the optical propagation of data signals over long distances.

Audience:

This course is intended for the student who wants an understanding of how information is transmitted over long distances using fiber optic transmission lines. This includes new entrants into the fiber optic field with an engineering background, engineers with fiber optics exposure, people in the fiber optic telecommunications industry, and fiber optic research and development management.

Instructor Biography:

Neal S. Bergano is Managing Director of System Research and Network Development at TE SubCom. In 1981 he received a B.S.E.E. degree from the Polytechnic Institute of New York, and then joined the technical staff of Bell Labs' undersea systems division. In

1983 received an M.S.E.E. degree from the Massachusetts Institute of Technology. In 1992 he was named a distinguished member of the technical staff of AT&T Bell Labs. In 1996 he was promoted to AT&T Technology Consultant. In 1997 he was promoted to AT&T Technology Leader.

Neal is on the Board of Directors for the Optical Society of America, and has served on the Board of Governors for IEEE LEOS from 1999 to 2001. Neal is a long-time volunteer and supporter of the OFC/NFOEC meeting, which includes Chair and co-chair in 1999 & 1997, Chair of the Steering committee from 2000 to 2002, and is currently the Chair of OFC/NFOEC's long-range planning committee.

Neal is a Fellow of the IEEE, OSA, AT&T and Tyco Electronics and holds 31 US patents in the area of lightwave transmission systems. Neal Bergano is the recipient of the 2002 John Tyndall Award "for outstanding technical contributions to and technical leadership in the advancement of global undersea fiber optic communication systems."

SC160 Microwave Photonics

Monday, March 5, 2012
8:30 AM - 12:30 PM

Instructor: Keith Williams; Naval Research Lab, USA.

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

There has been significant progress in photonic components and technology applicable to microwave (analog) systems; several unique microwave functions have been implemented in the photonic domain. Along with or because of these technical advancements, there has been a slow, but expanding acceptance of photonics for microwave systems. This updated/revised Short Course will review some of the current capabilities and limitations of photonics as divided into four areas. They are: techniques and devices for generating microwave-modulated light, techniques and devices for detection, RF transmission links (distinguished from digital transmission

systems), and microwave signal processing (including time-delay beamforming, downconverting, filtering and photonic analog-to-digital conversion). Emphasis will be placed on relating device operation to basic photonic subsystem performance and relating the photonic link and functions to comparable microwave techniques (e.g., link loss, noise figure, dynamic range and phase error). More recent technology advancements will also be incorporated.

Benefits:

- Explain limitations of photonics and photonic devices for microwave systems.
- Identify promising technologies for analog system improvements.
- Discuss and relate analog and digital fiber optic system differences.
- Design optical systems for microwave applications.
- Identify and compare RF systems which may benefit from utilizing RF Photonics.

Audience:

The course attendee should have a basic understanding of lasers, photodetectors, and fiber optics. A bachelor's degree in engineering or the physical sciences or an equivalent level of experience would be necessary to understand the system design and application-need aspects of the course.

Instructor Biography:

Keith J. Williams received his B.S.E.E. degree from the University of Nebraska and the M.S. and Ph.D. degrees from the University of Maryland. His doctoral research was conducted on microwave p-i-n photodetector nonlinearities. Since 2000, he has been the head of the Photonics Technology Branch of the Naval Research Lab, Washington,

D.C., where his research interests include microwave-optical devices, microwave fiber-optic links and systems and high current photodiodes.

SC178 Test and Measurement of High-Speed Communications Signals

Monday, March 5, 2012
8:30 AM - 12:30 PM

Instructor: Greg LeCheminant; Agilent Technologies, USA

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

The ability to accurately characterize signals and waveforms is an essential element in the development and manufacturing of high-speed communications components and systems. This course will emphasize measurement tools and techniques to characterize signal quality and how well it is maintained when transmitted through an optical system. It will focus on three measurement areas: bit-error-ratio (BER) analysis, oscilloscope waveform analysis with emphasis on the eye diagram and jitter analysis. The basics for each measurement type will be covered, gradually building to the more difficult aspects of measurements, including common measurement problems and their solutions. Results from tests performed on actual components and systems using BERTs, high-speed sampling oscilloscopes and jitter test sets will be presented. The course will emphasize research and development and manufacturing measurements of components and subsystems and will not discuss installation and maintenance test.

Benefits:

- Determine the relationships between BER, eye-diagrams and jitter tests.
- Avoid common mistakes that degrade measurement accuracy.
- Define the relationship between Q-factor and BER.
- Identify ways to increase test efficiencies.

- Develop test strategies to verify compliance to industry standards.
- Compare the different approaches to characterizing jitter and recognize what the results imply in a systems context.

Audience:

This course is appropriate for engineers, technicians and scientists who have a basic or higher knowledge of high-speed communications systems and signals. A basic knowledge of common laboratory measurement instrumentation will be helpful.

Instructor Biography:

Greg LeCheminant holds B.S.E.E.T. (1983) and M.S.E.E. (1984) degrees from Brigham Young University. He began work for Agilent Technologies/Hewlett-Packard in 1985 as a microwave circuits manufacturing development engineer. Since 1989, he has been involved in the development of measurement tools and applications for high-speed digital communications signals and systems with an emphasis in optical transmission.

SC210 Hands-on Polarization-Related Measurements Workshop

Monday, March 5, 2012
8:30 AM - 12:30 PM

Instructor: Daniel Peterson[1], Tasshi Dennis[2], Brian Teipen[3], Christine Tremblay[4]; [1]Verizon, USA, [2]NIST, USA, [3]ADVA Optical Networking, USA, [4]École de technologie supérieure, Université du Québec, Canada.

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

In this Short Course you will measure the polarization-related parameters that are important to high-speed fiber optic communications. The course begins with a brief review of key polarization concepts and a short description of the course equipment and setups. The participants then divide into small groups and rotate among four lab stations. In Lab 1, you will control and measure the state and degree of polarization. You will also measure polarization cross-talk on polarization-maintaining fiber and create a polarization reference frame for absolute polarization measurements. Equipment for this lab includes a polarimeter, a DOP meter, various polarization controllers, and a polarization extinction ratio meter. Tasshi Dennis is the instructor. In Lab 2, you will measure the polarization dependent loss (PDL) of optical components (including filters) using the all-states and Mueller matrix PDL methods. You will also measure and correct for the polarization dependence of optical power meters and OSAs. Equipment for this lab includes a swept Mueller matrix setup, polarization controllers and scramblers, a PDL meter, an OSA and an optical power meter. Christine Tremblay is the instructor. In Lab 3, you will measure the polarization mode dispersion (PMD) of transmission paths with combinations of high-PMD fibers. The measurement methods used in this lab include Interferometry and Jones Matrix Eigenanalysis (JME). Danny Peterson is the instructor. In Lab 4, participants will explore the effects from first- and second-order PMD on a 40 Gb/s optical signal and verify the technical difficulties associated with PMD compensation. Equipment for this lab includes an optical transceiver, a PMD source, a polarimeter and an optical oscilloscope. Brian Teipen is the instructor.

Benefits:

- Operate a wide variety of polarization-related test equipment.
- Measure polarization dependent loss (PDL) using all-states and Mueller methods
- Measure polarization-mode dispersion (PMD) using Interferometric and JME methods
- Demonstrate the effect of PMD on high-speed digital signals and describe the technical difficulties associated with PMD compensation.
- Determine the outage probability in optical fiber transmission systems due to PMD-induced degradation.
- Measure polarization cross talk “in-line” and at the end of a polarization-maintaining (PM) fiber.

- Achieve optimum performance in PM fiber applications.
- Measure the polarization dependent response (PDR) of everyday test equipment and describe how to overcome PDRs by means of high-speed polarization scrambling.
- Describe the system-level effects of polarization-related impairments on long-haul optical transmission.

Audience:

This course is ideal for engineers, technicians and managers involved with optical fiber, components, and/or 8G Fibre Channel, 10G SONET/SDH, or 10G/40G/100G Ethernet transmission interfaces.

Instructor Biography:

Tasshi Dennis received the Ph.D. in electrical engineering from Rice University. He is a staff scientist at NIST in the Optoelectronics Division working on high speed optical measurements. He is an OSA member.

 Daniel Peterson is a distinguished member of the technical staff at Verizon. He is an internal advisor on optical technologies for Verizon's ULH network. He received a Ph.D. in electrical engineering from the University of Texas at Dallas. He is a senior member of IEEE.

 Christine Tremblay is a professor at the École de technologie supérieure, Université du Québec where she set up the Laboratoire de technologies de réseaux, an advanced WDM physical layer testbed for studying high-speed transmission and

networking technologies, and established courses on optical communications. She is a member of OSA and the IEEE Photonics Society.

 Brian T. Teipen, Ph.D., researches advanced optical transport techniques for ADVA Optical Networking. Brian received the Bachelor of Science degree in physics at Indiana University in 1995, and his doctorate degree in electrical engineering at The University of Texas at Dallas in 2000. He is an IEEE and OSA member.

SC239 Short-Reach Optical Interconnects

Monday, March 5, 2012
8:30 AM - 12:30 PM

Instructor: Steve Joiner; Finisar, USA

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

This course will present an overview of short-reach optical interconnect technology, from traditional LED-based Ethernet transceivers all the way to high-density multichannel solutions now being investigated for multi-Terabit/s optical backplanes. Material will include applications and standards, basic component technologies (e.g. optoelectronics, IC's, optics, packaging, connectors), the basics of optical link analysis (e.g. power budgets, eye-diagrams, link penalties), and a survey of high-bandwidth, short-reach optical interconnect solutions including serial, parallel optics and coarse WDM.

Benefits:

- Determine the suitability of optical interconnects for system applications.
- Compare technology options for short-reach optical interconnects.
- Compute a simple optical power budget.
- Identify the components best suited for a given optical interconnect application.
- Explain short-reach optical interconnect technology to system engineers and management.

Audience:

This introductory course is intended for an audience with at least some technical background in engineering, physics or related disciplines, and is ideally suited for engineers from related fields in optics, electronics, networking or computing systems who want to learn more about short-reach optical interconnects. Marketing or business development professionals seeking a deeper understanding of the technology may also consider taking this course.

Instructor Biography:

Steve Joiner has been developing products for emerging fiber-optic communication applications for 25 years. Steve currently works with Finisar Corp. Prior to joining Finisar, Steve was Director of Marketing for pluggable transceivers at Bookham. Steve works with both customers and standards bodies to create the best application of technology to meet market needs. Steve joined Hewlett-Packard in 1978, working in III-V devices, fiber-optic cable fabrication, fiber-optic transceiver development, and standards development. He was Program Manager for HP's first 1300-nm LED transceiver for the ESCON and FDDI markets. Later, he was responsible for all fiber-optic product development, then moved into technology planning and pre-competitive collaboration. In 1999 he joined the newly-formed Agilent Technologies Corporate Laboratory, where he managed the Network Architecture and Technology Department. He has chaired numerous standards committees, participating in the development of several multi-source agreements for fiber-optic packaging. St eve earned his B.A., M.A., and Ph.D. degrees in physics from Rice University in Houston.

SC342 Digital Coherent Optical Systems

Monday, March 5, 2012
8:30 AM - 12:30 PM

Instructor: Maurice O'Sullivan; Ciena, Canada

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

Transmission systems operating at 40 Gb/s and 100 Gb/s, including network spectral efficiencies above 1 b/s/Hz, are being installed to address the need for capacity in long haul optical networks. Coherent transmission can provide the optical performance to allow the use of these signals on a flexible meshed network of continental dimensions. CMOS electronics has enabled the digital signal processing (DSP) and error correction (FEC) necessary for practical coherent transceivers.

This course will introduce DSP-assisted digital coherent optical transmission. This includes electric field transmitters, coherent receivers, linear filtering and data recovery. Single and multicarrier implementations will be examined. Aspects of the dependence of the performance upon the dispersion map and upon the composition of the wavelength division multiplexed (WDM) spectrum will be addressed.

Benefits:

- Understand basic implementations of electric field transmitters.
- Understand basic implementation of coherent receivers.
- List or describe the main linear equalization function performed by DSP.
- Compare architectures of single and multicarrier coherent transceivers.
- Anticipate relative performances of coherent phase modulated channels vs. dispersion map and WDM channel spectrum.

Audience:

This course is intended for network operators, system integrators and other interested parties seeking introductory insight into DSP assisted coherent optical transmission.

Instructor Biography:

Before joining ciena, Maurice O'Sullivan has worked at Nortel for a score of years, at first in the optical cable business, developing factory-tailored metrology for optical fiber, but, mainly, in the optical transmission business developing, modeling and verifying physical layer designs and performance of Nortel's line and highest rate transmission product including the first commercial 10 Gb/s system, several commercial terrestrial line systems, the first commercial DSP assisted electric field modulation transceiver with complete electronic compensation for optical dispersion and the first commercial coherent 40Gb/s and 100Gb/s transceivers . Many of these products remain in the ciena product catalog. He is at present contributing to the design of ciena's next coherent product. He holds a Ph.D. in physics (high resolution spectroscopy) from the University of Toronto and has more than 20 patents.

SC356 40G/100G Ethernet Technologies and Applications

Monday, March 5, 2012
9:00 AM - 12:00 PM

Instructor: Osamu Ishida; NTT, Japan

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

This short course provides an overview of the challenges, current solutions, and future trends in the highest speed Ethernet technologies and their applications.

The paradigm of the optical interface has shifted at 40 Gb/s both in terms of technology and application, from serial to multi-lane and from Telecom-driven to Datacom-driven, respectively. The course first reviews the historical trends, the evolution in Ethernet in terms of speed and applications, and the degree of penetration

of Ethernet into WANs and SANs. The 40-Gb/s and 100-Gb/s Ethernet (IEEE802.3ba) Physical Layer architecture, technologies, and implementation with pluggable modules are discussed in detail to provide insight into current and future technology trends. Finally, the course highlights emerging 40G and 100G Ethernet usage cases both in telecom and datacom applications such as aggregated transport in Optical Transport Networks (OTNs) and a converged network interface for Fiber Channel over Ethernet (FCoE) in a cloud data center.

Benefits:

- Summarize the evolution of Ethernet in terms of speed and applications.
- Identify key concepts behind the Ethernet Physical Layer technologies.
- Describe 40G and 100G Ethernet Physical Layer architecture and interfaces.
- Appreciate the 10G technologies leveraged with the lane distribution mechanism.
- Discuss the various form-factors of 40G and 100G pluggable transceiver modules.
- Derive insight into future trends regarding higher speed Ethernet.
- Compare technological options for wide- and storage-area-network applications.
- Explain 40G and 100G Ethernet accommodation in OTNs.
- Discuss data center Ethernet converged with fiber channel applications.

Audience:

This course is intended for engineers, researchers, and technical managers who would like to gain a better understanding of newly-standardized IEEE802.3ba 40G/100G Ethernet technologies and relevant usage cases both in telecom and datacom applications. No prior knowledge of Ethernet is required.

Instructor Biography:

Osamu Ishida is a senior research engineer/supervisor at NTT, and leads the Photonic Networking Systems Research group at NTT Network Innovation Labs, Yokosuka, Japan. He has over 20 years of experience at NTT Labs in research on high-speed Ethernet transport, WDM cross-connect, and coherent optical fiber communications. He has been involved with standards development of 10G/40G/100G Ethernet (IEEE 802.3) and the revision of OTN (ITU-T G.709). Recently, he has served as a guest editor for IEEE COM-M. He is the author or coauthor of more than 50 journal and conference articles in English and a coeditor of the textbook 10 Gb/s Ethernet Technologies published by Impress Japan in 2005. He received his M.E. and B.E. degrees in electrical engineering from the University of Tokyo, Japan.

SC358 Data Center Cabling: Transitioning from Copper to Fiber

Monday, March 5, 2012
9:00 AM - 12:00 PM

Instructor: Lisa Huff; DataCenterStocks.com, USA, [2]Discerning Analytics, LLC, USA

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

This short course is intended to help data center and network managers understand the value proposition of an all-optical data center. Topics that will be discussed include looking at basic data center network infrastructure design and hardware needs. The course was developed with the TIA-942, Telecommunications Infrastructure Standard for Data Centers in mind, but will also address the fact that many data centers really have not used this standard in practice. Networking standards such as IEEE 802.3, Fibre Channel, iSCSI and InfinBand will be reviewed along with their applicability to certain aspects of the data center. Technology roadmaps and data

center networking trends will be included as well as how to handle transitioning from lower to higher data rates within your data center. When it makes sense to implement fiber optics and what types of transceivers and cabling should be used for different scenarios will be presented. Other technologies such as Fibre Channel over Ethernet, RDMA (InfiniBand) over Converged Ethernet, IO virtualization and how virtualization and network consolidation will affect data rates will also be discussed. Detailed cost analysis of fiber versus copper in the data center will be presented considering not only equipment and infrastructure cost, but potential staff, port and cabling density, power and cooling costs. Also included will be analysis of whether it matters what vertical market a data center supports – for example, does a financial sector data center have different requirements than a higher-education data center? Several real-world case studies will be presented.

Benefits:

- Design data center networks in accordance with TIA-942
- Determine when a fiber-optic cabling solution would be appropriate
- Define Ethernet, Fibre Channel and InfiniBand technologies and their appropriate applications
- Compute how cost-effective your current network topology is
- Determine appropriate measures for upgrading network equipment to higher data rates
- Accurately and realistically compare copper and fiber technologies in the data center
- Identify different defined areas of a data center
- Determine appropriate technologies for your data center

Audience:

This course is valuable to engineers, technicians, networking professionals and managers interested in transitioning their networks and data centers from copper to fiber optics. Data center operators and facilities managers may also be interested in attending to understand some of the networking technologies contained in their data centers.

Instructor Biography:

Lisa Huff is Chief Technology Analyst for DataCenterStocks.com and Principal Analyst at Discerning Analytics, LLC. Lisa is a Certified Data Center Professional (CDCP) and degreed electrical engineer with more than 25 years experience in the electronics industry. She has held various industry marketing and engineering positions at Berk-Tek, A Nexans Company, Communications Industry Researchers, FCI and Tyco Electronics. Her expertise is in data centers, data communications cabling and connectivity, networking equipment and optical components. Lisa writes for two blogs: DataCenterStocks and Optical Components. She has presented at several industry conferences and has produced more than 20 publications and her most recent market research can be found at Discerning Analytics Web site.

SC266 Quantum Cryptography and Quantum Information

Monday, March 5, 2012
9:00 AM - 12:00 PM

Instructor: Richard Hughes[1], Thomas Chapuran[2]; [1]Los Alamos Natl. Lab, USA, [2]Telcordia, USA

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

This course will describe the new and rapidly expanding field of quantum communications, which promises to revolutionize some aspects of communication networks. It will provide a view of an early application of quantum information and quantum communications, namely quantum cryptography and why it may be of

interest for the OFC/NFOEC community. After a brief motivation as to "what is cryptography" and "What are the limitations with conventional cryptography," the course will provide a high-level view of quantum cryptography and quantum key distribution. The course will provide a brief history of quantum cryptography from its inception to the present time and will walk through detailed examples of how the BB-84 QKD protocol works. The course will then turn to the realities of real-world light sources and photon detectors. The course will include both fiber and free space environments and will identify and summarize some of the major efforts worldwide in this area. Finally the course will describe recent “quantum hacking” research results, and will discuss how recent QKD network testbed results set the stage for quantum information systems for the future.

Benefits:

- Identify benefits of quantum key distribution techniques.
- Determine free-space and fiber based applications.
- Describe single photon sources and compute their expected characteristics.
- Describe concepts of quantum entanglement.
- Determine appropriate networking applications for quantum communications.

Audience:

The audience may include optical networking and optoelectronic technology researchers with an interest in quantum communications, managers of research groups, and engineers who want a glimpse of a new and forward-looking technology. An undergraduate-level understanding of quantum mechanics is helpful.

Instructor Biography:

 Richard J. Hughes is a Laboratory Fellow at the Los Alamos National Lab. He is co-principal investigator of projects in both free-space and optical fiber based quantum key distribution and holds two US patents in these areas. He obtained his doctorate from the University of Liverpool and has held positions at Oxford University, Queens College Oxford, Caltech, CERN, and the University of Oslo. His awards include the Los Alamos Distinguished Performance Award, Los Alamos Fellow's Prize, co-winner of an R&D Development 100 Award for "Free Space Quantum Cryptography," and co-winner of the European Union's Descartes Prize. He is an APS Fellow and has authored more than 150 scientific papers.

 Thomas Chapuran is a Senior Scientist at Telcordia. He has served as co-principal investigator and Telcordia technical lead in experimental investigations of the compatibility of quantum key distribution with optical networking. He holds a doctorate in physics from the University of Illinois, and served on the faculty at the University of Pennsylvania. His research interests include quantum communications and computing, optical network architectures, broadband access, and signaling and control for next-generation networks. He received Telcordia CEO Awards in 2000 and 2001 and has authored numerous papers in the fields of telecommunications and physics.

SC208 Optical Fiber Design for Telecommunications and Specialty Applications

Monday, March 5, 2012
9:00 AM - 12:00 PM

Instructor: David J. DiGiovanni; OFS Labs, USA.

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

Optical fiber design remains a robust field for innovation in both telecom and nontelecom applications. As worldwide bandwidth demand continues to grow, new fiber types and fiber-based components can increase speed, reduce cost and improve the bandwidth of communications networks. In addition, application-specific fiber can enable or benefit a wide array of functions such as simply transporting light between two points, amplifying light, processing signals, sensing environmental characteristics and even transporting particles. The tools available in adapting fiber to particular uses, whether for high speed communications or other applications, include a range of materials and dopants (glasses, polymers), the mechanics of the fiber (size, coatings, microstructure), waveguiding properties (index profile), and various fiber-based devices such as gratings and amplifiers. These tools have been used to establish an industry that continues to expand as photonics penetrates more and more industries and applications.

This short course will discuss the many ways in which optical fiber design can be used in a wide range of applications and will review an array of current fiber technologies. We will consider the role and capabilities of materials, structures and waveguide design for both fiber and fiber-based photonic components. The focus will be on understanding the capabilities of fiber design and engineering with the goal of demonstrating the many opportunities available with novel optical fibers. Specific attention will be on the impact of transmission fiber design and properties for high-speed optical communication such as >40Gb/s transmission and coherent detection; designs for optical amplification and dispersion compensation; and the design of waveguides to produce effects such as enhanced nonlinearity and bandgap operation.

Benefits:

- Understand how certain fiber attributes, like attenuation, modal area and dispersion can impact current and next-generation high speed communications technologies
- Describe the wide array of optical fibers available and discuss how their designs have been engineered for particular applications
- Compare the benefits of different materials in fiber design, including different glass dopants.
- Design simple fibers for various applications, such as amplifiers, dispersion compensators, sensors and component pigtails.
- Determine whether particular applications can benefit from modified or novel optical fiber.
- Understand the potential offered by fiber engineering which may be exploited to improve existing applications or create new functions.

Audience:

This course is intended for the technical community seeking to understand the potential of optical fiber and waveguide design. Basic understanding of optical fiber properties is desirable though not required. The course will provide an understanding of the operating principles of fiber while also exploring the limits of waveguide and materials engineering. Specific designs for high speed transmission, optical amplification and dispersion compensation will be studied, among others.

Instructor Biography:
D.J. DiGiovanni received several engineering and mathematics degrees from Brown University, including a PhD in 1987. He joined Bell Laboratories in the Optical Fiber Research department in 1990 and has worked on various phenomena related to optical fibers for erbium-doped amplifiers, high power amplifiers and lasers and Raman amplification. He is now president of OFS Laboratories and continues to explore designs, fabrication and applications of specialty and transmission optical fibers and devices.

SC187 Hands-on Basic Fiber Optics for the Absolute Beginner

Monday, March 5, 2012
1:00 PM - 5:30 PM

Instructor: Dennis Horwitz; Micronor Inc., USA

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

This Short Course provides a very practical introduction to fiber optics with extensive show-and-tell and hands-on experiments to help better understand the concepts and industry trends by both seeing and doing. It has proven a popular and useful course to not just engineers but also purchasing, manufacturing, program management, sales, marketing, and management. The course provides a practical overview to the essential concepts behind fiber optics, including: single-mode, multi-mode, core, cladding, numerical aperture, attenuation, dB, dBm, dispersion, bandwidth, SONET, DWDM, and GbE. We also will discuss the broad range of applications from commercial telecommunications to military and aerospace, from medical to geophysical, and more. Mixed in with the various topics are hands-on test and measurement experiments to help better understand fiber optics and its nuances: visual fault location, optical power, attenuation, insertion loss, return loss, and optical time-domain reflectometry. The hands-on experiments help to introduce the participant to popular fiber optic standards used throughout various industries, including TIA fiber optic test procedures (FOTPs) and optical fiber system test procedures (OFSTPs). The participant will also come to understand some of the many variations in testing, the meaning of the results, and important tips when working with fiber.

Benefits:

- Explain the fundamental optical differences and applications of single-mode fiber (SMF) vs. multimode fiber (MMF), including the different fiber types and fiber sizes.

- Identify the different connector types and understand their specific performance features (e.g. E2000, FC, LC, MIL styles, MTP, SC, ST, etc.) plus the various end-face options (i.e., Expanded Beam, NC, PC, SPC, UPC, and APC).
- Test connectors and cable assemblies for insertion loss (IL) and return loss (RL).
- Measure attenuation differences and bend loss effects in single-mode and multi-mode fiber links.
- Explain the differences between standard OTDRs and high resolution, short haul OTDRs, as well as their applications.
- Apply proper handling and cleaning techniques.
- Explain DWDM concepts and trends in telecommunications as well as Gigabit Ethernet technology driving LAN/WAN applications.
- Explain limitations of COTS components vs. requirements of harsh/hazardous environments.

Audience:

The course is the ideal introduction to fiber optics and is geared toward the engineer or manager just making the transition into fiber optic technology. Every two participants will share a test and troubleshooting set consisting of a visual fault locator (VFL), optical power meter (OPM), LED source, laser source, connector cleaning tools, and a variety of test cables to simulate different test scenarios.

Instructor Biography:

Dennis Horwitz received his M.S.E.E. from the University of California at Los Angles and has more than 30 years experience in research and development, product development, sales, and marketing of fiber optic test equipment and components. He was co-founder of two successful start-ups in fiber optic test and measurement: Photodyne Inc. (1979–1990, sold to 3M) and Rifocs Corp. (1990–2003, sold to Textron). He is actively involved in fiber optic standards development (ARINC, ISA, SAE, and TIA) and has been an OFC/NFOEC Short Course instructor for more than 10 years.

He is currently Vice President for Sales/Marketing for Micronor Inc., which has developed and commercialized the first totally passive fiber optic rotary encoder for motion control applications.

SC205 Integrated Electronic Circuits and Signal Processing for Fiber Optics

Monday, March 5, 2012
1:30 PM - 4:30 PM

Instructor: Y. K. Chen, Noriaki Kaneda; Bell Labs, Alcatel Lucent, USA.

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

High speed electronics at 10-, 40-, 100-Gbit/s and beyond is a critical enabler for fiber-optic networks. We will review the basic functions of high speed lightwave circuits in optical terminals, with emphasis on physical layer transceiver electronics. The basic functions and architectures of these circuits will be reviewed. The high speed IC technologies and their implementation of these important high bit-rate digital and analog applications will be presented. The presentation materials include receiver front-ends including trans-impedance amplifiers and limiting amplifiers, clock-data recovery circuits including phase locked loop and digital phase detectors, SERDES such as electrical time-domain multiplexers, de-multiplexers and transmitter circuit such as driver amplifiers. Methods to enhance the performance and bandwidth are illustrated with examples from literature, along with results showing the current state of the art. A low-cost electronics solution such as FFE, DFE electronic front-end to equalize and mitigate optic fiber transmission impairments will be illustrated. The basic requirement, characteristics, and circuit topologies of emerging data converters technologies (ADC, DAC) for optical communications will be reviewed. As an increasingly important electronic component in today's optical communication, the course will cover the topics on digital signal processing for coherent optical transmission. The basic architectures, algorithms, and implementation techniques of

digital signal processing in optical communication will be reviewed. The techniques for transmission mitigation and intradyne detection will be presented on single carrier and multi-carrier modulation formats with examples.

Benefits:

- Describe the functions and performance of high-speed electronics for optic fiber terminals.
- Evaluate the design and implementation of physical layer electronic circuits.
- Describe commonly used circuit architectures.
- Compare the merits among different IC technologies.
- Justify advanced electronic equalization techniques.
- Compare implementation complexity of various DSP techniques for optical transmission.

Audience:

This course is intended for engineers, scientists or managers who must make or understand the choice of electronic circuits for optical transmission products or evaluate electronic solutions used in purchased products.

Instructor Biography:

Young-Kai Chen is a director of high speed electronics and optoelectronics research department at Bell Labs, Alcatel-Lucent. He received his doctorate in electrical engineering from Cornell University. He worked for General Electric Co. before joining Bell Labs. He is a Fellow of IEEE, a member of the National Academy of Engineering, and a recipient of the IEEE David Sarnoff Award. He has published three book chapters,

more than 100 journal papers and more than 150 conference papers, and he has received 15 patents.

Noriaki Kaneda is member of technical staff at Bell laboratories, Alcatel-Lucent, Murray Hill, NJ. His Ph.D academic work included microwave photonics at the University of California, Los Angeles. Since he joined Lucent Technologies in 2000, he has worked on various topics regarding optical data formats including direct detection DPSK, digital coherent QPSK, coherent optical OFDM for the high bit rate optical transmission systems. His current research interest consists of high-speed digital signal processing in optical transmission systems.

SC176 Metro Network: The Transition to Ethernet

Monday, March 5, 2012
1:30 PM - 4:30 PM

Instructor: Loudon Blair; CIENA Corp., USA

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

Metro networks are being stretched by new broadband services that are forcing the capacity of customer access links to increase by two to three orders of magnitude. Because service revenues are not growing in proportion to bandwidth, new network solutions are needed to dramatically lower the cost per unit bandwidth of the network infrastructure. Consequently, service providers almost universally are migrating from SONET/SDH to Ethernet for both equipment interfaces and the creation of a new packet transport layer. In this course, the motivation for new service offerings for both residential and business environments and we analyze how these new services are changing the magnitude and pattern of traffic flows across the metro area. We then explore traffic projections at several key points in the metro network and estimate the required capacity of networking switches and transmission systems that will result from different service-mix scenarios. We will examine the mix of networking technologies that can be employed in the metro to yield a highly functional yet

economic network solution. This will include an introduction to Carrier Ethernet and different implementation approaches to achieving carrier-grade performance as well as how Carrier Ethernet will operate in conjunction with other key network technologies including IP, OTN and DWDM. With the anticipated dramatic growth in network capacity, the optical networking layer will play an increasingly important role in the metro network, both in enabling capacity scaling and in network reconfiguration. We discuss how the convergence of Carrier Ethernet and optical technologies is leading to the development of new packet-optical transport and switching systems. Applications of how packet-optical systems may be used in metro networks are explored using use cases.

Benefits:

- Describe how new services are changing metro network traffic characteristics.
- Describe the impact that these new services will have on metro network traffic patterns and network equipment capacity in both aggregation and core metro networks.
- Describe the meaning of Carrier Ethernet and discuss different implementation approaches.
- Describe the key networking technologies used to build next generation metro networks, including DWDM, OTN, and IP/MPLS.
- Discuss the role of Carrier Ethernet in new metro architectures and how it operates in combination with other key technologies.
- Describe how packet and optical technologies are converging to form packet-optical transport and switching systems.
- Discuss how packet-optical systems may be used in different metro application scenarios.

Audience:

This course is intended for network architects and planners from service providers, engineering and marketing staff to network equipment providers, technologists with an interest in the evolution of networks, industry analysts, and financial analysts.

Instructor Biography:

Loudon Blair is Principal Network Architect at Ciena. Since joining the company in 1997, he has performed several roles in the development of Ciena's optical networking products. He has also worked at Iridium, BT and Hitachi. He has been a long-term contributor to OFC and was general co-chair for OFC/NFOEC in 2008.

SC312 Parametric Optical Processing and Systems

New Course!

Monday, March 5, 2012
1:30 PM - 4:30 PM

Instructor: Stojan Radic; UCSD, USA

Level: TBD

Description:

The course will introduce the basics of parametric signal processing and its application in communication and sensing. The course is structured in three segments and will cover:

1. parametric physics in lumped and distributed platforms,
2. device design in time and spectral domains and
3. digital, analog and coherent applications.

Performance, impairments and physical limits of parametric amplification, band conversion, signal regeneration, coherent sampling and conjugation will be described in detail. The course will introduce wideband device synthesis and outline fundamental

and practical performance limits. Emerging applications that include tunable sources, coherent sampling, analog-to-digital conversion, reconfigurable delays, and low-latency spectral monitoring will be covered. Finally, the parametric processor role in sensing systems such as distant-band LIDAR will conclude the course.

Benefits:

- Design the basic parametric amplifier using conventional, off-the shelf elements.
- Design and test single- and multiple-band converter.
- Construct coherent parametric processor.
- Design and construct high-rate multiplexer, demultiplexer.
- Design and construct scalable multicaster blocks.
- Introduce parametric module into general purpose instruments in communication, sensing and measurements.
- Design, construct and characterize high-rate analog-to-digital converter.
- Explain advantages and disadvantages between translated and band-specific sensing and communication systems.

Audience:

Recommended audience includes researchers interested in ultrafast signal processing, high performance amplification, band conversion and general parametric technology. The course requires only basic fiber course background and will support attendance from junior graduate students and up. The course will cover topics in communications, sensing, metrology and general laser design and welcomes attendance from diverse backgrounds.

Instructor Biography:

Stojan Radic is a Professor of Electrical Engineering at University of California. He graduated from The Institute of Optics, served as a Senior Scientist at Corning until 1998, when he joined Bell Laboratories. He was a Committee Chair at the Optical Amplifier Conference, Optical Fiber Communications Conference and a Program Chair of Coherent Optical Technologies and Applications Conference. He serves as an Associate Editor for Optics Express and is an OSA Fellow.

SC327 Modeling and Design of Fiber-Optic Communication Systems

Monday, March 5, 2012
1:30 PM - 4:30 PM

Instructor: René-Jean Essiambre; Bell Labs, Alcatel-Lucent, USA

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

The broad objective of this course is to provide a working knowledge of the numerous techniques and tools used to design the transport layer of advanced fiber-optic communication systems, from metropolitan to ultra-long haul systems. The primary focus is on providing a comprehensive overview of how to model propagation over optical fibers, with emphasis on the various fiber nonlinear effects involving signal and noise, for both singly-polarized and polarization-division-multiplexed signals. This includes a description of the techniques suitable for modeling nonlinear propagation of various advanced modulation formats in optically routed networks. The course also provides a comparative description of various optical amplification technologies, such as erbium-doped and Raman amplification, for different types of transmission lines. A description of the tools used to characterize system performance is covered in this course, including evaluations of optical signal-to-noise ratio (OSNR) penalties and Q-factors. In addition, the course presents an introduction to the issues faced when configuring the physical layer of optical networks, including ring and mesh network topologies. Finally, the course concludes with an overview of the ultimate capacity of the “fiber channel” that helps participants understand technological limits associated with increasing the capacity of fiber-optic communication systems.

Benefits:

- Develop a functional understanding of the basic building blocks of fiber-optic communication systems.
- Learn the basic elements of optical transmission modeling.
- Develop a detailed understanding of how to model nonlinear transmission over fibers, especially how to navigate through the numerous pitfalls of nonlinear transmission modeling.
- Choose a suitable technique for modeling specific systems, such as systems using advanced modulation formats.
- Compare the performance of various amplification technologies.
- Understand the basic technical issues faced when configuring optical networks with complex topologies.
- Estimate the ultimate limit to fiber capacity.

Audience:

This course is intended for engineers and scientists working on fiber-optic transmission as well as those working on components and subsystems interested in developing an expertise at the transmission level. The course also addresses academic researchers and graduate students with basic knowledge on optical or digital communication interested in developing a detailed knowledge of fiber-optic transmission modeling and in understanding system implications of advanced technologies.

Instructor Biography:

René-Jean Essiambre is a Distinguished Member of the Technical Staff at Bell Labs, Alcatel-Lucent. He received his doctorate from Université Laval and studied at the University of Rochester before joining Lucent Technologies (now Alcatel-Lucent) in 1997. Essiambre is contributing to the design of advanced optical transmission systems, especially in relation to the management of fiber nonlinearities. His interests

include modulation formats, detection and optimization techniques for the design of optically routed networks to increase capacity, optical transparency, and functionality of wavelength-division multiplexed communication systems. He is a recipient of the 2005 Engineering Excellence Award from OSA, where he is a fellow.

SC369 Test and Measurement of Complex Modulated Optical Signals

New Course!

Monday, March 5, 2012
1:30 PM - 4:30 PM

Instructor: Bernd Nebendahl & Oliver Funke, Agilent Technologies, Germany

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

Device bandwidth constraints and typical 50 GHz channel spacing force system designers to consider combined phase and amplitude modulation as a method to increase channel information capacity. Test and measurement of the transmitters and receivers used in these complex modulation systems requires techniques that are vastly different than those used for the simple amplitude modulation based systems that have dominated optical communications. This course will give an overview of the basics of complex modulation. For test and measurement there will be an emphasis on systems based on polarization diverse coherent receivers with their signals being sampled in real time. In order to extract meaningful results topics like polarization and carrier phase tracking are discussed. Various parameters that quantify the signal quality of a complexly modulated signal are introduced that allow rating the performance and identifying problems of a transmitter for complexly modulated signals. The definition of the error-vector-magnitude (EVM) and its relationship to BER and Q-factor will be explained. Methods to quantify the uncertainty of a test system and to validate its performance will be presented.

Benefits:

- Compare the quality of various transmitters through the use of EVM measurements
- Determine the relationships between EVM, BER, and Q-factor
- Compare the different techniques used for complex modulation analysis and determine which provide optimum results for a given measurement scenario
- Relate details of constellation diagrams to specific device and/or measurement system impairments
- Identify the root causes of measurement degradation and uncertainty
- Develop test strategies to validate the accuracy of test results

Audience:

This short course is intended for engineers who start to work or already have experience in manufacturing and development of transmitters, links and receivers operating with complex modulated signals. Attendees should be aware of basic concepts of optical
transmission and polarization of light. Research and manufacturing managers as well as technical buyers will get a profound background in order to make optimal decision for their test and measurement needs. Students will extend their knowledge in complex signal analysis to setup optimal test concepts.

Instructor Biography:


Oliver Funke
Product Manager, Agilent Technologies

Oliver joined Agilent Technologies in 1992 (formerly Hewlett Packard) as Engineer of the Optical Communication Measurement Division. Oliver has worked in various R&D projects, including low noise OTDR receiver, optical power meter, coherent optical all parameter test and lightwave component analyzer in various positions from engineer to project lead. In 2006 he joined product marketing. He is now responsible as Product

Manager for coherent transmission test.
Oliver has a degree in Communication Theory from the Technical University in Munich.

 Bernd Nebendahl
Project Lead, Agilent Technologies

Bernd joined Agilent Technologies in 2000 as Engineer of the Optical Communication Measurement Division. Bernd has worked in various R&D projects, including tunable external cavity lasers, optical attenuators, coherent optical all parameter testers, distributed temperature sensing and the optical modulation analyzer in positions from optics designer to project lead. He currently focuses on all topics around coherent transmission.
Bernd received a diploma and a PhD in physics, both from University of Stuttgart.

SC370 FEC Technology in Optical Communications

New Course!

Monday, March 5, 2012
1:30 PM - 4:30 PM

Instructor: Takashi Mizuochi and Yoshikuni Miyata; Mitsubishi Electric, Japan

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

Watch Scott Hamilton, MIT Lincoln Laboratory, USA, OFC/NFOEC General Chair Discuss New Short Course SC370 FEC Technology in Optical Communications

This course describes the types of forward error correction (FEC) technique used for optical communications. The basic concepts and terminology of FEC, e.g. block codes, Hamming distance, parity check matrix, and syndrome, are explained using the

fundamental equations. The key terms related to FEC in optical communications are clarified, e.g. net coding gain, code rate, redundancy, interleaving, and Q limit. We then review the history of FEC in optical communications. The various types of FEC developed to date are classified as belonging to three generations: RS(255,239) represents the first generation, concatenated codes are the second generation, and more powerful FEC based on soft-decision decoding is the third generation. The second generation FECs will be explained, and recently developed concatenated codes discussed. The third generation FECs are analyzed in detail, with emphasis on low-density parity-check (LDPC) codes for superior NCGs with soft decision decoding. The positive impacts on existing systems are also discussed. We will relate each generation of FEC to the Shannon Limit, and discuss the ultimate NCG as a function of code rate. The circuit implementation of a 100G Digital Coherent DSP is discussed. The additional useful functionalities obtained by employing FEC and the application of FEC to error monitoring for adaptive equalization will also be covered. Finally, this course anticipates the possible roles for optical technologies in future optical communication networks.

Benefits:

- Explain key terms related to FEC in optical communications
- Define the FEC key parameters
- Compute the basic generator polynomial
- Describe the three generations of FEC
- Compare the net coding gain with the Shannon Limit
- Calculate the Q budget table based on the FEC performance
- Measure the FEC error correction capability
- Design a circuit implementation for 100G Digital Coherent DSP
- Discuss possible roles for optical technologies in future optical communication networks

Audience:

This course is intended for systems engineers, circuit-board designers, system operators and managers who need to understand and apply FECs to optical systems. Knowledge of information theory is not needed.

Instructor Biography:

 Takashi Mizuochi received a Ph.D. degree in electrical engineering from Osaka University, Japan. At Mitsubishi Electric Corporation, he has been engaged in research on coherent optical fiber communications, long-haul transmission systems, undersea WDM communication systems, FEC for transport systems, and electronic signal processing. He is currently R&D Senior Manager, Optical Communication Technology, at Mitsubishi Electric Corporation. He is serving as associate editor of IEEE JQE.

 Yoshikuni Miyata received an M.E. degree in industrial and management systems engineering from Waseda University, Japan. At Mitsubishi Electric Corporation, he has been engaged in research and development on error control coding methods for optical communications, wireless communications and data storage systems.

SC373 Specialty Fiber Splicing and Interconnection

New Course!

Monday, March 5, 2012
1:30 PM - 4:30 PM

Instructor: Andrew Yablon; Interfiber Analysis, USA

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

The recent emergence of a diversity of optical fiber designs and applications has made optical fiber interconnection more challenging even as it has become more important. Effective interconnection of optical fibers is critical for all applications, including traditional telecom links, optical fiber sensors, and high-power fiber amplifiers and sources.

This course provides an introduction to all aspects of optical fiber interconnection, and compares the benefits and disadvantages of fusion splices, fiber connectors, and free space optics. Performance metrics and their measurement are introduced, including optical loss, reflectance, mode conversion, polarization crosstalk, and tensile strength. Special issues relevant to field deployment, factory production, and laboratory environments are all covered. An overview of equipment for fusion splicing as well as for fiber preparation and splice packaging is presented. Special fusion splicing strategies and fusion splice optimization are reviewed. Practical approaches for interconnection specialty fibers, including multimode, single-mode, dispersion managed, rare-earth-doped, large effective area, multi-core, high-power, polarization-maintaining, non-silica, and microstructured fibers are all discussed. Proof testing and long term mechanical reliability of fusion splices are addressed. A numerical approach for modeling fusion splicing is presented.

Benefits:

- Improve the quality of your fusion splices
- Compare competing interconnection technologies
- Select equipment for optical fiber interconnection
- Estimate interconnection performance
- Test and measure optical fiber interconnections
- Avoid problems with splice reliability

- Evaluate and apply special fusion splicing strategies

Audience:

This course is intended for engineers and scientists who are concerned about the problem of optical fiber interconnection and are looking for practical solutions to their problems. This course presupposes a familiarity with contemporary optical fibers and their theory of operation.

Instructor Biography:

Andrew D. Yablon is President of Interfiber Analysis, an optical fiber test & measurement company. Dr. Yablon previously worked at Bell Labs, OFS Labs, and Vytran Corp and has consulted widely on optical fiber interconnection. He wrote the monograph *Optical Fiber Fusion Splicing*, is listed as an author on numerous peer-reviewed journal articles and conference publications, and holds 16 US Patents. He is a Senior Member of the OSA, was chair of the Optical Fiber Subcommittee for OFC/NFOEC 2010, and also teaches a fusion splicing course at SPIE Photonics West.

SC360 Hands-On Fiber Optic Terminations and Measurements with Emphasis on MTP Connectorized Ribbon Fiber

Monday, March 5, 2012
1:30 PM - 5:30 PM

Instructor: Caroline Connolly[1], Loïc Cherel[2], Tony Nicholson[3], Mike Hughes[4], [1]OptoTest Corp., USA, [2]Data-Pixel SAS, France, [3]Connected Fibers, USA, [4]Conec Ltd., USA

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

In a practical, hands-on setting the student will learn about industry standard inspection, measurement, and qualification methods and will solidify the measurement concepts with hands-on practice. With three fully equipped stations, we will discuss care and cleaning of fiber optic cable assemblies as well as the trends to high density connectivity and inspection. Students will use equipment during the class to measure insertion loss, return loss, and to measure and analyze interferometric results on simplex and multifiber connectors.

Students will learn the basic concepts of an interferometer and how these measurements are performed. A hands-on demonstration of making measurements on a single- and multifiber connector will be provided with reference to TIA and IEC standards. The main measurement parameters for fiber geometry will be discussed for single and multifiber terminations. The influence of each parameter on performance and long term reliability of the connector will be explained in detail.

Benefits:

- Identify fiber types such as simplex, duplex, and ribbon fiber and their practical applications
- Classify connectors and components that are used in networks and other long haul applications.
- Use several cleaning methods and recognize contamination versus scratches using various inspection methods.
- Measure insertion loss and return loss on terminated cable assemblies for single-mode and multimode simplex and ribbon fibers.
- Measure and analyze geometric data using an interferometer for simplex and ribbon fibers comparing achieved and expected results.

Audience:

Those in positions from technicians and engineers to managers interested in connector trends and measurements will find this class valuable. Familiarity with fiber optic testing and equipment is beneficial but not necessary.

Instructor Biography:

 Caroline Connolly is a Sales Director at OptoTest Corp. and has been involved with fiber optic test and measurements technologies and cable assemblies for more than 12 years. Her experience covers all areas of physical layer optical testing ranging from laboratory to field applications. Before joining OptoTest, she worked in various key sales positions at Rifocs Corp. Connolly holds a bachelor's degree in business management from the University of Phoenix.

Loïc Cherel is the CEO and founder of Data-Pixel SAS, a leading manufacturer of interferometry and inspection systems dedicated to the field of fiber optics. Mr. Cherel is a contributing expert to the IEC standardization organization (86B, WG4 & WG6). In particular, he is the editor of some of the IEC standards related to single and multifiber geometry measurements using interferometers.

 Tony Nicholson is currently the Director of Technology at Connected Fibers, a company focused on selling manufacturing and test equipment, components, consumables, and tools for optical cable assembly fabrication. Since 1984, Mr. Nicholson has worked in various positions for companies manufacturing and developing test equipment primarily for the fiber optic industry. For the last 16 years he has been involved in the manufacture, sales, and support of interferometers for the fiber optic connector market and was on the technical advisory panel for the TIA during the draft of the first FOTP for measuring fiber optic connectors.

 Mike Hughes is the Product Manager for multifiber connectivity products at US Conec Ltd. He has held engineering and commercial positions in MT ferrule technology for over 9 years and has over 17 years of experience in copper and fiber optic connectors and cabling products. Mike is a US National Committee contributing expert to IEC SC86B, WG4, and WG6. Mike holds a Bachelor of Science degree in mechanical engineering from North Carolina State University and a Master of Business Administration degree from Wake Forest University.

Brian Teague is the Product Manager at US Conec Ltd. for fiber optic connector cleaning tools. Brian has over 13 years of experience working with fiber optic connectors and cabling in telecommunications, enterprise, and harsh environment applications. Brian has been instrumental in releasing multiple fiber optic cleaning solutions for a variety of optical connector types in both field and factory use. Brian holds a Bachelor of Science degree from the University of South Carolina and a Master of Business Administration degree from Florida State University.

SC347 Reliability and Qualification of Fiber-Optic Components

Monday, March 5, 2012
1:30 PM - 5:30 PM

Instructor: David Maack; Corning, USA.

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

Reliability is one of the most important requirements for our modern telecommunication systems. It is one of a customer's first areas of intensive inquiry for a new supplier and potentially one of the biggest problems in deployed systems. An unreliable sub-component can easily bring down entire systems and, in the worst

scenario, force recalls costing thousands of times the original components price leading to substantial financial liabilities and highly strained customer-vendor relationships. Qualification and reliability must both be performed for photonic components.

This course is a combination of two prior courses, “Reliability Methodologies for Fiber Optic Components” and “Qualification Programs for Fiber Optic Components” along with new material which tries to bridge the relationship and gap between qualification and reliability. When is it appropriate to rely on the qualification tests and when must expensive and time consuming reliability models be developed? This is a difficult balance that goes beyond just technical analysis; it involves risk taking, business decisions, judgment and experience. Qualification programs are performed primarily to reduce the high costs of true reliability programs, and as such, act as a proxy for reliability.

Benefits:

- Learn the strategic and tactical differences between performance, qualification and reliability testing.
- Understand how and where reliability and qualification fit at the high level in organization structure and strategy.
- Review the multitude of tools, roles and tactical functions that a reliability group performs particularly during product development.
- Discuss and learn what constitutes a complete qualification program and get the author's interpretation of the "letter of the law" for the most popular standard.
- See detailed charts comparing different qualification standards.
- Appreciate what each of the qualification tests really test for and its limitations.
- Determine why and when reliability testing and modeling needs to be done
- Understand the limitation of both reliability modeling and qualification testing..
- Learn how to establish appropriate reliability tests and gather meaningful data.
- Apply the basics of reliability testing and modeling mathematics to determine the proper statistical distribution for a set of failure data.
- Calculate the reliability of a device using accelerated testing data with case studies for guidance.

- Find information on standards, components, reliability software and other reference materials.
- Read reliability and qualification reports and determine their adequacy.

Audience:

This course is intended for a general audience including non-technical persons with no particular background except an interest in or need for knowledge of reliability and qualification of fiber optic components. It is meant to impart valuable information to audiences of all levels.

Instructor Biography:
David Maack has more than 30 years of engineering and management experience in photonics with the last 15 years in qualification and reliability for passive and active fiber optic components. Currently, he is the reliability manager for the Components and Systems Group at Corning, Inc. in Corning, NY. He is the past chairman of the IEC TC86B Working Group 5 writing standards for passive fiber optic components, has participated in multiple Telcordia GR rewrites, and is the author of numerous papers. He has bachelor's degrees in physics and nuclear science along with a master's degree in business administration.

SC185 Hands-on Polishing, Inspection and Testing of Connectors

Monday, March 5, 2012
1:30 PM - 5:30 PM

Instructor: Jerry Renville[1], Steve Baldo[2], Neal Wagman[3]; [1]Light Brigade Inc., USA, [2]Seikoh Giken Co. Ltd., USA, [3]Norland Products, USA.

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

This course consists of three stand-alone segments that are supervised by fiber-optic experts specializing in each particular discipline. Each segment includes both

knowledge and skill (hands-on) components. The first segment, Fiber-optic Polishing, focuses on mass-production termination techniques that work with fiber optic connectors including SC, LC, and multifiber connector types with UPC and APC polishes. Learn how to achieve low insertion loss, low reflectance, optimum end-face geometry and improved production yields. The second segment, Fiber-optic End-face Inspection, explains the principles of microscopy and interferometry as they relate to the inspection and testing of fiber-optic plugs and termini. Hands-on demonstrations will show how microscopes and interferometers help to control the polishing process by checking for damage and measuring end-face geometry. The third segment, Connectorization Testing, reviews the test equipment used for attenuation and reflection testing after the polishing process is complete. The assemblies manufactured in the course are used in the testing to allow the course attendee to follow the production from assembly through testing processes.

Benefits:

- Measure optical attenuation measurements and expected variations at 1310/1550/1625nm.
- Measure optical return loss and define its relationship to connector polishes, polishing procedures and test methods.
- Identify contaminants, their cause, and how to resolve contamination issues with a variety of cleaning products.
- Identify and discuss the fundamentals of the polishing processes and their impact on attenuation and reflection.
- Identify and determine how to adjust variables that affect end-face geometry.
- Measure scratches using automatic analysis equipment.
- Apply the criteria for pass/fail in quality assurance programs and applications.
- Determine how the immediate feedback from the interferometer will help control the manufacturing process, creating higher performance terminations and increased production yields.

Audience:

This course is applicable to those involved with fiber optic terminations from the novice to production engineers and managers involved with laboratory, manufacturing, and field disciplines. A basic knowledge of fiber optics is expected.

Instructor Biography:

Jerry Renville

Since 1987, The Light Brigade (TLB) has instructed more than 41,000 attendees in its classes on fiber optic design, maintenance and testing, including topics such as OSP, networking, FTTx, DWDM and PMD/CD. Since 1990 TLB has provided a variety of special events at the OFC/NFOEC and CLEO conferences.

Norland Products Inc. has been manufacturing novel products to meet critical customer needs for more than 40 years. One of its specialties is 3-D interferometric testing and inspection of fiber-optic connectors. As the leader in this area, it has been actively involved in providing the optimum methods to achieve higher quality and cost savings.

Seikoh Giken (SG) provides high performance interconnectivity solutions for network systems and chip level applications. For networks and testing, Seikoh Giken provides premium patchcords (SMF and PMF), adaptors and attenuators. For manufacturers, SG manufactures ferrules, tunable connectors, polishing equipment, and films and photonic packaging technologies.

SC291 Hands-on Fiber Optics for Engineers Designing for Military, Aerospace, Shipboard and Industrial Harsh Environmental Applications

Tuesday, March 6, 2012
8:00 AM - 12:30 PM

Instructor: Dennis Horwitz; Micronor Inc., USA

Level: Intermediate (prior knowledge of topic is necessary to appreciate course material)

Description:

This Short Course provides a very practical and interactive experience for the engineer involved in designing fiber optic components and systems for deployment in harsh environments. Whether military, aerospace, or industrial in nature, a harsh environment application encompasses one or more attributes (temperature, vibration, shock, etc.) that exceeds the “benign environment” baseline associated with commercial telecom/datacom oriented BELLCORE or IEC standards. (The military design might also refer to these commercial products as COTS—commercial off the shelf—which largely dominates the OFC/NFOEC exhibition floor.) The course takes the engineer through a quick, practical overview of fiber optics and then demonstrates a 10-step methodology for designing a fiber optic system for a harsh environment application. At each step the application as well as misapplication of COTS technology will be discussed, including lessons learned from similar programs. From soup to nuts, the course takes the participants through a generic system design and offer guidelines and background to assist decision making at each step: defining the system architecture and lifecycle requirements; choosing the right fiber, cable, and connectors; designing the cable plant; selecting active/passive components; establishing proper installation practices, performing system testing, and certification; developing proper maintenance /restoration methodology; establishing training standards; and evaluating system reliability. Throughout the course, the participants will also perform some hands-on fiber optic test and measurement experiments to best understand the nuances of working with optical fiber, interpreting test standards, and basic troubleshooting techniques. Opportunity will also be provided for open discussion of experiences and problems faced by the participants—to show how the course's materials and 10-step methodology can be applied.

Benefits:

- Explain the difference between MIL-SPEC and COTS/BELLCORE as applied to fiber optic components selected for Harsh Environment applications.

- Determine the relevant environmental, operational, maintenance, reliability, and lifecycle requirements of the application for proper system design and planning.
- Explain pro/cons of DWDM versus GbE, FC, and other optical transmission techniques.
- Explain the fundamental differences and applications of single-mode fiber (SMF) versus multimode fiber (MMF), including the different fiber types and fiber sizes.
- Identify the different optical connector and cable types and understand their specific advantages/disadvantages plus suitability for various applications.
- Operate basic fiber optic test and troubleshooting equipment plus measure attenuation and return loss of optical cable plant cable to understand issues associated with launch condition and installation.
- Discuss lessons learned from a variety of military, aerospace, and industrial programs.
- Understand basic reliability and failure mode issues specific to fiber optic applications.

Audience:

The course is intended for engineers, technicians, or program managers who are involved in the design and deployment of fiber optic systems intended for harsh environment applications—whether military, aerospace, or industrial. At least a few years experience and basic understanding of fiber optics and harsh environment attributes is necessary to understand the course material.

Instructor Biography:

Dennis Horwitz received his M.S.E.E. from the University of California at Los Angles and has more than 30 years experience in research and development, product development, sales, and marketing of fiber optic test equipment and components. He

was co-founder of two successful start-ups in fiber optic test and measurement: Photodyne Inc. (1979-1990, sold to 3M) and Rifocs Corp. (1990-2003, sold to Textron). He is actively involved in fiber optic standards development (ARINC, ISA, SAE, and TIA) and has been an OFC/NFOEC Short Course instructor for more than 10 years. He is currently Vice President for Sales/Marketing for Micronor Inc., which has developed and commercialized the first totally passive fiber optic rotary encoder for motion control applications.

SC314 Hands-on Fiber Characterization for the Engineering of Long Haul and Metro Deployments

Tuesday, March 6, 2012
8:30 AM - 12:30 PM

Instructor: Daniel Peterson[1], Christine Tremblay[2]; [1]Verizon, USA, [2]École de technologie supérieure, Université. du Québec, Canada

Level: Advanced Beginner (basic understanding of topic is necessary to follow course material)

Description:

In this hands-on course you will measure all of the necessary fiber parameters for qualifying and engineering the optical fiber links of long haul and metro networks at a specified bit rate. The course will begin with a review of the basics of loss, reflectance, chromatic dispersion and polarization mode dispersion in optical fiber links, as well as the challenges in moving from 10G to 40G and 100G bit rates. Bit-rate dependent loss and dispersion limits will be calculated for fiber qualification purposes. Descriptions of the course equipment and experimental setups will follow. The participants will then divide into small groups and rotate among four lab stations. In Lab 1, participants will measure loss and optical return loss in optical fiber links using power meters and optical time-domain reflectometers (OTDR). In Lab 2, participants will measure the chromatic dispersion in optical fiber links using two different measurement techniques. The first one is the time-of-flight method and the second is the phase-shift method. Christine Tremblay is the instructor. In Lab 3, participants will measure the polarization mode dispersion (PMD) in optical links with combinations of high-PMD fibers using different measurement techniques: the interferometric method, the fixed

analyzer method, the Stokes parameter evaluation method and the random-scrambling tunable POTDR method. Daniel Peterson is the instructor. The course will conclude with a review of the pros and cons for each method as well as an analysis of measurements results. Please note that the PMD portion of SC314 and SC210 overlaps in content.

Benefits:

- Learn about transmission limits as a function of bit rate and application.
- Gain the knowledge to make decisions on when specific fiber testing is necessary dependent on the application.
- Measure polarization-mode dispersion (PMD) using Interferometric and JME methods.
- Measure chromatic dispersion (CD) using both time-of-flight (TOF) and phase-shift methods, and discuss CD compensation in mixed-fiber type mesh environments.
- Discuss the effect of PMD and chromatic dispersion on high-speed digital signals.
- Discuss the outage probability in optical fiber transmission systems due to PMD-induced degradation.
- Take optical time-domain reflectometry (OTDR) for loss and splice characterization.
- Describe the system-level effects of polarization-related impairments on long-haul optical transmission.

Audience:

This course is intended for engineers, technicians and managers involved with optical fiber, components or systems, including those that operate at or above 10 Gb/s.

Instructor Biography:

 Daniel Peterson is a distinguished member of the technical staff at Verizon. He has directed the characterization of the ULH network fiber. He is an internal advisor on optical technologies and is responsible for specifying new optical fiber and characterization of older fiber for Verizon's ULH network. Peterson is also an adjunct professor at the University of Texas at Dallas. He received a Ph.D. (electrical engineering) from the University of Texas at Dallas.

 Christine Tremblay is a professor at the École de technologie supérieure, Université du Québec. She set up the Laboratoire de technologies de réseaux, an advanced WDM physical layer test-bed for studying high-speed optical fiber transmission, measurement and networking technologies, and established courses on optical communications. She also held senior R&D and technology management positions at Nortel, EXFO and INO. She received a Ph.D. (optoelectronics) from the École Polytechnique de Montréal.

SC374 Cloud Computing and Dynamic Networks

New Course!

Tuesday, March 6, 2012
9:00 AM - 12:00 PM

Instructor: George Clapp, USA; Douglas Freimuth, IBM Research, USA

Level: Beginner (no background or minimal training is necessary to understand course material)

Description:

Watch Mehran Esfandiari, AT&T, USA, OFC/NFOEC General Chair Discuss New Course SC374 Cloud Computing and Dynamic Networks

Cloud computing is playing an increasingly prominent role as providers offer more complete and robust services and as enterprises adopt the technology into their IT infrastructure. Cloud computing lowers the total cost of computing through large pools of resources that are shared across many clients and managed as a single entity. Virtualization is a key enabler that creates a logical version of a physical resource such as a computer or storage device and permits the resource to be allocated to different users as demands change. Networks are essential resources in cloud computing, just as essential as computers and storage devices, but unlike virtual computers and storage, cloud providers have treated their networks between data centers as static resources over which they had little control. This model is changing rapidly as new network technologies and services emerge. The optical control plane has enabled agile, intelligent and autonomous networks that can rapidly provision new services, and carriers are deploying them to offer dynamic services. The Research & Education community is also offering dynamic network services and integrating them into cloud computing for large scale experiments.

This course is an introduction to cloud computing and to the emerging dynamic network services. The course will describe cloud computing infrastructures and technologies such as virtualization and cover the different dynamic network technologies and services, describing how they can be virtualized and integrated into cloud computing. It will also describe sample cloud applications and how they can make use of the new services.

Benefits:

Identify and describe the key technologies that underlie cloud computing.
Describe the network within the data center and how it is virtualized and managed by the cloud provider.
Describe the key technologies that underlie dynamic network services.
Describe and compare the different dynamic network services either presently offered or under development by carriers and the Research & Education community.
Describe how the dynamic network services can be virtualized and integrated into

cloud management systems.
Discuss sample cloud applications and how they can benefit from the dynamic network services.

Audience:

This course is intended for planners and architects of both networks and data centers who are involved in designing networks both between and within data centers. The course will also be helpful to system vendors who wish to understand the emerging requirements of cloud and network service providers for dynamic network services. The course is at an introductory level but some familiarity with data network architecture and protocols is assumed.

Instructor Biography:

George H. Clapp manages a research group in optical networking in Telcordia's Applied Research organization, focusing on the design and the control and management of optical networks. George previously managed data services at Ameritech, which was the first Regional Bell Operating Company to offer Internet Access in 1994 and created one of four Network Access Points (NAPs) for the National Science Foundation (NSF). George participated in the Internet Engineering Task Force (IETF), where he chaired working groups that defined the transport of IP over the data services of public carriers.

Douglas M. Freimuth is a Senior Technical Staff Member in the Enterprise Networking group at the IBM T.J. Watson Research Center where he has focused on the research, design and development of server networking technologies. He is a co-author of the IO Virtualization (IOV) specifications in the PCI SIG. He has also participated in the Distributed Management Task Force (DMTF) for activities related to deployment of Virtual Machines and cloud networks. Doug has 55+ disclosures and patents in the domain of enterprise networking, and has also published related papers, developed products and contributed to open source.

2012 Tutorial Speakers

OFC/NFOEC tutorial presentations are one-hour instructional talks designed to provide reviews of important progress in research. Speakers are chosen through a highly selective nominations process to keep attendees at the forefront of optical communications. Check back often, speakers are still being confirmed.

Category 1. Optical Network Applications and Services (Tutorial)

OpenFlow/SDN: How It Works, and What It Means for Networks Beyond the Campus, Srini Seetharaman ; *Stanford Univ., USA*

Category 2. Network Technologies and Applications (Tutorial)

No tutorials are being offered

Category 3. FTTx Technologies, Deployment, and Applications (Tutorial)

Power Saving Techniques for Optical Access, Junichi Kani; *NTT Access Network Service Systems Labs., USA*

Category 5. Fibers and Optical Propagation Effects (Tutorial)

Characterization Techniques for Installed Fibers, Vincent Lecoeuche; *JDSU, France*

Fiber Technologies: Materials and Processes, Ji Wang; *Corning, USA*

Category 6. Fiber and Waveguide-Based Devices: Amplifiers, Lasers, Sensors, and Performance Monitors (Tutorial)

Amplification in Extended Transmission Bands, Evgeny Dianov; *Russian Academy of Sciences, Russia* |

Category 7. Optical Devices for Switching, Filtering, and Interconnects (Tutorial)

III-V and Silicon Photonic Integrated Circuit Technologies, Tom Koch; *Lehigh Univ., USA*
presentation slides

Category 8. Optoelectronic Devices (Tutorial)

High-Speed Directly Modulated Lasers, Tsuyoshi Yamamoto; *Fujitsu, Japan*

Category 9. Digital Transmission Systems (Tutorial)

Coherent Optical Long-haul System Design, Sebastien Bigo; *Bell Labs, Alcatel-Lucent, USA*

Multi-Carrier Approaches for Next-Generation Transmission: Why, Where and How?, Sander Jansen; *Nokia Siemens Networks, Germany*

Category10. Transmission Subsystems and Network Elements (Tutorial)

FEC and Soft Decision: Concept and Directions, Stephan ten Brink and Andreas Leven; *Bell Labs, Alcatel-Lucent, Germany*

Performance Monitoring and Measurement Techniques for Coherent Systems, Bogdan Szafraniec; *Agilent, USA*

Category 11. Optical Processing and Analog Subsystems (Tutorial)

Microwave Photonic Filters, Jose Capmany; *Universidad Politécnica de Valencia, Spain*

Category 12. Core Networks (Tutorial)

Network Virtualization, George Rouskas; *North Carolina State Univ., USA*

Category 13. Access Networks (Tutorial)

Active Devices in Passive Optical Networks, Leo Spiekman; *Alphion Co.,USA*

Results from the OASE Project, Dirk Breuer; *Deutsche Telekom AG T-Labs (Research & Development), Germany*

Category 14. Datacom, Computercom, and Short Range and Experimental Optical Networks (Tutorial)

Delivering Scale Out Data Center Networking with Optics -- Why and How, Amin Vahdat; *Univ. California San Diego & Google, USA*

Optical Interconnect Opportunities in Supercomputers and High End Computing, Alan Benner; *IBM, USA*

Workshops and Panels

OFC/NFOEC Workshops provide opportunities to discuss and debate the latest technologies. Workshops will be highly interactive, amongst both the speakers and the audience. The format of each session is determined by the organizers. In the past, many workshops have consisted of a series of short presentations (5 to 10 minutes) from people involved in the field followed by a panel discussion driven by questions from the audience.

The 2012 conference features workshops in current areas of interest in optical communications. All OFC/NFOEC attendees are encouraged to participate. Workshops will be held on Sunday, March 4, 4:30 p.m.–7:30 p.m., and Monday, March 5, 8:00

a.m.–11:00 a.m. The workshops provide an interactive learning environment and are open to all conference registrants.

Panel sessions provide interactive discussions focused on topics of interest to the industry. Panel discussions are comprised of industry panelists and represent a broad range of viewpoints and technology. Panels will be held throughout the week, and all OFC/NFOEC technical registrants are encouraged to attend these exciting sessions.

Like invited and tutorial speakers, workshop and panel topics and organizers are chosen through a highly selective nominations process.

Check back often, workshops and panels are still being confirmed.

Category 1. Optical Network Applications and Services

Workshop: What is the Value of Flexible Grid Network?

Cancelled Panel: Dynamic Network Services

Panel: Latency Demystified

Category 2. Network Technologies and Applications

Workshop: Core Router Bypass: Via ROADM, OTN, Ethernet, MPLS or not at all?

Workshop: LTE: Driving Changes in Mobile Backhaul Networking

Panel: 100G Deployments

Panel: 100G Coherent Real-time Receivers

Panel: Recent Advances of Control Plane Technologies

Category 3. FTTx Technologies, Deployment, and Applications

Workshop: Technologies for NG-PON2: Why I Think This Technology Is the Clear Winner

Cancelled Panel: Revolution in HFC Networks

Panel: Bandwidth Demand Forecasting

Category 5. Fibers and Optical Propagation Effects

Workshop: Is Spatial-Division Multiplexing the Way for Future Optical Networks?

Category 6. Fiber and Waveguide-Based Devices: Amplifiers, Lasers, Sensors, and Performance Monitors

Workshop: All-optical Signal Processing: Next-generation Applications

Category 7. Optical Devices for Switching, Filtering, and Interconnects

Workshop: What is the Impact of Silicon Photonics on Network Architecture?

Category 8. Optoelectronic Devices

Workshop: Challenges for Silicon Photonics and III-V Packaging and Assembly

Category 9. Digital Transmission Systems

Workshop: Is Spatial-Division Multiplexing the Way for Future Optical Networks?
Workshop: Core Networks in 2020

Category 10. Transmission Subsystems and Network Elements

Workshop: The Road to the 3-Watt, 100G Transponder: Dream or Reality
Workshop: Is Spatial-Division Multiplexing the Way for Future Optical Networks?

Category 11. Optical Processing and Analog Subsystems

Workshop: All-optical Signal Processing: Next-generation Materials
Workshop: All-optical Signal Processing: Next-generation Applications

Category 12. Core Networks

Workshop: What is the Value of Flexible Grid Network?
Workshop: Core Networks in 2020

Category 13. Access Networks

Workshop: Energy and Cost-efficient Components and Architectures for Future Optical-Access Systems
Workshop: Building a Universal Access Platform: Can PON also Solve the Mobile Backhaul Problem?

Category 14. Optical Networking, Technologies, and Applications for Datacom and Computercom

Workshop: Optics in the Data Center: How Can We Efficiently Move and Control Large Amounts of Data?

What is the Value of Flexible Grid Network?

Event type: Workshop

Room number: 403B

Organizer: Annalisa Morea, *Alcatel-Lucent Bell Labs, France*; Anjali Agarwal, *Telcordia, USA*, Peter Roorda, *JDSU, USA*

Description:

Spectral efficiency in optical networks has steadily improved to cope with increasing traffic and limited fiber spectrum. To further improve spectral efficiency, it is desirable to allocate channel bandwidth proportionally to the transported data capacity, thus moving away from the standardized ITU fixed-grid. So far, the spectral efficiency value of such flexible-grid has been explored, but in optical networks other values are required: flexible and automated reconfiguration, failure detection and recovery, network upgradeability, ease of network planning, control and management, and overall cost and power efficiency.

This workshop will ask operators, component and equipment vendors not only about the impact of flexible-grid on component and transmission technologies but also whether flexible-grid networks are compliant with this wider set of network requirements.

Speakers: Jack Kelly, *COADNA, USA*
Steve Frisken, *FINISAR, USA*
Joe Berthold, *Ciena, USA* (*View Presentation*)
Olivier Rival, *Alcatel-Lucent Bell Labs, France* (View Presentation)
Sheryl Woodward, *ATT, USA*
Andrew Lord, *BT, UK* (*View Presentation*)

Juan Pedro Fernandez-Palacios Gimenez, *Telefonica, Spain* (*View Presentation*)
Glenn Wellbrock, *Verizon, USA*

Dynamic Network Services

Event type: Panel

Room number: 515A

Organizer: Inder Monga, *Energy Sciences Network/Lawrence Berkeley Labs, USA*

Description:

From Utility Computing in the late 90's to Cloud Computing as the current trend, IT infrastructure is facing a dramatic move from statically provisioned, capital-expensed resources to dynamic, pay-per-use, on-demand resources. NIST states that "On-demand self-service, Broad network Access, Rapid Elasticity, Resource Pooling and Measured Service" are the five essential characteristics of Cloud Computing. CIOs are investigating these requirements and the impact on dynamic network capabilities required in campus networks, data centers and the WAN. In a similar vein, global scientific collaborations and instruments have already created a perfect storm in the world of Research and Education networks, moving them to offer federated, dynamic network services.

The panel will focus on this trend, need for Dynamic Network Services, solutions being proposed and will solicit insightful discussion from the panelists and the audience to broad questions like:

- Bandwidth on Demand has not taken off, is there a reason to adopt it now?
- Will new ecosystems with centralized management like OpenFlow be able to deliver the promise?

- How can dynamic optical technologies like ROADMS drive a new paradigm of building flexible networks?

Latency Demystified

Event type: Panel

Room number: 515A

Organizer: Andreas Färbert, *ADVA Optical, Germany*

Description:

The needs of high speed applications are often characterized by a single adjective: “fast”. Closer examination exposes “low-latency” to ensure fast information transport. Let’s consider taking a photo during a sporting event. A shutter speed of 1/1000s makes a camera fast. But, if the delay between pressing the button and the camera actually taking the picture is too long, the event already passed. The speed was fast, but the latency was too high.

Each layer adds latency while the information is passed. Layers near the application are made fast using high performance computers. Layers below are optimized by special flow control and protocols. Moreover, a lot can be done on one of the largest contributors to latency, the physical transport itself.

So let's look into several aspects of low-latency networks and discus techniques and strategies.

Speakers:
Doug Richards, *Sprint, USA*
Michael Strickland, *Spread Networks, USA*

Jim Sauer, *ADVA AG Optical Networking, USA*
Michael Frankel, *Ciena, USA*
David Mazzarese, *OFS, USA*
Francesco Caggioni, *AppliedMicro, USA*

Core Router Bypass: Via ROADM, OTN, Ethernet, MPLS or not at all?

Event type: Workshop

Room number: 408B

Organizer: Peter Magill; *AT&T Labs Research, USA*

Description:

Internet Protocol networks have traditionally used IP routers (Layer 3 switches) ubiquitously. However, over the years large carriers have simplified packet transport in their core (inter-city) networks and, as such, do not require L3 functions at major core locations. As a result, simplifications and efficiencies of the traditional architecture have emerged. This workshop will explore alternative node/network architectures with the goal of reducing cost, complexity, power consumption and/or to simplify operations. There will be presentations from various large carriers and multiple equipment suppliers, some of which will have very different opinions on the solutions!

Speakers:
Shamim Akhtar, *Comcast, USA*
Max Zhang, *AT&T, USA*
Peter Hofmann, *Verizon, USA*
Dennis Morgen, *Ciena, USA*
Loukas Paraschis, *Cisco, USA*

Chris Bowers, *Juniper, USA*

LTE: Driving Changes in Mobile Backhaul Networking

Event type: Workshop

Room number: 515A

Organizer: Tom Rarick; *Tellabs, USA*

Description:

Growth of mobile networks is placing great demands on service provider infrastructures. One area of significant investment is the backhaul networks, which provide the aggregation and connectivity from base stations to the mobile switching centers. LTE in particular places new demands on the backhaul networks due to high bandwidth expectations at base stations and handset to handset communications. Another area of concern is achieving the Green Internet, where aggregate power utilization is actually reduced as network capacity is increased. Service providers must meet these challenges while providing the performance and reliability expected by mobile users. Several architectures have emerged to meet these challenges, including Ethernet over SONET/SDH or OTN, native Ethernet, PON and IP/MPLS based networking. This workshop explores several of these options and compares their merits.

Speakers:

Pasula Reddy, Fujitsu, USA
Alex Girshevitsky, Adtran, USA
Jaafar Elmirghani, Univ. of Leeds, UK

100G Deployments

Event type: Panel

Room number: 515A

Organizer: Frank Chang, *Vitesse, USA*

Description:

With 100G transport and 100GbE standards work complete, the stage of 100G has moved from the labs, and field trials into a commercial reality. The deployments of 100G are ramping up globally aiming for expanded capacity at lower bit cost. This technical panel will bring industry experts to incite discussions regarding the needs, applications, adoption and deployment of the commercially available next-gen 100G solutions for the metro, regional and long-haul backbone networks. Potential topics will focus on 100G technologies, solutions, and deployment issues associated with modulation schemes such as DP-QPSK, coherent detection, advanced electronic DSP techniques, enhanced FEC and OTN, plus the critical IC and/or PIC implementations. Interested participants are encouraged to contact the organizer, or bring slides and/or questions to the forum.

Speakers:

NA carrier perspective; *Darryl Wilson, Verizon, USA*
Optics/component perspective; *Winston Way, NeoPhotonics, USA*
Subsea system perspective; *Katya Golovchenko, TE Subcom, USA*
100G system perspective; *Mike Frankel, Ciena, USA*
Packet optical (core routing/switching) perspective; *Roberto Marcoccia, Juniper, USA*
100G System with Raman perspective; *Philippe Perrier; Xtera Communications, France*
System perspective; *Tajima Tsutomu, NEC, Japan*

Transceiver/transponder perspective; *Beck Mason, JDSU, USA*
APAC carrier perspective; *Makoto Murakami, NTT, Japan*

100G Coherent Real-time Receivers

Event type: Panel

Room number: 515A

Organizer: Thomas H. Wood; *LGS, USA*

Description:

Commercial 100 Gb/s systems are in development or on the market from several systems vendors. A key element in the system is the coherent 100G receiver, which generally includes a digital signal processor. In a reversal of general practice, practical real-time receivers have appeared in the marketplace before their being used in research labs, which have relied on off-line digital signal processing. This panel discussion will cover the technology status, choices, maturity, cost drivers, etc. for these receivers. Both ASIC and potential FPGA-based implementations will be described. Discussion of closely related aspects, including choices of modulation formats, DSP-based receivers at 40 G, paths to even higher speeds, etc., will be welcome.

Speakers:
Kim Roberts, *Ciena, USA*
Andreas Leven, *Alcatel-Lucent, Germany*
Ronald Freund, *Heinrich Hertz Institute, Germany*
Fabian Hauske, *Huawei, Germany*
Chris Dick, *Xilinx, USA*

Recent Advances of Control Plane Technologies

Event type: Panel

Room number: 409A&B

Organizer: Fred Gruman; Fujitsu Network Communications, USA

Description:

Research and development for control plane continues to evolve to keep pace with the ever changing transport network. Advances in control plane are necessary to adapt as new technology layers are deployed (e.g., MPLS-TP, Ethernet as Transport, evolved OTN), new features are developed (e.g., 100G and beyond data rates, gridless transport), and new applications are introduced (e.g., cloud computing). The control plane architecture is also evolving with recent work in areas such as multilayer and path computation element (PCE). Service providers are seeking solutions for these problems while at the same time insisting that these solutions work in a multivendor environment.

This panel will explore some of the recent activity in control plane development to address these challenges.

Speakers: Multi-Layer Control Plane Technologies for Hybrid Networks, Wes Doonan, ADVA, USA (View Presentation)
Recent advances in transport control plane technology and novel applications, Dan Getachew, Mahlet Consulting, USA (View Presentation)
Application of PCE to multi-domain optical networks, Lyndon Ong, Ciena, USA (View Presentation)
Control Plane for Multi-Technology Network Elements, Jim Jones, Alcatel Lucent, USA (View Presentation)
Control Plane for Super-Channels and FlexGrid DWDM, George Frank, Infinera, USA

(View Presentation)

Technologies for NG-PON2: Why I Think This Technology Is the Clear Winner

Event type: Workshop

Room number: 515A

Organizer: Frank Effenberger; *Huawei Tech., USA*

Description:

Presently, researchers from around the world are converging on the next step on PON system evolution, commonly referred to as NG-PON2. While there are nearly as many systems as there are voices, there are a few common technology themes that emerge. This workshop will attempt to provide an overall look at all the major NG-PON2 system technologies, including technologies such as: 40Gb/s serial, Time and Wavelength Division multiplexing, seeded WDM, wavelength reuse WDM, self-injected WDM, tunable WDM, UDWDM, OFDM, and OFDM-WDM PONs. World experts and leaders in each technology have accepted the challenge to present their favored system as the "best" for the widely varying requirements encountered in this emerging solution space.

Speakers: Panel 1: WDM-PON Systems:
Chang-hee Lee, LG-Ericsson, Republic of Korea (View Presentation)
Beong-whi Kim, *MEL, Republic of Korea* (View Presentation)
Jun Shan Wey, *Nokia Siemens Networks, USA* (View Presentation)
Michael Eiselt, *ADVA Optical Networking, Germany* (View Presentation)
Kerry Litvin, *Huawei, USA* (View Presentation)

Panel 2: Other Systems:
Ed Harstead, *Alcatel-Lucent, USA* (View Presentation)
Yuanqiu Luo, *Huawei Technologies, USA* (View Presentation)
Benoit Charbonnier, *France Telecom, France* (View Presentation)
Josep Prat, *Universitat Politecnica de Catalunya, Spain* (View Presentation)
Shunji Kimura, *NTT Access Network Labs, Japan* (View Presentation)

Revolution in HFC Networks

Event type: Panel

Room number: 515A

Organizer: Marek Hajduczenia; *ZTE Corp, China*

Description:

Hybrid Fiber Coax (HFC) networks are undergoing a series of revolutionary changes with the coax transport media being augmented by passive point-to-point and point-to-multipoint fiber access. Techno-economic conditions in brown and green-field scenarios are so diverse that a one-size fits all deployment approach is simply not possible. The mix of commercial and residential services in addition to the varied demand for a wide portfolio of services and their performance objectives for each, local construction constraints as well as spending targets for operators creates a very dynamic and challenging environment for any access technology. During this panel, we will put various HFC technologies into spotlight, examining their place in the ever evolving MSO environment, presenting the practical side of the optical networking rarely seen at OFC.

Bandwidth Demand Forecasting

Event type: Panel

Room number: 409 A&B

Organizer: Ed Harstead; *Alcatel-Lucent, USA*

Description:

It is critical for operators and equipment vendors to understand current and future broadband bandwidth demand, because there are significant risks associated with both underestimating and overestimating it. Obviously, if an access network is deployed that does not scale to meet near-to-mid-term demands, it will have been a poor investment. On the other hand, over-paying for unneeded capacity, or deferring deployment in the mistaken belief that only future technologies can meet these demands, also has negative business consequences. In addition, it is important to distinguish between services requiring sustained bandwidth (e.g. streaming video) and requiring burst bandwidth (e.g. file transfers). Finally, bandwidth asymmetry is another important aspect to be considered in the access network. This panel, with representatives from both operators and vendors, will consider these aspects and present data-based bandwidth demand forecasts.

Speakers: Jill Boyce, Director of Algorithms, Vidyo, USA (View Presentation)

Stephen Liu*, Director, Service Provider Marketing, Cisco, USA* (View Presentation)

Pete Magill, *Executive Director, AT&T Labs, USA*

Terry Shaw, *Director, Network Systems, CableLabs, USA* (View Presentation)

Is Spatial-Division Multiplexing the Way for Future Optical Networks?

Event type: Workshop

Room number: 408B

Organizer: Anping Liu, *Corning, USA*; Andrew Ellis, *Tyndall Inst., Ireland*; Xiang Liu, *Bell Labs, Alcatel-Lucent, USA*

Description:

Exponential growth of internet data services requires a drastic upgrade of fiber networks. Design of the next generation fiber networks has become increasingly urgent. Although it is not yet clear what the next generation fiber networks would be, it is certain that the fiber networks need to sustain the capacity growth without compromising cost and energy efficiency. Recently, spatial-division multiplexing (SDM) based on both multimode and multicore fibers have demonstrated great potential, but many technical challenges remain to be addressed. In this workshop, we will review and discuss promising fiber designs, MIMO signal processing, special network elements, and transmission system designs for realizing such SDM-based optical networks, and debate the pros and cons of various implementation approaches.

Speakers:
Guifang Li, *CREOL, USA*
Marianne Bigot-Astruc, *Draka Communications, France*
Francesco Poletti , *ORC, UK*
Tetsuya Hayashi, *Sumitomo Electric Industries, Japan*
William Shieh , *Univ. of Melbourne, Australia*
Ezra Ip, *NEC Labs, USA*
Tetsuya Kawanishi, *NICT, Japan*
Ton Koonen, *Eindhoven Univ. of Technology, The Netherlands*

Henning Buelow, *Alcatel Lucent, Germany*
John Fini, *OFS Optics, USA*
Roland Ryf, *Alcatel Lucent, USA*
Ming-jun Li, *Corning, USA*

All-optical Signal Processing: Next-generation Applications

Event type: Workshop

Room number: 406 A&B

Organizer: Nikola Alic, *Univ. California San Diego, USA*; Shu Namiki, *AIST, Japan*; Thomas Murphy, *Univ. of Maryland, USA*

Description:

As technologies evolve toward the digital coherent transmission, continued scaling of both transmission capacity and reach will eventually necessitate reinforcement to massive electronic signal processing devices. Consequently, the fundamental tradeoff between spectral efficiency versus reach - in particular considering the inherent power dissipation requires a careful reconsideration. This workshop will explore the possible means to alleviate system complexity and power consumption through the use of all-optical signal processing. Topics shall include: Ultrafast sampling and/or ADC; Optical front ends for advanced modulation formats; All-optical format conversion; Optical regeneration and signal conditioning of advanced modulation formats; Format-agnostic wavelength conversion; etc. The affinity and division of labor between all-optical and electronic signal processing will also be addressed, specifically optimizing the overall performance, subject to the power consumption constraint.

Speakers:
Andrew Ellis, *University College Cork, Ireland*
Juerg Leuthold, *Technical University of Karlsruhe, Germany*
Masayuki Matsumoto, *Osaka University, Japan*

Stojan Radic, *UCSD, USA*
Rod Tucker, *University of Melbourne, Australia*
Peter Winzer, *Bell Labs, Alcatel Lucent, USA*

What is the Impact of Silicon Photonics on Network Architecture?

Event type: Workshop

Room number: 403A

Organizer: Christopher Doerr, *Alcatel-Lucent, USA*; Solomon Assefa, *IBM, USA*

Description:

Photonic integrated circuits (PICs) can reduce the cost, footprint, and power consumption of existing optical components and enable new functionalities. The silicon platform has especially high potential because of its large wafer sizes, high-yield manufacturing, high index contrast, and ability to provide good oxides. InP PICs have already been shown to have a significant impact on network architecture. Can we expect even more from silicon PICs? Regarding cost, if optical transceivers can cost a small fraction of the fiber and optical amplifier cost, will we see more advanced modulation format transceivers and regeneration? Regarding footprint, if wavelength add-drop PICs become successful will we see them on every linecard? Regarding power consumption, if PICs can reduce power consumption will we see a redesign of Internet routers?

Speakers:
Roman Egorov, *Verizon, USA*
Ben Yoo, *UC Davis, USA*
Mark Nowell, *Cisco, USA*
Tetsuo Takahashi, *NTT, Japan*
Chris Doerr, *Acacia, USA*
Yurii Vlasov, *IBM, USA*
Tom Palkert, *Luxtera, USA*

Michael Frankel, *Ciena, USA*
Dave Welch, *Infinera, USA*
Greg Fish, *Aurion, USA*
Mehdi Asghari, *Kotura, USA*.

Challenges for Silicon Photonics and III-V Packaging and Assembly

Event type: Workshop

Room number: 403A

Organizer: Lars Zimmermann; *IHP, Germany*; Michael Tan, *HP, USA*

Description:

Recently, we have seen rapid progress in Silicon photonics and III-V based technologies, demonstrating the ability to achieve bandwidths in excess of Tb/s. However, the enthusiasm regarding near future deployment of integrated photonics has been somewhat curtailed by uncertainties in terms of packaging and assembly. Clearly, classic packaging approaches known from telecom and datacom will not suffice for integrated technologies. In this workshop, we will define the central challenges in packaging and assembly. Leading experts in the field will present their view on the status of optoelectronic packaging and on possible strategies to adopted new technologies to deal with the challenges. Our discussions will cover such key aspects as hybrid packaging and assembly technologies, optical interfaces, cost reduction and alignment with electronics packaging technologies.

Speakers:
Challenges for Silicon Photonics Packaging; Guido Chiaretti*, ST Microelectronics, Italy, and* Giovan Battista Preve*, UP Valencia, Spain*
PARADIGM Packaging Approach; Bob Musk*, Gooch & Housego, UK*
ePIXfab/ESSenTIAL Packaging Approach; Brad Snyder*, Tyndall Inst., Ireland,* Peter O'Brien*, Tyndall Inst., Ireland, and* Timo Aalto*, VTT, Finland*

To Be Determined; Mehdi Asghari and Dazeng Feng, *KOTURA, USA*
To Be Determined; Peter De Dobbelaere, *Luxtera, USA*
Packaging and Connectivity, Boris Golubovic, *TE Connectivity, USA*
MicroPod Technology, Rob Hannah, *Avago Tech, USA*
To be Announced, Ephrem Wu, *Xilinx, USA*
To be Announced, Frank Libsch, *IBM, USA*

Is Spatial-Division Multiplexing the Way for Future Optical Networks?

Event type: Workshop

Room number: 408B

Organizer: Anping Liu, *Corning, USA*; Andrew Ellis, *Tyndall Inst., Ireland*; Xiang Liu, *Bell Labs, Alcatel-Lucent, USA*

Description:

Exponential growth of internet data services requires a drastic upgrade of fiber networks. Design of the next generation fiber networks has become increasingly urgent. Although it is not yet clear what the next generation fiber networks would be, it is certain that the fiber networks need to sustain the capacity growth without compromising cost and energy efficiency. Recently, spatial-division multiplexing (SDM) based on both multimode and multicore fibers have demonstrated great potential, but many technical challenges remain to be addressed. In this workshop, we will review and discuss promising fiber designs, MIMO signal processing, special network elements, and transmission system designs for realizing such SDM-based optical networks, and debate the pros and cons of various implementation approaches.

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John Fini, *OFS Optics, USA*
Roland Ryf, *Alcatel Lucent, USA*
Ming-jun Li, *Corning, USA*

Core Networks in 2020

Event type: Workshop

Room number: 403B

Organizer: Dirk van den Borne, *Nokia Siemens Networks, Germany*; Angela Chiu, *AT&T Labs, USA*

Description:

Within the next decade, state-of-the-art optical transmission technologies will allow us to build the 'ultimate' core network, realizing a transmission capacity close to forecasted limits of the fiber infrastructure. At the same time, the emergence of ever more bandwidth intensive applications is a near guarantee that exponent traffic growth will continue unabated.

This is expected to create the need for a very different kind of network optimization, with a particular focus on 'smart' networks that dynamically optimize their architecture

based on both transmission infrastructure and traffic requirements. How will such smart optical networks look, and how will they cope with the traffic demands of the year 2020?

This workshop aims to address the question of how network architectures will evolve over the next decade, and to identify the key technical challenges that are still required to realize such network architectures.

Speakers: Zeljko Bulut, *NSN, USA*
Michiaki Hayashi, *KDDI Labs, Japan*
Andreas Leven, *Alcatel-Lucent, Germany*
Lynn Nelson, *AT&T, USA*
Kim Roberts, *Ciena, USA*
Reg Wilcox, *Huawei, USA*
Wendy Zhao, *Google, USA*

The Road to the 3-Watt, 100G Transponder: Dream or Reality

Event type: Workshop

Room number: 502B

Organizer: Chris Fludger, *Cisco, Germany*; Charles Laperle, *Ciena, USA*; Klaus Grobe, *ADVA, Germany*

Description:

Developments in the integration of optics and electronics has allowed the functionality of traditional 10G transceivers to be provided in compact and low power (0.01W/Gb/s) form factors. However, the unyielding demand for bandwidth has pushed line-side transceivers towards 40G, 100G+ capacities per wavelength, enabled using coherent detection and high performance DSP. Whilst the capacity has increased, the Power/Capacity for high-performance transceivers has stayed relatively constant at ~1W/Gb/s. This workshop discusses the challenges and solutions toward the development of low power transponders, and addresses the following topics:

1. Power dissipation challenges facing Service Providers
2. Past and current trends in transponder integration
3. Power contributors for line and client-side interfaces
4. Advances in low-power semi-conductor technology
5. Digital Signal Processing
6. Disruptive technologies

Speakers: Service Provider View on Power Consumption ? Is Power Dissipation a Problem? *Donn Lee, Facebook, USA*

Past and Current Trends in Transponder Integration; *Adam Hotchkiss, Menara, USA*

Client-side Interfaces for Beyond 100G; *Gary Nicholl, Cisco, USA*

Main Power Contributors for Line-side Transponders: How Do We Get Low Power/High Performance? *Joerg-Peter Elbers, ADVA Optical Networking, Germany*

Multi-level Formats for Low-power Client Optics; *Jonathan Ingham, Cambridge Univ.,UK*

Advances in Semiconductor Technology Towards Low Power; *Ian Dedic, FME, UK*

DSP=Digital Signal Processing/Doesn't Save Power? *Bruce Beggs, Ciena, Canada*

DSP=Digital Signal Processing/Doesn't Save Power? *Benny Mikkelson, Acacia Inc., USA*

Disruptive Technologies: Si-photonics; *Xuezhe Zheng, Oracle, USA*

Disruptive Technologies: What to PIC? *David Welch, Infinera, USA*

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Roland Ryf, *Alcatel Lucent, USA*
Ming-jun Li, *Corning, USA*

All-optical Signal Processing: Next-generation Materials

Event type: Workshop

Room number: 406 A&B

Organizer: Marco Presi, *Scuola Superiore Sant' Anna, Italy*; Guifang Li, *Univ. of Central Florida, USA;* Periklis Petropoulos*, Univ. of Southampton, UK*

Description: A large number of all-optical processing capabilities have been demonstrated in the laboratory but few have ventured out of the lab. Is there a future for all-optical signal processing in optical communication and networking? As baud rate and aggregate capacity increase in optical communication systems, can passive optical signal processing play a role in optical transport? Nonlinear all-optical signal processing including switching, wavelength conversion/regeneration and format conversion have been demonstrated on conventional platforms, such as highly nonlinear fibers and semiconductors-based devices. Does the deployment of all-optical signal processing function in optical networks depend on novel material platforms such as chalcogenides, silicon, PPLN, carbon-nanotubes, graphene, plasmonics and photonic crystals? This workshop will try to find answers to these questions.

Speakers: Leif Katsuo Oxenløwe, *Technical University of Denmark, Denmark*
Juerg Leuthold, *Karlsruhe Institute of Technology, Germany*
Giampiero Contestabile, *Scuola Superiore Sant'Anna, Italy*
Alan Willner, *University of Southern California, USA*
Masanori Takahashi, *FITEL Photonics Laboratory, Japan*
Mark Pelusi, *University of Sidney, Australia*

All-optical Signal Processing: Next-generation Applications

Event type: Workshop

Room number: 406 A&B

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Kim Roberts, *Ciena, USA*
Reg Wilcox, *Huawei, USA*
Wendy Zhao, *Google, USA*

Energy and Cost-efficient Components and Architectures for Future Optical-Access Systems

Event type: Workshop

Room number: 408A

Organizer: Lowell Lamb; *Broadcom Co., USA*

Description:

Concerted efforts by regulators, network operators, equipment manufacturers, and component suppliers to reduce the power consumption of broadband access-network equipment already have led to significant power savings, and we can anticipate further improvements in the future. In spite of this trend, however, it is almost certain that projected increases in the number of customers and the bandwidth requirements per customer will place so much new demand on access networks that the total power consumption will grow to be significantly higher than it is today.

Members of this panel will discuss projections for future service demand and the concomitant access-network power consumption, the evolving regulatory environment, prospects for power-reduction in next-generation components, and potential new directions in the design of access equipment and networks.

Building a Universal Access Platform: Can PON also Solve the Mobile Backhaul Problem?

Event type: Workshop

Room number: 408A

Organizer: Dalma Novak; *PHARAD, USA;* Ampalavanapillai Nirmalathas*, The University of Melbourne, Australia*

Description:

Mobile backhaul is a critical issue for the realization of a universal access platform offering full service operation. The proliferation of smart mobile devices along with new mobile technologies (LTE, 4G) offering faster network connection speeds is creating critical demands on the backhaul capacity to satisfy emerging data transport requirements (by the year 2015 mobile data traffic is projected to exceed 6 million terabytes per month along with a tenfold increase in mobile network connection speeds).

Important considerations for any mobile backhaul solution are capacity, coverage and cost. Fiber is often touted as the obvious transmission choice for backhaul. Backhaul over PON is being proposed as a potential cost-effective solution for satisfying capacity requirements while also providing a unified access to broadband services. A large number of cell sites however, are not located near a fiber node, in contrast to more conventional backhaul options such as microwave links. Will PON technology really be capable of solving the mobile backhaul problem? Can they support all the unique technical requirements of mobile operators which continue to evolve with time? Will a combination of backhaul technologies turn out to be the preferred solution? This workshop will address the ability of PON technology to successfully compete with alternative solutions for mobile backhaul. Participants are encouraged to bring their own material for contributing to the discussion.

Speakers:

Dr. Stephan Pachnicke, ADVA Optical Networking, Germany (*View Presentation*)
Dr. Benoit Charbonnier, France Telecom, France (*View Presentation*)

Dr. Ning Cheng, Huawei Technologies, China
Dr. Jonas Hansryd, Ericsson, Sweden *(View Presentation)*

Optics in the Data Center: How Can We Efficiently Move and Control Large Amounts of Data?

Event type: Workshop

Room number: 502A

Organizer: Odile Liboiron-Ladouceur, *McGill Univ, Canada*; Laurent Schares, *IBM, USA*

Description:

A new class of optical interconnects must be developed to meet demands of large-scale computing systems and highly-interconnected datacenters. In this workshop, leading experts will debate the key physical-layer and networking challenges of future datacenter optics. For example, will 10-Gb/s LAN-on-motherboard lead to deeper system integration of optics? Which is more cost- and power-efficient for datacenter interconnectivity, single-mode or multimode optics? Can relaxed transceiver specs lead to lower-cost datacenter optics? Beyond the physical layer, important questions remain about the network architecture, including the scalability of the control plane managing large amounts of traffic. Is there a need for optical architectures beyond point-to-point optical links, or for optical interconnects to remote memory? Can advanced circuits and traffic management lower the power consumption of the optical subsystem?

Speakers: First Panel:
Casimer DeCusatis, *IBM, USA*
Terry Morris, *HP, USA*
Hong Liu, *Google, USA*
Ashok Krishnamoorthy, *Oracle, USA*
Errol Roberts, *Cisco, USA*
George Papen, *UC San Diego, USA*

Second Panel:
Mitch Fields, *Avago, USA*
Shinji Tsuji, *Hitachi, Japan*
Loudon Blair, *Ciena, USA*
Shifu Yuan, *Calient, USA*
Andrew Alduino, *Intel, USA*

Special Symposia

Enabling Technologies for Fiber Capacities Beyond 100 Terabits/second

Organizers: Stojan Radic, *Univ. of California San Diego, USA*; Robert Tkach, *Alcatel-Lucent, USA*; Masatoshi Suzuki, *KDDI R&D Labs, Japan*; Toshio Morioka, *DTU Fotonik, Denmark*; Lars Gruner-Nielson, *OFS Fitel Denmark, Denmark*; Sander Jansen, *Nokia Siemens Network, Germany*

Just recently, fiber capacity demonstrations have reached the milestone of 100 Tb/s over a single mode fiber. Achieving this remarkable result required heroic efforts in the constellation size and consequently allowed transmission over only a few short Raman-amplified spans. With constant optical bandwidth, further increases in capacity come with significant reductions in performance. While we can anticipate further incremental improvements in error-correcting codes, fiber loss and core area, and perhaps usable bandwidth, all of these together are unlikely to result in a factor if ten increase in capacity. Yet traffic growth trends indicate that a factor of 10 increase will be needed in 5-10 years. This symposium will consider technologies and techniques that may allow fiber capacity to break out of the box described above. Both invited and contributed talks that address the question will be presented.

Topics will include those mentioned below but submissions of new ideas are especially encouraged:

- Multimode fibers for spatial multiplexing
- MIMO processing for mode multiplexed transmission
- Mode coupling in multimode fibers

- Multicore fibers for spatial multiplexing
- Crosstalk in multicore fibers
- Nonlinear effects in multimode and multicore fibers
- Amplification in multimode and multicore fibers
- Integrated photonics for spatial multiplexing and high capacity systems
- Techniques for transmission outside the C and L band
- Techniques for achieving high spectral efficiency
- Fiber capacity calculations and limitations

Invited Speakers

Tuesday, March 6, 3:30 PM--4:00 PM

Characterisation of MC Fibers: New Techniques and Challenges, Katsuhiro Takenaga; *Fujikura Ltd, Japan*

Katsuhiro Takenaga received the B.S. degree in physics from Shinshu University, Nagano, Japan, in 1999. He received the M.S. degree in physics from Hokkaido University, Sapporo, Japan, in 2001. Since 2001, he joined the Optics and Electronics Laboratory, Fujikura Ltd., where he has been engaged in research and development of optical fibers. Mr. Takenaga is a member of the Institute of Electronics, Information and Communication Engineers (IEICE) of Japan.

Wednesday, March 7, 8:00 AM--8:30 AM

Optical Amplifiers for Multimode/Multi-core Transmission, Peter Krummrich; *Dortmund Univ. of Technlogy, Germany*

Peter. M. Krummrich received his Dipl.-Ing. and Dr.-Ing. degrees in Electrical Engineering from TU Braunschweig, Germany, in 1992 and 1995, respectively, where he worked on tunable laser diodes and Praseodymium-doped fiber amplifiers. In 1995 he joined Siemens AG where his research interest focused on technologies for ultra high capacity DWDM transmission systems with an emphasis on more robust transmission and enhanced reach such as distributed Erbium-doped fiber and Raman amplification, advanced modulation formats, adaptive equalizers, and PMD compensation. Since 2007, he is working as a university professor at Technische Universitaet Dortmund, heading the chair for high frequency technology. He is a member of IEEE and VDE/ITG.

Wednesday, March 7, 2:30 PM--3:00 PM

Adaptive MIMO Signal Processing for Mode-division Multiplexing, Sebastian Randel; *Bell Labs, Alcatel-Lucent, USA*

Sebastian Randel is a Member of the Technical Staff at Bell Laboratories, Alcatel-Lucent in Holmdel, New Jersey. He is currently engaged in research on ultra-high capacity optical transmission systems. For his work on nonlinear OTDM transmission, he received the Ph.D. degree (with highest honors) in electrical engineering from TU Berlin, Germany, in 2005. From 2005 to 2010 he was a Research Scientist at Siemens AG in Munich, Germany, working on physical layer aspects of optical access, in-house, automotive, and industrial networks.

Dr. Randel was a founding chairman of the DKE Working Group Polymer Optical Fiber and is a Senior Member of the IEEE and a Member of the VDE.

Wednesday, March 7, 1:45 PM--2:15 PM

Mode-coupling Effects in Multi-mode Fibers, Joseph M. Kahn; *Stanford Univ, USA*

Joseph M. Kahn is a Professor of Electrical Engineering at Stanford University. His current research interests include rate-adaptive and spectrally efficient modulation and coding methods, coherent detection and associated signal processing algorithms, and multimode fiber transmission. He received A.B. and Ph.D. degrees in Physics from U.C. Berkeley in 1981 and 1986. From 1987-1990, he was at AT&T Bell Laboratories, Crawford Hill Laboratory, in Holmdel, NJ. From 1990-2003, he was on the Electrical Engineering faculty at U.C. Berkeley. In 2000, he co-founded StrataLight Communications (now Opnext Subsystems). He received the National Science Foundation Presidential Young Investigator Award in 1991. He is a Fellow of the IEEE.

Tuesday, March 6, 5:45 PM--6:15 PM
Mode Division Multiplexed Transmission with a Weakly-coupled Few-Mode Fiber, Sébastian Bigo; *Bell Labs*, *Alcatel-Lucent, USA*
Sébastien Bigo received an engineering diploma from the Institut d'Optique Graduate School, then a PhD degree, for his work on all-optical soliton processing, while with Alcatel Research & Innovation, France (now Bell Labs). In 1997, he started conducting large-scale demonstration experiments, at 10 Gbit/s, 40 Gbit/s and 100 Gbit/s data rates. He is now leading the WDM Dynamic Networks Department of Bell Labs, in France. He has authored and co-authored more than 220 journal and conference papers, and 32 patents. He has served as Member of the Committees of several conferences. He also teaches optical communications at the university.

Tuesday, March 6, 2:00 PM--2:30PM
Extremely Advanced Transmission with 3m Technologies (multi-level modulation, multi-core & multi-mode), Masataka Nakazawa; *Tohoku Univ., Japan*
M. Nakazawa received his Ph. D. degree from the Tokyo Institute of Technology in 1980. Then, he joined the Ibaraki Electrical Communication Laboratory of Nippon

Telegraph and Telephone public corporation (NTT), where he was engaged in research on EDFAs, soliton transmission, Terabit/s OTDM transmission, and fiber lasers. He was a visiting scientist at MIT in 1984-1985. He became the first NTT distinguished researcher in 1994 and an R&D Fellow in 1999. In 2001, he became a professor of the Research Institute of Electrical Communication at Tohoku University and was promoted to a Distinguished Professor. He is now the director of the Institute. At the Institute, he has been intensively working on ultrahigh-speed transmission, multi-level coherent transmission, and new fiber lasers. He published more than 400 papers and presented 230 international conference presentations. He was the president of Electronics Society of the IEICE and is now the Board member of Optical Society of America. Dr. Nakazawa received many awards including the IEE Electronics Letters Premium Award, IEEE Daniel E. Noble Award/Quantum Electronics Award, OSA R. W. Wood Prize, and Thomson Scientific Laureate. He is a Fellow of the IEEE, OSA, IEICE, and JSAP.

Wednesday, March 7, 9:30 AM--10:00 AM
Recent Progress in Transmission Fibers for Capacity beyond 100-Tbit/s, Benyuan Zhu; *OFS Labs, USA*
Benyuan Zhu joined Bell Laboratories at Holmdel, NJ in 1999, and he is currently a Distinguished Member of Technical Staff in OFS Laboratories, Somerset NJ. He has been primarily working on high-speed DWDM transmission systems, and his current interests include 100G & above optical coherence transmission system, novel fiber and advanced optical amplifier technologies. He has authored/ coauthored more than 100 journal and conference papers, and one book chapter in the field of optical fiber communications. Benyuan Zhu received the Ph.D. degree in applied physics from Bath University, Bath, UK, in 1996.

Wednesday, March 7, 9:00 AM--9:30 AM

Mode-division Multiplexed Transmission with Fiber Mode Couplers, Nobutomo Hanzawa; *NTT Labs, Japan*

Nobutomo Hanzawa received the B.E. and M.E. degrees in electrical engineering from Yamagata University, Yonezawa, Japan, in 2005 and 2007, respectively. Since 2007, he joined the NTT Access Network Service Systems Laboratories, Tsukuba, Japan. He has been engaged in research on optical fiber design. Mr. Hanzawa is a member of the Institute of Electronics, Information and Communication Engineers (IEICE) of Japan.

Tuesday, March 6, 3:00 PM--3:30 PM

 **Multicore Fibers for High Capacity Transmission**, Tetsuya Hayashi; *Sumitomo, Japan*

Tetsuya Hayashi was born in Tochigi, Japan, in 1981. He received his B.E. and M.E. degrees in electronic engineering from the University of Tokyo, Tokyo, Japan, in 2004 and 2006, respectively. In 2006, he joined Optical Communications R&D Laboratories, Sumitomo Electric Industries, Ltd. He has been engaged in research on fiber optic sensing, and on design and evaluation of optical fibers.His current research interests include fibers for spatial multiplexing and other advanced fibers.

Wednesday, March 7, 1:00 PM--1:30 PM

Capacity Limits in Single Mode Fiber and Scaling for Spatial Multiplexing, René-Jean Essiambre, *Bell Labs, Alcatel-Lucent, USA*

René-Jean Essiambre is a Distinguished Member of Technical Staff at Bell Labs, Alcatel-Lucent. He received his Ph.D. from Université Laval and studied at the University of Rochester before joining Lucent Technologies (now Alcatel-Lucent) in 1997. Dr. Essiambre's interests include optical fiber nonlinearity, modulation formats, information theory applied to fibre-optic communication systems, detection and optimization techniques for the design of optically routed networks to increase capacity, optical transparency and functionality of wavelength-division multiplexed

communication systems. He has served on many conference committees including OFC, ECOC, CLEO and LEOS. He is a recipient of the 2005 Engineering Excellence Award from OSA, where he is a Fellow.

Tuesday, March 6, 4:30 PM--5:00 PM
Spectrally Efficient Four-dimensional Modulation, Magnus Karlsson; *Chalmers Univ. of Tech., Sweden*
Magnus Karlsson received his Ph.D. in 1994 and is since 2003 Professor in photonics at Chalmers University of Technology, Sweden. He has authored or co-authored around 200 scientific journal and conference contributions, served as guest editor for the Journal of Lightwave Technology, and is currently associate editor of Optics Express. He has served in the technical program committee for the Optical Fiber Communication Conference (OFC), and is currently active in the TPCs for the Asia Communications and Photonics Conference (ACP) and the European Conference on Optical Communications (ECOC).

Plasmonics for Optical Interconnects

Organizers: Nikos Pleros, *Aristotle Univ. of Thessaloniki, Greece*; Jeurg Leuthold, *Karlsruhe Inst. of Tech. (KIT), Germany;* Harry Atwater, *California Inst. of Tech., USA*.

Plasmonics is emerging as a promising technology platform towards enabling the deployment of small-footprint and low-energy integrated circuitry, holding a great promise for chip-scale and high integration density optical interconnects. This new discipline relies on the propagation of electromagnetic waves along a metal-dielectric interface, yielding in this way strong mode confinement factors while seamlessly interfacing photonics and electronics. Its credentials to drive next-generation optical interconnects into new performance metrics have led to intense research during the last years for bringing plasmonics from proof-of-principle demonstrations into

system-qualified device development concepts. The goal of this Symposium is to collect the latest achievements in the field of plasmonics for optical interconnects, bringing together all relevant concepts, fabrication techniques, waveguide technologies, components, devices and systems that could in principle be utilized in the areas of datacom and computercom. This Symposium aims at introducing this new powerful technology in the OFC community, stimulating plasmonic research along a well-defined application domain like Optical Interconnects. As such, this Symposium welcomes but not limits contributed submissions on the following list of research topics:

- Plasmonic waveguides
- CMOS-compatible plasmonics
- Silicon-plasmonics
- Optical gain in plasmonics and plasmonic amplification
- Active plasmonics: thermo-optic, electro-optic and all-optical components / devices / systems
- Plasmonic switches
- Plasmonic modulators
- Plasmonic lasers
- Passive plasmonic circuitry (filters, couplers, multiplexers, etc.)
- Plasmonic or plasmonic-enhanced photodetectors
- Plasmonic interconnects
- Novel applications of plasmonics in datacom and computercom

Invited Speakers

Wednesday, March 7, 8:00 AM--9:00 AM *(Now a Tutorial)*
Plasmonic Waveguides: Challenges and Opportunities; Sergey Bozhevolnyi, *Univ. of Southern Denmark, Denmark*
Sergey I. Bozhevolnyi received the M.Sc. and Ph.D. degrees from Moscow Institute of

Physics and Technology in 1978 and 1981, respectively, and the Dr.Scient. degree from Århus University, Denmark, in 1998. He has been doing research in Denmark since 1991, and, in 2008, he started as Professor in Nano-Optics at the University of Southern Denmark. During 2001-2004, he was also the Chief Technical Officer (CTO) of Micro Managed Photons A/S set up to commercialize plasmonic waveguides. His current research interests include linear and nonlinear nano-optics, surface plasmon polaritons, plasmonic waveguides and circuits, as well as integrated and fiber optics.

Wednesday, March 7, 1:00 PM--1:30 PM

Active Plasmonics for Optical Interconnects, Anatolyi Zayats, *King's College London, UK*

Professor Anatoly V. Zayats is the head of the Experimental Biophysics and Nanotechnology Group at the Department of Physics, King's College London, where he also leads Nano-optics and Near-field Spectroscopy Laboratory (www.nano-optics.org.uk). He is also a visiting professor at Sogang University in Seoul (South Korea). His current research interests are in the areas of nano-optics, scanning probe microscopy, nanophotonics and plasmonics, nonlinear optics and spectroscopy, surface plasmons and polaritons, and optical properties of surfaces, thin films, semiconductors and low-dimensional structures. He is the director of the UK research programme on Nanoplasmonics. He is a Fellow of Institute of Physics and Optical Society of America.

Wednesday, March 7, 2:30 PM--3:00 PM

Data Transfer for Optical Interconnects using Long Range-SPP Transmission Lines, Jung Jin Ju, *Electronics and Telecommunications Research Institute (ETRI), Korea*

Jung Jin Ju, He received his Ph.D. degree from Pusan National University, Korea in

1997. Since August 2000, he has been with Electronics and Telecommunication Research Institute as a Member of Technical Staff. Since 2009, he has been a team leader of the Next Generation Photonic Devices Team. His current research interest is in high speed optical devices, LED and plasmonic devices. Dr. Ju has contributed to more than 90 technical papers and fifteen patents in the field of polymeric optical devices, plasmonic optical interconnectors, and LED devices. He is a topical editor of the Journal of the Optical Society of Korea and the Journal of Korea LED Lighting.

Tuesday, March 6, 5:30 PM--6:00 PM
Plasmonics for Optical Interconnection, Mark Brongersma, *Stanford Univ., USA*
Mark Brongersma is an Associate Professor in the Department of Materials Science and Engineering at Stanford University. His research is directed towards nanoscale electronic and photonic devices. He has authored\co-authored over 100 publications, including papers in Science, Nature Photonics, Nature Materials, and Nature Nanotechnology. He received the International Raymond and Beverly Sackler Prize in the Physical Sciences (Physics) for his work on plasmonics, and is a Fellow of the Optical Society of America, the American Physical Society, and the SPIE. Brongersma received his PhD from the FOM Institute in Amsterdam and was a postdoctoral research fellow at the California Institute of Technology.

Rump Session

Tuesday, March 6, 7:30 PM -- 9:00 PM
Room 502A

Is Space Division Multiplexing an Industry-Transforming Technology or a Research Curiosity?
Moderator: Pat Iannone; *AT&T Labs – Research, Optical Systems Research Department, USA*

The question for this year's Rump Session is the subject of heated debate across the optical communications industry: "Is space division multiplexing (SDM) an industry-transforming

technology or a research curiosity?” Substantial research expenditures have already been committed to SDM as a means of breaking through the nonlinear Shannon limit, which sets a hard ceiling on the ultimate capacity achievable in single-mode fiber transmission systems. Proposed SDM systems use multi-core or multi-mode fibers to multiply the fiber’s capacity. Many believe SDM will be essential if the industry is to continue the dramatic decades-long reductions in cost per bit of optical long-haul systems. Skeptics worry that the huge investment required to invent and commercialize critical cost-effective SDM-compatible network elements, such as optical amplifiers and ROADMs, will not be justified by a one-time increase in capacity.

The rump session will be a spontaneous discussion among the audience members. Other than a brief introduction to the issue, there will be no scheduled speakers. You can participate by attending and raising your hand to inform the moderator that you wish to speak or respond. A slide or two can be used to illustrate a point, but each speaker will be limited to a total of two minutes at the microphone. Conversation will flow most freely if your slide is on a plastic transparency, but we will accommodate digital slides on USB sticks and possibly slides transmitted over the wireless network. We will provide pens and transparencies for spontaneously written hand-drawn slides, which, after all, reflect the true spirit of a "rump" session.

The moderator encourages prospective participants to send their 1 or 2-slide presentation to ppi@research.att.com before March 1st. This will ensure that your slides are pre-loaded, thus streamlining the process. This will not, however, guarantee a speaking slot. You will still have to be called on by the moderator.