

OFC/NFOEC 2009 Archive

Technical Conference: March 22-26, 2009

Exposition: March 24-26, 2009

San Diego Convention Center, San Diego, California, USA

OFC/NFOEC 2009 showed that industry innovation is alive and well. With milestone technical talks – from a post-deadline paper that revealed a record-breaking 32Tb/s of data carried over a single fiber to a proof-of-concept study for a more cost-effective way of extending high-speed Internet into rural areas – and more than 100 new product introductions – including a tunable circuit pack for 40G transmission and a tunable XFP – the conference and exposition continued to provide the most relevant technical and commercial developments in the field.

The plenary session was the talk of the show with three dynamic speakers who provided thought-provoking discussions of some of the hottest topics in the field. The Market Watch and Service Provider Summit programs also addressed some of the topics at the forefront of everyone's thoughts – from the state of the optical industry to the growth of FTTx on a global scale. The special Rump Session on the capacity crunch challenge was one of the conference's highlights – a true exchange of ideas – and the Future Internet Symposium deeply examined what's needed for the next-generation network.

Despite the difficult economy and continued industry consolidation, OFC/NFOEC 2009 boasted nearly 9,500 attendees and 550 participating companies, well ahead of today's tradeshow industry trends. It goes to show that even when times are tough, OFC/NFOEC remains the industry's premier forum for the science and business of optical communications.

For next year, attendees again can look forward to innovative sessions on the most important technical and business topics. 100G surely will still be a central subject – with Philippe Morin's assertion that 100G will become a reality in 2009 – and the growing work on tomorrow's network will also be a critical point as OFC/NFOEC attendees and exhibitors explore new ways to meet expanding bandwidth demands on a global scale. Mark your calendars for OFC/NFOEC 2010, March 21-25, back in San Diego.

For access to full conference papers please visit [Optics InfoBase](#) and [IEEE Xplore](#).

2009 OFC/NFOEC Technical Program

For access to full conference papers please visit [Optics InfoBase](#) and [IEEE Xplore](#).

OFC and NFOEC Abstracts

[Postdeadline Paper Abstracts](#)

[Postdeadline Paper Key to Authors](#)


[Monday, March 23, 2009](#)

[Tuesday, March 24, 2009](#)

[Wednesday, March 25, 2009](#)

[Thursday, March 26, 2009](#)

Agenda of Sessions and Key to Authors and Presiders

 [Agenda of Sessions](#)

 [Key to Authors and Presiders](#)

2009 Committees

OFC General Chairs

Mark Feuer, *AT&T Labs – Res., USA*

Leo Spiekman, *Alphion Corp., USA*

NFOEC General Chair

E. Bert Basch, *Verizon, USA*

OFC Program Chairs

Biswanath Mukherjee, *Univ. of California at Davis, USA*

Atul Srivastava, *OneTerabit, USA*

NFOEC Program Chair

Mehran Esfandiari, *AT&T, USA*

OFC Committees

A. Fibers and Optical Propagation Effects

Magnus Karlsson, *Univ. of Chalmers, Sweden*, **Subcommittee Chair**

Xin Chen, *Corning, USA*

Vladimir Grigoryan, *Ciena Inc., USA*

Tomoharu Hasegawa, *Asahi Glass Co., Japan*

Georg Mohs, *Tyco Telecommunications, US*

David Richardson, *Univ. of Southampton, UK*

Carsten Schmidt-Langhorst, *Heinrich-Hertz-Inst., Germany*

Terence Shepherd, *QinetiQ, UK*

Akira Shirakawa, *Univ. of Electro Communications, Japan*

Andrew Yablon, *Interfiber Analysis, USA*

B. Fiber and Waveguide Based Devices: Amplifiers, Lasers, Sensors and Performance Monitors

Magnus Colin McKinstrie, *Alcatel-Lucent, USA*, **Subcommittee Chair**

Nikola Alic, *Univ. of California at San Diego, USA*

Maxim Bolshtyansky, *JDSU, USA*

Joseph Friebele, *NRL, USA*

Almantas Galvanauskas, *Univ. of Michigan, USA*

Masaaki Hirano, *Sumitomo Electric Industries, Ltd., Japan*

Morten Ibsen, *Univ. of Southampton, UK*

Jeff Nicholson, *OFS Labs, USA*

Martin Kristensen, *Aarhus Univ., Denmark*

Namkyoo Park, *Seoul Natl. Univ., Korea*

Siddharth Ramachandran, *DTU-Fotonik, Denmark*

David Sampson, *Univ. of Western Australia, Australia*

C. Optical Devices for Switching, Filtering, and Signal Compensation

Hiroshi Takahashi, *NTT Photonics Labs, Japan*, **Subcommittee Chair**

Ray Chen, *Univ. of Texas, USA*

Rance Fortenberry, *Sirrus Technology, USA*

Lih Y. Lin, *Univ. of Washington, USA*

David Moss, *Univ. of Quebec, Canada*

Myo Ohn, *Avanex, USA*

Michael J. Steel, *Macquarie Univ., Australia*

Bogdan Szafraniec, *Agilent, USA*

Yurii Vlasov, *IBM, USA*

Pierre Wall, *JDSU, Canada*

D. Optoelectronic Devices

Chuck Joyner, *Infinera, USA*, **Subcommittee Chair**

Masahiro Aoki, *Hitachi, Japan*

Liam Barry, *Dublin City Univ., Ireland*

Kent Choquette, *Univ. of Illinois, USA*

Hiroyuki Ishii, *NTT, Japan*

Karl Kissa, *JDSU, USA*

Paul Morton, *Morton Photonics, USA*
Bryan Robinson, *MIT, USA*
Martin Schell, *Heinrich-Hertz-Inst. Fraunhofer, Germany*
Clint Schow, *IBM, USA*
Jin-Wei Shi, *Natl. Central Univ., Taiwan*

E. Digital Transmission Systems

Jin-Xing Cai, *Tyco Telecommunications, USA, Subcommittee Chair*
Peter Andrekson, *Univ. of Chalmers, Sweden*
Richard J. Hughes, *Los Alamos Natl. Lab, USA*
Hoon Kim, *Natl. Univ. of Singapore, Singapore*
Shiva Kumar, *Univ. McMaster, Canada*
Doug McGhan, *Nortel, Canada*
Yutaka Miyamoto, *NTT, Japan*
Tetsuya Miyazaki, *NICT, Japan*
Werner Rosenkranz, *Univ. of Kiel, Germany*
Paul Toliver, *Telcordia Technologies, USA*
Peter Winzer, *Alcatel-Lucent, USA*

F. Transmission Subsystems and Network Elements

Giuseppe Bordogna, *Nortel, Canada, Subcommittee Chair*
Dave Atkinson, *JDSU, Canada*
Fred Buchali, *Alcatel-Lucent, Germany*
Sarah Dods, *Monitoring Division Inc., Australia*
Ken-ichi Kitayama, *Osaka Univ., Japan*
Arthur Lowery, *Monash Univ., Australia*
Erwan Pincemin, *France Telecom, France*
David Plant, *McGill Univ., Canada*
Sander L. Jansen, *Nokia Siemens Networks GmbH & Co. KG, Germany*
Seb Savory, *Univ. College London, UK*
Wolfgang Sauer-Greff, *Univ. of Kaiserslautern, Germany*

G. Optical Processing and Analog Subsystems

Luc Boivin, *Verizon Business, USA, Subcommittee Chair*
Greg Abbas, *EOSpace, USA*
Randall Babbitt, *Montana State Univ., USA*
Ernesto Ciaramella, *Scuola Superiore Sant'Anna, Italy*
Thomas Clark, *John Hopkins Univ., USA*
Sophie Larochelle, *Univ. Laval – COPL, Canada*
Juerg Leuthold, *Univ. of Karlsruhe, Germany*
Alexandre Shen, *Alcatel-Lucent, III-IV Research Lab, France*
Chester Shu, *Chinese Univ. of Hong Kong, China*
Idelfonso Tafur Monroy, *Denmark Technical Univ., Denmark*

Ian White, *Cambridge Univ., UK*
Jianjun Yu, *NEC Labs America, USA*

H. Core Networks

Dominic Schupke, *Nokia Siemens Networks, Germany*, **Subcommittee Chair**
Vincent Chan, *MIT, USA*
Piet Demeester, *Broadband Communication Networks (IBCN), Belgium*
Ashwin Gumaste, *Indian Inst. of Technology (IIT), India*
Junqiang Hu, *NEC, USA*
Monika Jaeger, *T-Systems, Germany*
Admela Jukan, *Technische Univ. Carolo-Wilhelmina zu Braunschweig, Germany*
Iraj Saniee, *Alcatel-Lucent, USA*
Suresh Subramaniam, *George Washington Univ., USA*
Alex Vukovic, *Communications Res. Ctr. (CRC), Canada*
Jennifer Yates, *AT&T Labs – Res., USA*

I. Access Networks

Shoichi Hanatani, *Hitachi, Japan*, **Subcommittee Chair**
GK Chang, *Georgia Tech, USA*
Nasir Ghani, *Univ. of New Mexico, USA*
Byung Whi Kim, *ETRI, South Korea*
Soo Jin Park, *KT Advanced Technology Lab, Korea*
Petar Pepeljugoski, *IBM Res., USA*
Paul Prucnal, *Princeton Univ., USA*
Niall Robinson, *Mintera Corp., USA*
Vik Saxena, *Comcast, USA*
Abdallah Shami, *Univ. of Western Ontario, Canada*
Ting Wang, *NEC, USA*
Naoto Yoshimoto, *NTT Labs, Japan*

J. Network Experiments and Non-Telecom Applications

Chunming Qiao, *SUNY at Buffalo, USA*, **Subcommittee Chair**
Philippe Becker, *Wasserstein, USA*
Keren Bergman, *Columbia Univ., USA*
Milorad Cvijetic, *NEC America, USA*
Christoph Glingener, *ADVA Optical Networking, Germany*
John Jacob, *BBN Technologies, USA*
Yaohui Jin, *Shanghai Jiao Tong Univ., China*

Ashok Krishnamoorthy, *Sun Microsystems SSG Physical Sciences Ctr., USA*

Yuichi Mastushima, *NICT, Japan*

Nageswara S. Rao, *Oak Ridge Natl. Labs, USA*

Dimitra Simeonidou, *Essex Univ., UK*

NFOEC Committees

1. Optical Networks and Services

Monica Lazer, *AT&T, USA*, **Subcommittee Chair**

Mark Allen, *Infinera, USA*

Frank Effenberger, *Huawei, USA*

Jim Jones, *Alcatel-Lucent, USA*

Haim Kobrinski, *Telcordia Technologies, USA*

Glen Kramer, *Teknovus, USA*

Satoru Okamoto, *Keio Univ., Japan*

Stevan Plote, *Stratalight Communications, USA*

Claus Popp Larsen, *Acreo, Sweden*

George Rouskas, *North Carolina State Univ., USA*

Kathy Tse, *AT&T, USA*

TJ Xia, *Verizon, USA*

2. Network Technologies

Vishnu Shukla, *Verizon Labs, USA*, **Subcommittee Chair**

Mark Boduch, *Tellabs, USA*

Paul Bonenfant, *Morgan Keegan, USA*

Frank Chang, *Vitesse Semiconductor, USA*

Michel Chbat, *Siemens, USA*

Mei Du, *Huawei Technologies, USA*

Hans-Martin Foisel, *Deutsche Telekom, Germany*

Alysha Godin, *Nortel, Canada*

Yoshinori Hibino, *NTT, Japan*

Jin Hong, *StrataLight Communications, USA*

Paparao (Rao) Palacharla, *Fujitsu, USA*

Daniel Peterson, *Verizon, USA*

Alexander Sergienko, *Boston Univ., USA*

John Spencer, *Optelion, USA*

Thomas Wood, *LGS, USA*

3. Market Watch and Service Provider Summit

Christoph Pfistner, *Neophotonics, USA*, **Subcommittee Chair**

Karen Liu, *Ovum RHK, Inc., USA*

Serge Melle, *Infinera, USA*

OFC/NFOEC Steering Committee

IEEE/Lasers and Electro-Optics Society

Neal Bergano, *Tyco Telecommunications, USA*

George Harvey, *Tyco Telecommunications, USA*
Patrick Iannone, *AT&T Labs – Res., USA*
Bruce Nyman, *Princeton Lightwave, USA*

Optical Society of America

Douglas Baney, *Agilent Labs, USA*
Andrew Chraplyvy, *Bell Labs, Alcatel-Lucent, USA*
Robert Tkach, *Bell Labs, Alcatel-Lucent, USA, Chair*
Ann VonLehmen, *Telcordia Technologies, USA*

IEEE/Communications Society

Loudon Blair, *Ciena Corp., USA*
Stewart Personick, *USA*
Jane Simmons, *Monarch Network Architects, USA*
Doug Zuckerman, *Telcordia Technologies, USA*

Ex-Officio

E. Bert Basch, *Verizon, USA*
John Cartledge, *Queen's Univ., Canada*
Mehran Esfandiari, *AT&T, USA*
Mark Feuer, *AT&T Labs – Res., USA*
Ekaterina Golovchenko, *Tyco Telecommunications, USA*
Scott A. Hamilton, *MIT, USA*
Robert M. Jopson, *Bell Labs, Alcatel-Lucent, USA*
Biswanath Mukherjee, *Univ. of California at Davis, USA*
Leo Spiekman, *Alphion Corp., USA*
Atul Srivastava, *OneTerabit, USA*

2009 Invited Speakers

Category A. Fibers and Optical Propagation Effects

OThD1, Simple and Precise Chromatic Dispersion Measurement Using Sinusoidally Phase-Modulated CW Light, Takashi Yamamoto, Kenji Kurokawa, Katsusuke Tajima, Toshio Kurashima; *NTT Access Network Service Systems Labs, Japan.*

OThD4, Spatially Resolved Measurements of Fiber Parameters by Localized Four-Photon Mixing, Stojan Radic; *Univ. of California at San Diego, USA.*

OThK1, Progress in Metamaterials for Optical Devices, Alexander V. Kildishev¹, Shumin Xiao¹, Uday K. Chettiar¹, Hsiao-Kuan Yuan², Wenshan Cai³, Vladimir P. Drachev¹, Vladimir M. Shalaev¹; ¹Birck Nanotechnology Ctr., Purdue Univ., USA, ²Intel Corp., USA, ³Geballe Lab for Advanced Materials, Stanford Univ., USA.

OTuL4, Bend Insensitive Fiber for FTTX Applications, John M. Fini^{1,2}, Peter I. Borel², Peter A. Weimann³, Poul Kristensen², John Bjerregaard^{2,4}, Kenneth Carlson², Man F. Yan^{1,3}, Patrick

W. Wisk¹, Siddharth Ramachandran¹, Andrew D. Yablon¹, David J. DiGiovanni¹, Dennis Trevor¹, Calvin J. Martin⁴, Alan McCurdy⁴; ¹Optical Fiber Res., OFS Labs, USA, ²OFS Fitel Denmark, Denmark, ³OFS Optical Cable, USA, ⁴OFS-Fitel, LLC, USA.

OWD7, Optical WDM Regeneration: Status and Future Prospects, Lionel A. Provost, Periklis Petropoulos, David J. Richardson; *Optoelectronics Res. Ctr., Univ. of Southampton, UK.*

OWN1, Parabolic Pulse Formation and Applications, Christophe Finot¹, John M. Dudley², David J. Richardson³, Guy Millot¹; ¹Inst. Carnot Bourgogne, Univ. de Bourgogne, France, ²Inst. FEMTO-ST, Univ. de Franche-Comté, France, ³Optoelectronics Res. Ctr., Univ. of Southampton, UK.

OWN3, Long Period Fiber Gratings for High Speed Optical Pulse Shaping: Principles and Applications, Radan Slavik², Jose Azaña², Yongwoo Park²; ¹Inst. of Photonics and Electronics, Acad. of Sciences of the Czech Republic, Czech Republic, ²Inst. Natl. de la Recherche Scientifique (INRS), Canada.

OWU7, Stimulated Supercontinuum Generation, Daniel R. Solli¹, Claus Ropers^{1,2}, Bahram Jalali¹; ¹Electrical Engineering Dept., Univ. of California at Los Angeles, USA, ²Courant Res. Ctr. Nano-Spectroscopy and X-Ray Imaging, Univ. of Göttingen, Germany.

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

OMH1, Recent Advances in Real-Time Processing Based on Parametric Processes, Camille-Sophie Brès; *Univ. of California at San Diego, USA.*

OMP1, Fiber-Based Entangled Photon Sources and Their Applications, Alan Migdall^{1,2}, J. Fan^{1,2}, J. Chen^{1,2}, A. Ling^{1,2}, S. Polyakov^{1,2}; ¹NIST, USA, ²Joint Quantum Inst., Univ. of Maryland, USA.

OTuP3, Advances in Fiber Laser Beam Combination, Joshua E. Rothenberg; *Northrop Grumman Space Technology, USA.*

OWB3, Generation of Energetic Wavelength Tunable Femtosecond Pulses in Higher-Order-Mode Fiber, Chris Xu; *Cornell Univ., USA.*

OWT1, High Power Thulium Doped Fiber Lasers, W. Andrew Clarkson, Lee Pearson, Zhaowei Zhang, Ji Won Kim, Deyuan Shen, Alex J. Boyland, Jayanta K. Sahu, Morten Ibsen; *Optoelectronics Res. Ctr., Univ. of Southampton, UK.*

OWT6, Novel Crystalline Core Optical Fibers, John Ballato, T. Hawkins, B. Kokuoz, A. James, R. Stolen, P. Foy; *Ctr. for Optical Materials Science and Engineering Technologies, Clemson Univ., USA.*

OThH5, Performance Monitoring Using Coherent Receivers, Jonas C. Geyer¹, Chris R. S. Fludger², Thomas Duthel², Christoph Schulien², Bernhard Schmauss¹; ¹Univ. of Erlangen-Nuremberg, Germany, ²CoreOptics GmbH, Germany.

Category C. Optical Devices for Switching, Filtering and Signal Compensation

OMJ3, All-Optical Processing on a Silicon Chip, Alexander Gaeta; *Cornell Univ., USA.*

OMJ4, Multi-Wavelength Message Routing in a Non-Blocking Four-Port Bidirectional Switch Fabric for Silicon Photonic Networks-on-Chip, Benjamin G. Lee¹, Aleksandr

Biberman¹, Keren Bergman¹, Nicolás Sherwood-Droz², Michal Lipson²; ¹Columbia Univ., USA, ²Cornell Univ., USA.

OTuF1, Flexible and Reconfigurable Time-Domain De-Multiplexing of Optical Signals at 160 Gbit/s, *Michael Roelens¹, Jeremy A. Bolger^{2,1}, David Williams¹, Steve Frisken², Glenn W. Baxter², Aisling M. Clarke¹, Benjamin J. Eggleton¹; ¹Univ. of Sydney, Australia, ²Finisar Australia, Australia.*

OTuF3, The Osmosis Optical Packet Switch for Supercomputers, *Ronald Luijten¹, Richard Grzybowski²; ¹IBM Res. GmbH, Zurich Res. Lab, Switzerland, ²Corning Inc., USA.*

OWC2, Ultra-Compact Optical Switch Based on Photonic Crystal Waveguides, *Thomas Krauss; School of Physics and Astronomy, Univ. of St. Andrews, UK.*

OWO1, Recent Progress on Athermal AWG Wavelength Multiplexer, *Shin Kamei; NTT Photonics Labs, NTT Corp., Japan.*

OWO4, Low Power Consumption PLC-Type 43Gb/s DQPSK Demodulator, *Kuninori Hattori, Yohei Sakamaki, Yusuke Nasu, Shin Kamei, Toshikazu Hashimoto, Hiroshi Takahashi, Yasuyuki Inoue; NTT Photonics Labs, NTT Corp., Japan.*

OWV3, Optical Isolator with SOI Waveguide, *Tetsuya Mizumoto, Yuya Shoji; Tokyo Inst. of Technology, Japan.*

Category D. Optoelectronic Devices

OMK1, High-Speed Photodiode and Optical Receiver Technologies, *Atsushi Wakatsuki¹, Tomofumi Furuta¹, Yoshifumi Muramoto¹, Tadao Ishibashi²; ¹NTT Photonics Labs, Japan, ²NTT Electronics Corp., Japan.*

OMK4, Highly Linear Integrated Coherent Receivers for Microwave Photonic Links, *Jonathan Klamkin¹, Leif A. Johansson², Anand Ramaswamy², Nobuhiro Nunoya², Sasa Ristic², Uppili Krishnamachari², Janet Chen², John E. Bowers², Steven P. DenBaars^{1,2}, Larry A. Coldren^{1,2}; ¹Materials Dept., Univ. of California at Santa Barbara, USA, ²Dept. of Electrical and Computer Engineering, Univ. of California at Santa Barbara, USA.*

OMR5, State of the Art Si-Based Receiver Solutions for Short Reach Applications, *Mike Morse¹, T. Yin¹, Y. Kang¹, O. Dosunmu¹, H. D. Liu¹, M. Paniccia¹, G. Sarid², E. Ginsburg², R. Cohen², Y. Saado², R. Shnaiderman², M. Zadka²; ¹Intel Corp., USA, ²Numonyx Corp., Israel.*

OTuK6, Novel Concepts for High Speed VCSELs, *Nicolai Ledentsov; VI Systems GmbH, Germany.*

OWJ5, Recent Advances in Long Wavelength Quantum Dot Lasers and Amplifiers, *Richard Nötzel, E. A. J. M. Bente, M. K. Smit, H. J. S. Dorren; COBRA Res. Inst., Eindhoven Univ. of Technology, Netherlands.*

OThG1, Optical Quadrature Amplitude Modulation (QAM) with Coherent Detection up to 128 States, *Masataka Nakazawa; Res. Inst. of Electrical Communication, Tohoku Univ., Japan.*

OThN3, Compact Integrated 100Gb/s Optical Modulators Using Hybrid Assembly Technique with Silica-Based PLCs and LiNbO₃ Devices, *Akimasa Kaneko, Hiroshi Yamazaki, Takashi Yamada; NTT Photonics Labs, NTT Corp., Japan.*

OThN6, Integration and Packaging of Devices for 100-Gb/s Transmission, *Jeffrey H. Sinsky; Bell Labs, Alcatel-Lucent, USA.*

Category E. Digital Transmission Systems

OMT5, Experimental Experiences in High Speed QPSK Transmission, *Cornelius Fürst, M. Camera, H. Wernz, H. Griesser; Ericsson, Germany.*

OTuD1, Overlaying Coherent-Detection Channels over Direct-Detection Channels in Multi-Bit-Rate Systems, *Sébastien Bigo, Gabriel Charlet, Jérémie Renaudier, Massimiliano Salsi, Oriol Bertran-Pardo; Bell Labs, Alcatel-Lucent, France.*

OTuN1, Modulation Formats for 100Gb/s Coherent Optical Systems, *Han Sun, Jamie Gaudette, Yue Pan, Maurice O'Sullivan, Kim Roberts, Kuang-Tsan Wu; Nortel Networks, Canada.*

OTuN6, Requirements for 100Gb/s Metro Networks, *Michael H. Eiselt, Brian T. Teipen; ADVA AG Optical Networking, Germany.*

OWE1, Operating Points for Low-Density Parity-Check Codes in on-off Keyed Fiber-Optic Transmission Systems, *Benjamin P. Smith, Frank R. Kschischang; Univ. of Toronto, Canada.*

OWW1, High Spectral Efficiency Coherent Optical OFDM for 1 Tb/s Ethernet Transport, *William Shieh; Dept. of Electrical and Electronic Engineering, Univ. of Melbourne, Australia.*

OWW6, Enhanced Deep Space Data Return by Integrated RF-Optical TT&C, *Thomas Dreischer, Michael Tuechler, Klaus Kudielka, Guy Baister; Oerlikon Space AG, Switzerland.*

OThC3, Long-Haul Raman/ROPA-Assisted EDFA Systems, *Alan J. Lucero, D. G. Foursa, J.-X. Cai; Tyco Telecommunications, USA.*

OThL2, The SECOQC Quantum-Key-Distribution Network in Vienna, *Momtchil Peev, Thomas Länger, Thomas Lorünser, Andreas Happe, Oliver Maurhart, Andreas Poppe, Thomas Themel; Austrian Res. Ctr.s GmbH, Austria.*

OThR1, System Technologies for 100G Transport Networks, *Peter Magill; AT&T Labs, USA.*

Category F. Transmission Subsystems and Network Elements

OMM3, Fundamental Limits of Signal Processing in Optical Communications, *Michele Franceschini¹, Gianluigi Ferrari², Riccardo Raheli², Giorgio Bongiorni³, Fausto Meli⁴, Andrea Castoldi⁴; ¹IBM T.J. Watson Res. Ctr., USA, ²Univ. of Parma, Italy, ³Selta S.p.A., Italy, ⁴Cisco Photonics Italy, Italy.*

OTuO3, No-Guard-Interval Coherent Optical OFDM for 100-Gb/s/ch Long-Haul Transmission Systems, *Akihide Sano, Yasushi Takatori, Yutaka Miyamoto; NTT Corp., Japan.*

OWG5, High-Bit-Rate Optical QAM, *Takahide Sakamoto, Akito Chiba, Tetsuya Kawanishi; NICT, Japan.*

OWM3, Performance Monitoring in Optical OFDM Systems, *Markus Mayrock, Herbert Haunstein; Univ. of Erlangen-Nürnberg, Germany.*

OThE1, Reduced Complexity Rx Concepts for Optical Multilevel Transmission, *Fabian N. Hauske¹, Maxim Kuschnerov¹, Bernhard Spinnler², Berthold Lankl¹; ¹Federal Armed Forces Univ., Germany, ²Nokia Siemens Networks GmbH & Co. KG, Germany.*

OThE4, Microelectronics Advancements to Support New Modulation Formats and DSP Techniques, *Bruce Beggs; Nortel Networks, Canada.*

OThJ1, Agile Photonic Architectures Enabled by New Modulation Formats and DSP, *David Boertjes; Nortel Networks, Canada.*

OThJ4, Towards Real-Time Implementation of Coherent Optical Communication, *Timo*

Pfau, Ralf Peveling, Vijitha Herath, Sebastian Hoffmann, Christian Wördehoff, Olaf Adamczyk, Mario Pormann, Reinhold Noé; Univ. of Paderborn, Germany.

Category G. Optical Processing and Analog Subsystems

OMI4, Toward Tera-Sample/s 5-Bit All-Optical Analog-to-Digital Conversion, Yuji Miyoshi¹, Seiki Takagi¹, Hiroshi Nagaeda², Shu Namiki³, Ken-ichi Kitayama¹; ¹Osaka Univ., Japan, ²Trimatiz Ltd., Japan, ³AIST, Japan.

OMU1, All-Optical Label Processing and Swapping in Packet Switched Networks: Opportunities for Silicon Photonics, Javier Marti, Alejandro Martínez, Javier Herrera; Ctr. de Tecnología Nanofotónica, Univ. Politecnica de Valencia, Spain.

OTuE5, Photonics for Microwave Generation, Transmission, and Processing, Ronald Esman¹, Steve Pappert¹, Brian Krantz², Ganesh Gopalakrishnan³; ¹Microsystems Technology Office, DARPA, USA, ²Booz Allen Hamilton, USA, ³Independent Consultant, USA.

OTuE6, Photonic-Enabled Microwave and Terahertz Communication Systems, Alwyn J. Seeds¹, Martyn J. Fice¹, Francesca Pozzi¹, Lalitha Ponnampalam¹, Cyril C. Renaud¹, Chin-Pang Liu¹, Ian F. Lealman², Graeme Maxwell², Dave Moodie², Michael J. Robertson², Dave C. Rogers²; ¹Univ. College London, UK, ²CIP Technologies, UK.

OTuM1, Novel Optically Generated Ultra Wide Band (UWB) Signals, Leslie A. Rusch, Mohammad Abtahi; Dept. of Electrical and Computer Engineering, Univ. Laval, Canada.

OWF3, Broadband Antennas and Efficient Electro-Optic Interfaces for Fiber-Radio Applications, Rod Waterhouse, Dalma Novak; Pharad, LLC, USA.

OWS1, Microwave Photonic Applications for Silicon Photonics, Drew Guckenberger; Luxtera Corp, USA.

OThF3, 640 Gbit/s Optical Signal Processing, Leif K. Oxenløwe, M. Galili, H. C. H. Mulvad, A. T. Clausen, H. Ji, P. Jeppesen; Technical Univ. of Denmark, Denmark.

OThS4, All-Optical Regeneration for Ultra-Long Fiber Links and its Prospects for Future Applications with New Modulation Formats, S. J. Ben Yoo; Univ. of California at Davis, USA.

Category H. Core Networks

OML7, IP and Optical Integration in Dynamic Networks, Ori A. Gerstel; Cisco Systems, USA.

OMQ1, Optical Communication Challenges for a Future Internet Design, Darleen Fisher; Natl. Science Foundation, USA.

OWI3, Impact of Topology and Traffic on Physical Layer Monitoring in Transparent Networks, Dan Kilper¹, Alex Ferguson², Barry O'Sullivan², Steven K. Korotky¹; ¹Bell Labs, Alcatel-Lucent, USA, ²Univ. College Cork, Ireland.

OWL1, Optical Multi-Domain Routing, Xavi Masip Bruin, Marcelo Yannuzzi; Technical Univ. of Catalonia, Spain.

OWL6, Multi-Layer Network Architectures, Jan Spaeth; Tesat-Spacecom GmbH & Co.KG, Germany.

OThO3, Network Coding and Its Implications on Optical Networking, Minkyu Kim, Muriel Médard, Una-May O'Reilly; MIT, USA.

OThQ1, CAPEX and OPEX in Aggregation and Core Networks, Claus G. Gruber; Nokia Siemens Networks, Germany.

Category I. Access Networks

OMN1, New Passive Optical Technologies Enabling Faster, Lower Cost MDU Installations, John George, Peter A. Weimann, Daniel A. Hendrickson, Hongbo Zhang, Andrew Oliviero; *OFS Optics, USA.*

OMV1, Optical OFDM Transmission in Metro/Access Networks, Dayou Qian, Neda Cvijetic, Junqiang Hu, Ting Wang; *NEC Labs America, Inc., USA.*

OWH1, Investigation into Optical Technologies for Access Evolution, Philippe Chanclou, J.-P. Lanquetin, S. Durel, F. Saliou, B. Landousies, N. Genay, Z. Belfqih; *France Telecom Res. & Development Div., France.*

OWH6, 10-Gbit/s TDM-PON and over-40-Gbit/s WDM/TDM-PON Systems with OPEX-Effective Burst-Mode Technologies, Shunji Kimura; *NTT Access Network Service Systems Labs, NTT Corp., Japan.*

OThA1, Plug-and-Play WDM-PON Technologies for Future Flexible Optical Access Networks, Hiro Suzuki, Masamichi Fujiwara, Tetsuya Suzuki, Hideaki Kimura, Kiyomi Kumozaki; *NTT Access Network Service Systems Labs, NTT Corp., Japan.*

OThI1, CDM-Technologies for Next Generation Optical Access Networks, Takeshi Kamijoh, M. Kashima, H. Tamai, M. Sarashina, H. Iwamura, G. C. Gupta; *Oki Electric Industry Co. Ltd., Corporate R&D Ctr., Japan.*

OThI6, Secure OCDM-Based PON, Gabriella Cincotti¹, Naoya Wada², Ken-ichi Kitayama³; ¹*Univ. of Roma Tre, Italy,* ²*NICT, Japan,* ³*Osaka Univ., Japan.*

OThP5, WDM-PON Development and Deployment as a Present Optical Access Solution, Bongtae Kim¹, Byoung-Whi Kim²; ¹*ETRI, Network Res. Div., Republic of Korea,* ²*ETRI, Optical Communications Ctr., Republic of Korea.*

Category J. Network Experiments and Non-Telecom Applications

OMG1, Virtualized Optical Network (VON) for Agile Cloud Computing Environment, Masahiko Jinno, Yukio Tsukishima; *NTT Network Innovation Labs, Japan.*

OMO5, GENI: Overview and Plans, Kristin Rauschenbach; *BBN Technologies, USA.*

OTuA3, Dynamically Reconfigurable Optical Links for High-Bandwidth Data Center Networks, Madeleine Glick¹, David G. Andersen², Michael Kaminsky¹, Lily Mummert¹; ¹*Intel, USA,* ²*Carnegie Mellon Univ., USA.*

OTuI2, Cost-Efficient Dragonfly Topology for Large-Scale Systems, John Kim¹, William J. Dally², Steve Scott³, Dennis Abts⁴; ¹*Northwestern Univ., USA,* ²*Stanford Univ., USA,* ³*Cray Inc., USA,* ⁴*Google, USA.*

OWA1, Design and Development of Optical Grid over Wavelength Switched Optical Network, Hiroaki Harai, Sugang Xu; *NICT, Japan.*

OWK4, A Bandwidth Challenge at Super Computing (SC) Conference: Large-Scale Data Transfer Using 10Gbps Network, Ken T. Murata^{1,2}, Eizen Kimura², Kazunori Yamamoto², Daisuke Matsuoka², Hironori Shimazu¹, Yasuichi Kitamura¹, Keiichiro Fukazawa¹, Jin Tanaka³, Takatoshi Ikeda³, Yuuichi Kurokawa³; ¹*NICT, Japan,* ²*Ehime Univ., Japan,* ³*KDDI Corp., Japan.*

NFOEC 1: Optical Networks and Services

NMC5, G.709 Hierarchy Optical Transport Core Network Design, Requirements and Challenges, *Nee Ben Gee, Bert E. E. Basch, Steven Gringeri; Verizon Inc., USA.*

NMD3, Management and Control Architecture of Intelligent Transparent Optical Networks, *Wataru Imajuku; NTT Labs, Japan.*

NTuA1, Managing the Convergence of Carrier Ethernet with Optical Transport, *Ronald Skoog; Telcordia Technologies, USA.*

NTuA4, The Continuing Evolution of Ethernet, *John D'Ambrosia; Force10 Networks, USA.*

NTuB2, GMPLS Ethernet and PBB-TE (A Carrier's View), *Kenichi Ogaki, Tomohiro Otani; KDDI R&D Labs Inc., Japan.*

NTuC1, Serial 40G Submarine Deployments, *Wes George¹, Walter Chen¹, Samuel Liu²; ¹Sprint, USA, ²StrataLight Communications, Inc., USA.*

NThE3, Service Oriented Optical Network Architecture, *F. Baroncelli¹, B. Martini¹, V. Martini², Piero Castoldi²; ¹Consorzio Nazionale Interuniversitario per le Telecomunicazioni (CNIT), Italy, ²Scuola Superiore Sant'Anna, Italy.*

NThF5, Interworking of IP and OTN Networks-Making IP over OTN a Reality, *Mark Nowell; Cisco Systems, Canada.*

NFOEC 2: Network Technologies

NMB3, AT&T Optical Transport Services, *Barbara Smith; AT&T, USA.*

NWA4, Automated Fiber Optical Switching in FTTP PON Access Networks, *Joseph Finn; Verizon, USA.*

NWC3, Impact of FTTP on Metro Network Architecture, *David Templeton; Verizon, USA.*

NWD3, Highly Integrated DQPSK Modules for 40Gb/s Transmission, *Chris Clarke, Robert Griffin, Thomas Goodall; Bookham Inc., UK.*

NThA1, Ethernet to the Cell Site, *Hany Fahmy; AT&T, USA.*

NThA2, The Deployment and Operation of Fiber to the Cell Site, *Benjamin Parker; Verizon, USA.*

NThB1, Recent Advances in 100G OTN, *Masahito Tomizawa; NTT Network Innovation Labs, Japan.*

2009 Market Watch

Select Market Watch PowerPoint presentations are available for download. Click on the titles below to open a pdf of the presentations.

Tuesday, March 24 - Thursday, March 26, 2009
OFC/NFOEC Exhibit Floor Theater, Exhibit Hall F

This three-day series of panel sessions engage 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 Organizers:

Christoph Pfistner, *Vice President, Product Marketing, NeoPhotonics, USA*

Serge Melle, *Vice President, Technical Marketing, Infinera, USA*

Schedule-at-a-Glance

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

Tuesday:

12:00 p.m.– **Panel I: State of the Optical Industry**

2:00 p.m. Moderator: Myo Ohn, *Director, Business Development, Avanex Corp., USA*

3:00 p.m.–5:00 p.m. **Panel II: More Wavelengths, Higher Bit Rates, More Spectrum...The Path to Harnessing Maximum Fiber Capacity at the Lowest Cost**

Moderator: Niall Robinson, *Vice President, Product Marketing, Mintera Corp., USA*

Wednesday:

2:00 p.m.–4:00 p.m. **Panel III: Photonic Integration: Mainstream at Last?**

Moderator: Vijay Vusirikala, *Director, Technical Marketing, Infinera, USA*

Thursday:

10:00 a.m.–12:00 p.m. **Panel IV: Optical Switching and Reconfigurable Networks: Balancing Agility, Reliability, and Economy as Networks Evolve**

Moderator: Dana Cooperson, *Vice President, Network Infrastructure, Ovum, USA*

1:00 p.m.– **Panel V: 100G Standards Update**

3:00 p.m. Moderator: Rod Smith, *Tyco Electronics, USA*

Panel I: State of the Optical Industry



Moderator: Myo Ohn, *Director, Business Development, Avanex Corp., USA*

The goal of this session is to provide more insight into the state of the optical industry by having the suppliers and users of bandwidth share their views on the drivers, applications and deployment plans in the coming years. This panel will have representatives from the various stakeholders, ranging from Tier-1 Telco and Enterprise users, and fiber suppliers, equipment vendors to optical component vendors. To complement the views of the stakeholders, this panel will also have speakers from the market and equity research world to provide a Wall Street view of the industry.

Speakers



Network Traffic, Cost and Revenue: Putting the Relationship in Perspective

Dana Cooperson, *Vice President, Network Infrastructure, Ovum, USA*

Traffic growth projections over the next 10 years vary only in the degree to which they predict we will be awash in video. Network capacity is often viewed purely as a cost to be contained rather than an asset to be used to support new services that could more closely couple service value to revenue received (and bandwidth used). This is not surprising, given how hard it is to predict the Next Big Thing in services and who will profit from it. Bandwidth will never be free, however, and although increased network agility and intelligence make it more useful as an enabler for whatever new services might arise, they do not inherently make bandwidth cheaper. This introduction will be to provide some context for the opportunities as well as threats of continued strong traffic growth.

As head of Ovum's Networks practice, Dana is responsible for managing Ovum's broadband access, IP services, carrier Ethernet, optical networks, and mobile infrastructure research and advisory team. Her personal area of expertise is in optical networking, where she does much of her research and consulting. Her most recent custom research collaborations include opportunity and competitive analysis regarding specific ON and Ethernet markets in EMEA and Asia-Pacific, the GPON market, the CWDM market, the ON enterprise market, and specific Ethernet services country markets and road-mapping next-gen optical networks. She also is called to help clients with product launch and product line strategy questions. Before becoming practice leader, Dana had various analyst roles within Ovum and RHK. She has been an industry analyst for 10 years. Dana brings 16 years of telecoms vendor and service provider experience to her role as industry analyst. Prior to becoming an industry analyst, Dana was a marketing manager for Tektronix, where she was responsible for its high-speed WDM/SONET/SDH test and measurement products. Before Tektronix, she was a product manager at Telco Systems, with responsibility for its MX3 and SONET OC-3 multiplexers. She began her telecoms career as a network engineer at NYNEX (now part of Verizon Communications), where she managed the first 100% - fiber-optic connection to a major business customer in New York City. Dana was awarded

an M.S. in management from MIT and a B.S. in engineering from Cornell University.



Perspectives on the Worldwide Optical Fiber Marketplace

Brad M. Boersen, *Manager, Business Strategy, Corning Optical Fiber, Corning Inc., USA*

The market for optical fiber posted an industry record and grew an average of 15% year over year between 2002 and 2007. This was driven by a) positive public policy, b) consumers' appetite for bandwidth-consuming applications, and c) facilities-based competition. This presentation will highlight and give more insight into future deployment rates and patterns in all segments of the fiber market.

Brad has 20 years of professional experience, 7 with Corning. Presently he manages Market & Strategic Analysis for Corning Incorporated's Optical Fiber business. Brad holds a B.S. degree in chemical engineering from Michigan State University and an S.M. degree in engineering and management from MIT's Sloan School of Management.



Bandwidth Drivers in Carrier Networks and Technology Solutions

Joe Huggins, *Director, Access and Transport Technology Management, Qwest Communications, USA*

Network traffic grows at an ever-increasing rate and carriers must find solutions to keep pace with the increasing demands. It is a challenge the industry faces as a whole and carriers and vendor partners will need to find innovative ways to increase network capacity and improve network efficiency while driving costs down so end users can continue to benefit from current and emerging services without dramatic increases in cost. I will discuss bandwidth drivers and potential strategies for managing the increasing network requirements in order to economically deliver the services customers want today and in the future.

Joe Huggins is the Director for Access and Transport technologies within the Technology Management organization at Qwest. He is responsible for the evaluation, selection, and certification of these technologies for Qwest's Local and National networks; as well as driving the overall strategy of the Qwest Access and Transport networks. He has held positions in network engineering, planning, strategy and economic analysis. He has experience in transport, packet technologies, switching and finance. Mr. Huggins graduated from The Colorado College in 1977 with a degree in geology and received a Masters of Business Administration - Finance degree from Regis University in 1985. He holds three patents related to VDSL and ATM.

Title To Be Announced

Steven Gringeri, *Verizon Communications, USA*



State of the Optical Industry: A Wall Street Perspective

Paul A. Bonenfant, *Communications Components Analyst, Vice President - Equity Research, Morgan Keegan & Co., USA*

At last year's OFC/NFOEC Market Watch session, the topic of consolidation was discussed as a potential means to help restore profitability in a market that has long suffered since the Optical/Internet bubble burst in the early 2000s. Subsequently, we have witnessed several announced mergers and acquisitions leading to perhaps the most pronounced changes in the competitive landscape in almost a decade. In this presentation, we will discuss recent consolidation efforts along with demand shifts and levers for business model improvement that we think may contribute to improved operating models.

Paul A. Bonenfant joined Morgan Keegan in January 2005 as Associate Analyst for Communications Equipment, and in February 2008 assumed the role of Senior Analyst for Communications Components. Prior to his move to Wall Street, Paul spent over 15 years in the telecommunications industry. He was Principal Network Architect at Mahi Networks, Chief Architect at (and a founding member of) optical networking start-up Photuris, and a business development manager for mergers and acquisitions in Lucent's Optical Networking Group. Before joining Lucent, he led requirements and standards development for optical transport systems at Bell Communications Research (Bellcore, now Telcordia Technologies). Paul received both his B.S. in engineering and applied science and his M.S. in electrical engineering from the California Institute of Technology. He is a member of Eta Kappa Nu, Tau Beta Pi, a Senior Member of the IEEE, and serves on the Technical Program Committee for OFC/NFOEC and Globecom.

Panel II: More Wavelengths, Higher Bit Rates, More Spectrum...The Path to Harnessing Maximum Fiber Capacity at the Lowest Cost



Moderator: Niall Robinson, *Vice President, Product Marketing, Mintera Corp., USA*

Continued solid capacity growth in core, metro, access and submarine networks has researchers and product developers once again looking at strategies to maximize the transmission capability of optical networks. Of course, an eye to maximizing revenue and profits is critical too. We'll explore how these key factors are influencing commercial solutions and directing forward-looking research aimed at powering the next decade of optical networking. This session will feature leaders from companies in the carrier space to the component space sharing their views of tomorrow's high

capacity networks.

Speakers



Market View from 10G to 40G to 100G

Michael Howard, *Principal Analyst and Co-Founder, Infonetics, USA*

With over 35 years of network industry experience, Michael is recognized worldwide as one of the industry's leading experts in emerging markets, service provider network market trends and user buying patterns. In the 1960s, he worked on operating systems and programming language compilers for ARPAnet, the first operational packet switching network and predecessor of the Internet. He co-founded Infonetics Research in 1990 and now focuses on optical, routing and metro Ethernet.



All of the Above...

Glenn Wellbrock, *Director of Optical Transport Network Architecture and Design, Verizon, USA*

Traffic growth continues across all applications forcing operators to employ higher bit rates, higher degree ROADM counts and higher channel counts. This presentation will focus on how Verizon is taking steps to stay ahead of the curve while creating network architectures that are both more robust and easier to operate than conventional transport infrastructures.

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 and 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.



Providing Cost Effective DWDM Solutions for High Volume and High Growth

Alan Gibbemeyer, *Head of Solution Sales and Product Management, Nokia Siemens Networks, North America Fixed Networks Business, USA*

High volume customers for DWDM solutions are looking for ways to extend the life of their DWDM system investments. Systems providers with products offering higher

capacity per fiber of 3.2Tb today are winning in these applications and are successful in providing the lowest total cost of ownership (TCO) in these applications. Key technologies are 40G per wavelength today and 100G per wavelength in the near future. Nokia Siemens Networks would like to present the key technologies, standards and product attributes today and those on the near-term horizon.

Alan Gibbemeyer has played a key role in business development and strategy execution in Nokia Siemens Networks' fixed network solutions in North America. He has 17 years of international experience in telecommunications network infrastructure and semiconductors. His previous role was General Manager for the optical business line in North America, where he was responsible for strategy and sales execution in optical network solutions across the region. Other roles with Siemens Information and Communications included Vice President and General Manager for Optisphere Networks a Siemens optical start-up company based in North America. Previously, Gibbemeyer worked for Lucent Technologies and Digital Equipment Corp., focused on portfolio and product management for global SDH/SONET, network management systems products and semiconductors. He earned a B.Sc. degree in electrical engineering from University of Cincinnati and an M.B.A. from Babson College in Wellesley, Massachusetts, and is currently based in Iselin, New Jersey.



Photonic Integrated Circuits as a Key Enabler to Effective Scaling of High Capacity Fiber Networks

Stephen Grubb, *Senior Director, Optical Systems, Infinera, USA*

The three metrics of total fiber capacity scaling will be discussed: increasing the bit rate per channel, increasing the channel density and increasing usable fiber spectrum. The ability of photonic integration to address these three key areas while simultaneously lowering the cost per bit and increasing reliability will be outlined.

Dr. Grubb is currently a Senior Director in the Optical Systems Group at Infinera. He has previously held positions at Corvis, SDL, and AT&T Bell Laboratories. He led R&D that was responsible for the first commercial deployment of Raman amplification in a network, and developed several novel high power fiber lasers and amplifiers. He received his Ph.D. in chemical physics from Cornell University. Dr. Grubb has authored well over 100 publications and conference presentations and is an inventor on over 60 issued U.S. patents.



[The Never-Ending Quest for Bandwidth on Real World Fiber](#)

Stephen Carlton, *Vice President, Planning and Product Management, Fujitsu Network Communications, USA*

The ever increasing need for more bandwidth is pushing the industry towards yet another period of bandwidth growth. The fiber in the ground today has survived three generations of such growth but current technologies are pushing many limits; can it accommodate yet another generation of growth? Can we push to higher wavelength counts and higher bit rates on the installed infrastructure or do we need a massive investment in new fiber? This talk will explain why Fujitsu believes we can use the installed fiber base for at least one more generation of optical technologies, what these technologies are and what they will mean to the network.

Stephen Carlton is vice president of Planning and Product Management at Fujitsu Network Communications. In this role, Stephen is responsible for planning and writing of requirements for new product developments and also product line management of FLASHWAVE products. Stephen's career in telecommunications began in 1982 at Bell Northern Research (now Nortel) as a design engineer. In this position, he helped develop pointers, a key innovation on the SONET standard. Stephen moved to Rockwell International (now Alcatel) in 1986 to be a system designer of fiber optics transmission and progressed to the position of director of development where he was responsible for 140 developers engaged on the design of SONET and WDM systems, hardware, and software. Stephen joined Fujitsu in 1998 as an individual contributor to assist planning of SONET system requirements. He eventually became vice president responsible for product line management and planning of SONET and WDM products developed by Fujitsu. Stephen holds a Bachelor of Science degree in electronics from De Montfort University in Leicester, UK. He holds seven patents relevant to the field of transmission engineering.

Panel III: Photonic Integration: Mainstream at Last?



Moderator: Vijay Vusirikala, *Director, Technical Marketing, Infinera, USA*

As optical networking systems evolve to meet rapidly growing bandwidth requirements, there is an increasing focus on photonic integration as a key enabler of cost-effective scalability, richer functionality, higher density and lower power consumption. This panel will review the breadth of photonic integration technologies and discuss current deployment status, application scenarios and commercial implications for the optical component and systems companies. Topics ranging from active opto-electronic devices (InP integration), passive optics integration (PLCs) to silicon PICs will be discussed. The panel will comprise key industry players representing optical component companies, system vendors, market analyst firms, and academia/corporate R&D labs to provide perspectives not only on near-term commercialization successes and challenges but also on exciting developments in the

labs and the transition path to commercial products.

Speakers



[Redefining Optical Cost, Scale and Performance with Optical Integration](#)

Sterling Perrin, *Senior Analyst, Heavy Reading, USA*

Photonic integration, with the photonic integrated circuit (PIC) at the center of it, is quickly emerging as the best way to resolve the high-bandwidth/low-profits dilemma that is affecting the entire communications industry. A small number of PIC devices are available today, but a major development effort is underway to drive down their cost. This presentation will discuss new developments in photonic integration, including innovation that is available today, as well as a realistic roadmap for the future.

Sterling Perrin has more than 12 years' experience in telecommunications as an industry analyst and journalist. His coverage areas at *Heavy Reading* include optical networking, cable MSO infrastructure and services, and digital content. Perrin joined *Heavy Reading* after five years at IDC, where he served as lead optical networks analyst, responsible for the firm's optical networking subscription research and custom consulting activities. Prior to IDC, Perrin worked for Standard & Poor's, where he delivered global industry analysis on a range of IT segments. He is a former journalist and editor at *Telecommunications Magazine*, and has also done consulting work for the research firm Current Analysis. Perrin is a frequent speaker at telecom industry events and is a highly sought-after source among the business and trade press.



[Next Generation of Optical Integration—The Impact of CMOS Photonics](#)

Dave D'Andrea, Senior Director, Marketing and Sales, Lightwire Inc., USA

Imagine a basic CMOS Mach-Zehnder Interferometer (MZI) modulator where the figure of merit ($V\pi L\pi = 2V \cdot \text{mm}$) is 150 times more efficient than Lithium Niobate. Then take that extremely efficient modulator and drive it directly with a simple CMOS inverter. Add all the optical circuits to connect them in any configuration required and the applications are unlimited. CMOS photonics is currently used to provide standards based products such as SFP+ ER and LR. These modules consume one third to one half the power of existing solutions with the added benefit of zero dispersion. CMOS photonics can also be used to replace the vertical cavity surface emitting laser (VCSEL) for multi-channel applications. A single DC laser power source is mounted on a photonic IC with all the optical circuits and modulators integrated. Future applications exist for complex modulation techniques, such as DQPSK where all of the modulators are on the same IC. This CMOS photonics platform is realized by leveraging the vast investments made in silicon integrated circuits over the past several

decades. Just as CMOS structures in the IC industry have replaced bipolar structures where power is critical, so will CMOS photonic structures play an important part in the fiber optic industry. This will enable the fiber optic industry in its quest to increase integration and manufacturing capacity, while reducing size, power and cost.

Dave D'Andrea has been in the fiber industry for over 20 years. Prior to joining Lightwire, Dave was the Marketing Director for the Fiber Optic Product Division of Avago Technologies. He has served in various roles at Avago Technologies (formerly Agilent Technologies and Hewlett Packard) and AMP Inc. (Tyco), including design engineering, test engineering, and applications engineering. In addition he has had management roles in marketing, sales and R&D. Dave has a B.S.E.E. in microprocessor systems and a M.S.E.E. in computer networking, both from the New Jersey Institute of Technology.



[Photonic Integration on Silicon](#)

John Bowers, *Director, Energy Efficiency Inst., and Profesor, Dept. of Electrical and Computer Engineering, Univ. of California at Santa Barbara, USA*

The evolution of optical networks is requiring increasing complexity in photonic integrated circuits (PICs), together with continual pressure to reducing the cost and power consumption of PICs. Silicon CMOS foundries have the maturity and process control to allow larger PICs with greater yield and reliability with substantially lower cost. Recent developments have allowed the premier performance of passive silicon PICs to be integrated with active components for optimum results. This will allow new markets and opportunities to be exploited for both higher performance and high volume applications.

John E. Bowers is Director of the Energy Efficiency Institute and a professor in the Department of Electrical and Computer Engineering at the University of California at Santa Barbara. He is also CTO and co-founder of Calient Networks and Chairman of the Board of BioIQ. His research interests are primarily concerned with silicon photonics, optoelectronic devices, optical switching and transparent optical networks. Prof. Bowers is cofounder of the Center for Entrepreneurship and Engineering Management, and founder of Terabit Technology (sold to Ciena). Prof. Bowers received M.S. and Ph.D. degrees from Stanford University. He worked for AT&T Bell Labs and Honeywell before joining UCSB. Dr. Bowers is a fellow of the IEEE, OSA and the American Physical Society, and a recipient of the IEEE LEOS William Streifer Award and the South Coast Business and Technology Entrepreneur of the Year Award. He was an elected member of the IEEE LEOS Board of Governors, a LEOS Distinguished Lecturer, and Vice President for Conferences for LEOS. He has published eight book chapters, 450 journal papers, 700 conference papers and has received 52 patents. He is a member of the National Academy of Engineering. He and

co-workers received the ACE Award for Most Promising Technology for the hybrid silicon laser in 2007.



Photonic Integrated Circuits for Optical Communications with High Spectral Efficiency

Christopher R. Doerr, *Distinguished Member of Technical Staff, Bell Labs, Alcatel-Lucent, USA*

As the demand for bandwidth increases on each optical fiber, there is significant pressure for optical transceivers to be cheaper, smaller, more power efficient, yet generate and receive increasing numbers of bits per second. As the bit rate increases, factors such as optical dispersion tolerance, optical filtering tolerance and spectral occupation become more important, requiring more complex transmitters and receivers. A potential solution to having all these characteristics is monolithic integration of the various functions onto a single photonic integrated circuit (PIC). The only material platform known today that can provide all the necessary optical functions for a transceiver on a monolithic PIC at wavelengths in the fiber low-loss wavelength window is InP. This presentation discusses InP PIC transmitters and receivers with advanced features.

Christopher R. Doerr earned a B.S. in aeronautical engineering and a B.S., M.S., and Ph.D. in electrical engineering from the Massachusetts Institute of Technology (MIT). He attended MIT on an Air Force scholarship and earned pilot wings in 1991. 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, received the OSA Engineering Excellence Award in 2002, and became an IEEE Fellow in 2006. Doerr is Editor-in-Chief of IEEE *Photonics Technology Letters*. He is married to Neriko Musha and has two children.



Photonic Integration in the Real World: Scaling Optical Networks with PICs

David F. Welch, *Founder and Chief Marketing and Strategy Officer, Infinera Corp., USA*

Sustained bandwidth growth and emerging high speed services (40/100G) are spurring optical network deployments with a strong focus on capacity scaling while lowering the cost and power per bit. This talk describes how Photonic Integrated Circuit (PIC) technology enables cost-effective and flexible optical transport networks compared to solutions based on multiple discrete optical components. The talk describes exciting PIC technology advances and highlights PIC evolution beyond today's commercially deployed 100 Gb/s PICs. Future PICs and PIC-based optical systems incorporate

higher capacity (400 Gb/s and higher), higher data rates per channel, integrated optical amplification and advanced modulation schemes—all of which drive network costs lower and simplify network operations.

David Welch is a co-founder of Infinera and his original role was CTO. Currently, Dr. Welch is the Chief Marketing and Strategy Officer. Dr. Welch's responsibilities include direction and management of technology development, product management and marketing, business development for Infinera—a leading supplier of optical systems based on innovative Photonic Integrated Circuit (PIC) technology. Dr. Welch was previously CTO and VP of Corporate Development of SDL and JDS Uniphase, where he was responsible for technology and acquisition strategies. Dr. Welch has published over 250 articles and has over 80 patents in the area of optical components and systems. Dr. Welch has been awarded the 1992 Adolph Lomb Award from OSA, the 1998 Engineering Achievement Award from LEOS, and the 1999 OSA Joseph Fraunhofer/Robert M. Burley Award, and his contributions have been acknowledged in over 17 product of the year awards while at SDL. Dr. Welch is on the board of directors of OSA and is a fellow of the IEEE. Dr. Welch earned his B.S. degree in electrical engineering from the University of Delaware and his Ph.D. in electrical engineering from Cornell University.

Panel IV: Optical Switching and Reconfigurable Networks: Balancing Agility, Reliability, and Economy as Networks Evolve



Moderator: Dana Cooperson, *Vice President, Network Infrastructure, Ovum, USA*

Network operators must do a difficult balancing act: They must support existing services and customers while planning and evolving networks for new services and keeping expenditures reasonable and networks reliable. How can ROADMs/optical switches help balance infrastructure needs and financial requirements? What tradeoffs need to be made and how can new technologies help operators optimize choices? How are ROADMs/optical switches being used today, and what new applications do we foresee in the future? This session will discuss ROADM/optical switch-based networks from multiple angles.

Speakers



Road towards Next Generation Optical Transport Networks (OTN)

Hans-Martin Foisel, *Head of Hybrid Technology Department, Deutsche Telekom, Germany*

For facing the carrier challenges of today, DT has started a comprehensive network transformation project, including Next Generation Layer 2 and Layer 1 transport network technologies. In this presentation a short introduction to DT's network

transformation efforts will be given, focusing on the OTN platform characteristics and features.

Hans-Martin Foisel is Head of Hybrid Technology Department in the Technical Engineering Center at Deutsche Telekom. Currently he serves as President and Chair of Carrier Working Group of the Optical Internetworking Forum (OIF). At Deutsche Telekom his work is focused on multi-layer and multi-domain networks, their architectures, functions, standardization and interoperability aspects. Prior to joining Deutsche Telekom, he has worked at Heinrich-Hertz-Institute in Berlin for 19 years in R&D of optical transmission systems.



Network Transparency Helps in an Unclear Future Environment

Kazuo Hagimoto, *Executive Director, NTT Network Innovation Labs, Japan*

This talk provides an overview of current traffic trends in Japan and the recent transport network development using ROADMs and 40G transmission technologies. High-speed transmission technologies with the line-rate of 40G or 100G are reviewed, and the advanced modulation format suitable for constructing the metro-core network from the viewpoints of impairments is discussed. Finally the advanced functionalities that enhance ROADM network agility are described.

Kazuo Hagimoto joined the NTT Electrical Communications Laboratories, Yokosuka, Japan, where he has led R&D on high-speed optical communications systems including 10G and higher EDFA repeated systems. After serving as the Operation Support Systems group leader of the Network business unit of NTT Communications, he is currently the Executive Director of NTT Network Innovation Laboratories. His current research interests include very large capacity optical network systems and media networking technologies utilizing these systems. Mr. Hagimoto is a fellow of IEEE and the IEICE of Japan and a member of OSA. He has served as a program co-chair of OAA'93 in Yokohama, Japan, a general co-chair of OAA'94 in Colorado, and the general chair of APCC2008. He received the Sakurai Memorial Prize from the Optoelectronic Industry and Technology Development Association in 1989, the Oliver Lodge premium from the IEE in 1991, the Kenjiro Takayanagi memorial award in 1994, and the achievement award from the Institute of Electronics, Information and Communication of Engineers of Japan (IEICE) in 1994 and 2006.



Reconfigurable IP over DWDM Networks; Building Blocks of the Service Provider Next-Generation Network

Jeffrey Maddox, *Director, Product Line Management, Optical Transport Business Unit, Cisco Systems, Inc., USA*

The networking industry, as with the global economy, is facing a serious conundrum. Consumer price points are decreasing as the high-definition video demands on the network are rapidly increasing, threatening that in the very near future service providers will be losing revenue on these latest-generation networks. Fortunately, this convergence of IP, video and optical technologies has expedited the migration toward a much more highly integrated network architecture. OMNI-Directional ROADM technology allows for “optimal optical routing” to be realized and when integrated with IP routing products has led to dramatic cost and operational savings. This presentation will focus on how the combination of advanced ROADM technologies, when combined with IP products and the necessary monitoring and software capabilities, will offer a more efficient, operationally friendly and cost-effective network for the future.

As Director of the Optical Transport Business Unit’s product line management group, Jeffrey Maddox is a member of the leadership team implementing Cisco’s vision and strategy for next generation optical networking. Cisco’s optical team introduced the industry’s first next-generation multiservice transport platform (MSTP) and led the growth to #1 marketshare worldwide for deployment of ROADM technologies. Today, the MSTP DWDM product is the cornerstone of Cisco’s IP over DWDM strategy, which is changing the way service providers, cable operators, and enterprise companies build their networks. Mr Maddox has more than 14 years of experience in the telecommunications industry. Prior to Cisco, he worked at Nortel Networks. He received a bachelor’s degree in electrical engineering from McMaster University in Canada.



Leveraging Directionless and Colorless Upgrade to Existing ROADM-Based Networks

Kim Papakos, *Senior Product Manager, Tellabs, USA*

The presentation will focus on how directionless and colorless upgrades can be leveraged to increase network flexibility and offer enhanced optical protection mechanisms. The presentation will highlight how recent advances in optical technology are making directionless and colorless options economically attractive and also provide some options on upgrading existing ROADM-based networks.

Kim Papakos is senior product manager for optical networking and DWDM technology at Tellabs. In this role, he is responsible for product planning and business

development for Tellabs transport platform. Previously, Papakos worked for numerous carriers including Telstra and Optus communications where he was part of the team that designed and implemented Australia's second telephone network. He also worked in numerous countries designing SDH/SONET, GSM and two-way cable networks. Papakos has more than 16 years of telecommunications industry experience specializing in optical communications. He holds a Bachelors of Electronics Engineering and a Bachelors of Optical Engineering from Melbourne, Australia. Papakos has published numerous papers and has 14 patents granted or pending.



[Flexible Wavelength Selective Switches for Advanced Network Architectures and Modulation Formats](#)

Simon Poole, *Director, New Business Ventures, Finisar, Australia*

The increasing requirements for higher bit rates, higher channel density, greater network transparency and increased ease of operation are placing great demands on the development of next generation ROADMs. This presentation will discuss how liquid crystal on silicon (LCoS)-based wavelength selective switches provide a powerful, flexible platform for ROADM deployments and how they can assist in providing a “future-proof” platform for network architectures and transmission of advanced modulation formats.

Dr. Simon Poole has over 30 years of experience in communications and has been involved in many of the key developments in optical communications from both a research and commercial perspective. He was a member of the team that developed the first EDFA at Southampton University in 1985 and has founded several successful start-ups in the optical communications space including Indx Pty. Ltd. (acquired by JDSU) and Engana Pty. Ltd. (now Finisar Australia). He has published over 150 papers in journals and conferences and is currently Director of New Business Ventures at Finisar Australia.



[Economy of Key Optical Modules in Agile Optical Networks](#)

Doug Alteen, *Senior Director, Product Line Management, Subsystems, Communications and Commercial Optical Products, JDSU, USA*

The cost pressures that network equipment manufacturers are under in order to support and build out their transport infrastructures is at an all-time high. Today's agile optical transport node includes critical modules such as amplifiers, ROADMs and monitoring elements. A cost pareto will arrange these in order, starting with the highest cost element, WSS modules, amplifiers and monitors. WSS's are the newest of these technologies and hence subject to the highest cost pressures. Even so, today's annual

cost reduction expectations by NEMs for these products is unprecedented. This talk will cover the drivers behind these targets and why they are a critical measure for the health of our industry, what is realistically possible, and a forecast of impact to technology development.

Doug Alteen is the Senior Director of Product Line Management for Subsystems in the Communications and Commercial Optical Products business segment at JDSU. He is responsible for overseeing JDSU's optical amplifier and circuit packs business. Doug and his team have recently focused on developing innovative solutions that include the AON Super Transport Blade and the Photonic Integrated Amplifier. Doug has spent more than 20 years in the telecommunications arena, holding a number of senior positions in sales, marketing, R&D and product line management. For the past 10 years, he has worked specifically in the optical components modules and subsystems industry.

Panel V: 100G Standards Update



Moderator: Rod Smith, *Global Industry Lead, Data/Communications, Tyco Electronics, USA*

This session will provide an update on the status of 100G standards and associated implementation agreements. Standards work for 100G Ethernet is underway in the IEEE, while the ITU-T is well along on a coordinated activity to standardize a new signal format to transport 100G across global networks. Building on the IEEE and ITU-T standards, the OIF has several projects focused on a specific implementation for 100G transport across ultra long haul DWDM networks. Speakers will provide their perspectives on the work in these three bodies.

Speakers



[40 Gigabit Ethernet and 100 Gigabit Ethernet: An Update on the IEEE P802.3ba Project](#)

John D'Ambrosia, *Senior Scientist, Components Technology, Force10 Networks, USA*

The goal of this session will be to provide the audience with an overview on 40 Gigabit Ethernet and 100 Gigabit Ethernet. The author will give a update on developments efforts within the IEEE P802.3ba Task Force, and review the technical discussions and decisions that are shaping 40 Gigabit Ethernet and 100 Gigabit Ethernet.

As a senior scientist at Force10 Networks, John D'Ambrosia focuses on components technology and leads the company's involvement in industry groups. John has been an active participant in the development of Ethernet-related technologies since 1999. At

the present time, he is the chair of the IEEE P802.3ba Task Force, which is driving the standards development process for 40 Gb/s and 100 Gb/s Ethernet. John served as secretary for the IEEE 802.3ap Backplane Ethernet Task Force, and participated in the development of XAUI for 10 Gigabit Ethernet. John is a founder of the Ethernet Alliance and has served as a director, secretary. John was the chair of the XAUI Interoperability work group for the 10 Gigabit Ethernet Alliance. For all of his efforts related to Ethernet, John was recognized by Network World in 2006, as part of its “50 Most Powerful People in Networking” list. John also acted as secretary for the High Speed Backplane Initiative and chair of the Optical Internetworking Forum's Market Awareness & Education committee. Prior to joining Force10, John was with Tyco Electronics for 17 years.



[ITU-T Optical Transport Network \(OTN\) Support for 100 Gigabit Ethernet](#)

Mark Jones, *Staff Product Manager, Tellabs, USA*

This presentation describes the status of ITU-T developments related to transport of 100 GbE using the OTN. Reasons why service providers are requesting OTN support for transporting 100 GbE provide relevance for this work. Details on the items already agreed for inclusion in ITU-T standards are included along with a summary of the items still being debated.

Mark Jones is Staff Product Manager for optical transport products at Tellabs. He is responsible for marketing and assisting in product planning. He has more than 12 years of telecommunication industry experience. Prior to joining Tellabs, he was Principal Technology Strategist in the CTO's organization and Chief Architect of Sprint's optical transport network at Sprint Nextel. He represents Tellabs at industry standards development organizations, currently serving as a rapporteur in ITU-T Study Group 15. He holds Bachelor of Science and Master of Science degrees in electrical engineering from Oklahoma State University and a Ph.D. in electrical engineering from Georgia Tech.



[Review of OIF Work on 100G Long Distance DWDM Transmission](#)

Joseph Berthold, *Vice President, Network Architecture, Ciena Corp., USA*

This presentation will review the projects the OIF has underway to specify an implementation approach for 100G transmission in core backbone networks. It will review application objectives, the chosen modulation approach, and provide an overview of the OIF work in photonic module integration, forward error correction, and the physical and electromechanical specification of a transceiver module.

Joseph Berthold is Vice President, Network Architecture, at Ciena, where he has worked since 1997. There he contributes to the understanding of future network architecture directions, the definition of CIENA's networking products, and is responsible for coordination of CIENA's work in industry standards. He is a member of the Board of Directors of ATIS (Alliance for Telecommunications Industry Solutions) and a member of the Science Council for the National Science Foundation's GENI (Global Environment for Networking Solutions) Program. He chaired the Technical Committee of the Optical Internetworking Forum from 1998–2001, and was its' President from 2002–2007. Prior to Ciena he held various research and development positions at Bell Labs and Bellcore from 1977–1997. He received a Ph.D. in physics from Brown University in 1976, and did postdoctoral research at Cornell University from 1975–1977.



100Gb/s Standards: A Case for Progress

Bill Gartner, Vice President and General Manager, Optical Transport Business Unit, Cisco Systems Inc., USA

This presentation summarizes one vendor's experience with 40Gb/s and draws on lessons learned to discuss several industry goals as we progress towards 100Gb/s solutions. Drivers for 100Gb/s will be discussed as well as the motivation for standards around modulation formats and footprints emerging earlier in the product lifecycle.

Bill leads Cisco Systems' Optical Transport Business Unit (OTBU), which includes Cisco's portfolio of DWDM and TDM Optical Networking products. Bill has P&L responsibility for this business and is responsible for strategic direction, product development, product positioning and new product introduction. Prior to joining Cisco, Bill was Chief Operating Officer of Meriton Networks (acquired by Xtera Networks). Prior to Meriton, Bill served as President and COO of Mahi Networks and COO of Photuris. Before joining Photuris, he was Vice President and General Manager of Lucent's Optical Networking Systems business, responsible for Metro, Access, and Long Haul DWDM Products. In this role, he was responsible for well over \$1B of revenue, with 500 employees in 5 worldwide locations. His earlier tenure in the industry included roles at AT&T Bell Labs and Paradyne. Bill has served on the boards of OptronX (acquired by JDSU) and CyOptics. Bill has a bachelor's degree in electrical engineering from Georgia Tech, a Master's degree in electrical engineering from Cornell University, and an Executive Master's in technology management from University of Pennsylvania/Wharton. He is a University of Pennsylvania Moore Fellow and holds three patents.

2009 Plenary Session

The OFC/NFOEC 2009 Plenary Session was held on March 24. View the links below to watch the plenary presentations online or to download the presentations in pdf format. Each plenary speaker presents for 30-40 minutes.



The Changing Landscape in Optical Communications

Philippe Morin

President, Metro Ethernet Networks, Nortel, Canada

[PDF Presentation](#)

[Morin Video Part 1](#)

[Morin Video Part 2](#)

[Morin Video Part 3](#)

[Morin Video Part 4](#)

Abstract: Core network traffic continues to grow unabated at or near Moore's law, a doubling of traffic every year. Broadband access and services continue to drive telecoms and are a critical part of the economic engine despite the difficult global environment. For service providers there is a delicate balance between driving more cost reduction while planning for cost effective increase in capacity into the future, avoiding frequent network renewal. Mr. Morin will discuss the variances in global operator trends and provide an outlook on the innovations that are necessary for economic scaling of optical networks.

Biography: Nortel's Metro Ethernet Networks business is focused on leveraging the company's leadership in optical and carrier data to drive market share in super-fast Ethernet networks. These next-generation transport networks will be essential for supporting the explosion of network traffic fuelled by new consumer trends and business applications, including bandwidth-hungry applications such as video. Nortel is positioned as one of the top 3 solutions providers globally.

In his role as president, Morin has full accountability for P&L, R&D and product development as well as all aspects of running this business which encompasses Nortel's Optical and Carrier Ethernet portfolios that generate close to \$2B in revenues globally.

Prior to assuming this role, Morin held the position of Nortel's vice president and general manager, Optical Networks. In this position, he helped ensure Nortel's continued leadership and business momentum in Optical, which grew by approximately 24 percent in 2005 to US\$1.2 billion in revenues. To date, Nortel has deployed optical solutions in more than 1,000 enterprises and service providers in 65 countries.

During his 20 years at Nortel, Morin has held a number of leadership roles in manufacturing, marketing, sales and product management, both in North America and Europe.

Morin also serves as a Governor of the Jeune Chambre de Commerce de Montréal. He holds a Bachelor of Electrical Engineering degree from Université Laval in Quebec City and a Master of Business Administration (MBA) degree from McGill University in Montréal.



Getting the Network the World Needs

Lawrence Lessig

Professor, Stanford Law School, USA

[Lessig Video Part 1](#)

[Lessig Video Part 2](#)

[Lessig Video Part 3](#)

[Lessig Video Part 4](#)

[Lessig Video Part 5](#)

Abstract: In this talk, Professor Lessig will address the challenges facing the build-out of the next-generation network, one that will let innovation flourish.

Biography: One of America’s most original and influential public intellectuals, Lawrence Lessig is the foremost expert on intellectual property in the age of digital communication. He focuses on the social dimension of creativity: how creative work builds on the past and how society encourages or inhibits that building with laws and technologies. He is the founder of Stanford’s Center for Internet and Society and the authority on “cyberlaw”—the evolving law of the Internet. He has written several books, including *Free Culture: How Big Media Uses Technology and the Law to Lock Down Culture and Control Creativity* (April 2004). Lawrence Lessig is a professor of law at Stanford Law School.

A tireless advocate for the “innovation commons,” a free space where culture, ideas and expression can flourish, Lessig chairs the Creative Commons project at Stanford. He argued the landmark case *Eldred v. Ashcroft* challenging the 1998 Sonny Bono Copyright Term Extension Act before the United States Supreme Court. His most recent book, *Free Culture*, is a landmark manifesto about the freedom to create and the urgent need to protect the public domain of ideas, especially on the Internet, from control by big cultural monopolists. In this powerful wake-up call, Lessig shows how short-sighted interests blind to the long-term damage they’re inflicting are poisoning the ecosystem that fosters innovation.

In his two previous books, *Code* and *The Future of Ideas*, Lessig concentrates on the destruction of much of the original promise of the Internet. Blending knowledge, insight and eloquence, these books are profoundly important guides to the care and feeding of innovation, intellectual property, free speech and privacy. These books are not just for lawyers, but for anyone concerned with the survival of democratic values in the Information Age.

A seasoned lecturer, Lessig has appeared in forum after forum on the weighty issues that digital communication presents. Lessig was formerly a professor at Harvard Law School, where he earned the first endowed chair at the Berkman Center for Internet and Society. He currently holds several important board and public commission positions and was named one of *Scientific American's* Top 50 Visionaries. Lawrence Lessig is a unique force in the deliberations that will define the character of innovation and discourse in our future.



The Growth of Fiber Networks in India

Shri Kuldeep Goyal

Chairman and Managing Director, Bharat Sanchar Nigam Ltd., India

[PDF Presentation](#)

[Goyal Video Part 1](#)

[Goyal Video Part 2](#)

[Goyal Video Part 3](#)

[Goyal Video Part 4](#)

Abstract: At 550000 km of installed fiber, BSNL's network is the largest in the world and is growing at a rate of 50% per year. I will review BSNL's plans to provide FTTH throughout India and will also discuss anticipated broadband service offerings.

Biography: Shri Kuldeep Goyal took over as Chairman and Managing Director of BSNL on August 1, 2007. Shri Kuldeep Goyal joined the Indian Telecommunication Service of Govt. of India in 1972. He is an Engineering Graduate from IIT Roorkee.

Just prior to taking over as CMD at BSNL, Shri Goyal worked as Director (Planning and New Services) and was responsible for the planning and execution of strategy for expansion of BSNL's network.

With more than 35 years of service, Shri Goyal has vast experience in telecom sector viz. planning, installation, operation and maintenance of wirelines and wireless services, data services, computerization of various activities in telecom network and provision of value added services.

While working as chief General Manager, Maharashtra Telecom circle, he was in charge of operations, planning and expansion of telecom network of the largest circle of BSNL and contributed to rapid growth of telecom networks in Maharashtra and Goa. During his short tenure of ten months as Executive Director, MTNL Mumbai, he was able to double the connections in the GSM network of MTNL Mumbai and MTNL's market share was enhanced from 8.93% to 15.5%. During his tenure, broadband service was also started in January 2005 and 40,000 subscribers were enrolled during a short period of nine months.

Shri Goyal has worked in Yemen on a foreign project through Telecommunications Consultants India Ltd. He was also a Member of National Working Group of ITU-T Study Group 2 on operational aspect of service, provision and performance of telecom networks and participated in meeting of ITU-T Study Group 2 at Geneva.

Shri Goyal has delivered a number of talks on various topics relating to telecom in various forums like GSM Association, Institute of Engineers, Institute of Electrical and Telecommunications Engineers, CII, Door Darshan and A.I.R. Some of his articles - "Telecommunication Industry at a Glance", "Universal Access - An International Perspective" and "Trade in Telecommunications" have been published in *Telecommunications Journal*.

Service Provider Summit

Select Service Provider Summit PowerPoint presentations are available for download. Click on the titles below to open a pdf of the presentations.

Wednesday, March 25, 2009

OFC/NFOEC Exhibit Floor Theater, Exhibit Hall F

The Service Provider Summit is open to all Conference and Show-Only 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, 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 Organizers:

Christoph Pfistner, *Vice President, Product Marketing, NeoPhotonics, USA*

Karen Liu, *Vice President, Components and Video Technologies, Ovum., USA*

Schedule-at-a-Glance

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

- 8:15 a.m.–9:00 a.m. Continental Breakfast
- 9:00 a.m.–9:30 a.m. Keynote Presentation: Can the Internet Scale for the Coming Explosion of Media and Mission Critical Applications?
Robert Blumofe, *Senior Vice President, Networks and Operations, Akamai, USA*
- 9:45 a.m.–11:15 a.m. Panel I: Core Networks—Keeping Pace
Moderator: Karen Liu, *Vice President, Components and Video Technologies, Ovum, USA*
- 11:15 a.m.–11:45 a.m. Coffee Break
- 11:45 a.m.–1:15 p.m. Panel II: FTTH—Advancing on Many Fronts
Moderator: Chris Pfistner, *Vice President, Product Marketing, NeoPhotonics, USA*
- 1:15 p.m.–2:30 p.m. Lunch (on your own)
- 2:30 p.m.–5:00 p.m. Exhibit Time (on your own)

Keynote Presentation



[Can the Internet Scale for the Coming Explosion of Media and Mission Critical Applications?](#)

Robert Blumofe, *Vice President, Networks and Operations, Akamai, USA*

Robert Blumofe is the Senior Vice President of Networks and Operations at Akamai. Dr. Blumofe leads the Akamai team responsible for the global strategy, deployment, operation and security of Akamai's production and corporate infrastructure supporting all of the company's services. Dr. Blumofe joined Akamai in 1999 to lead the company's first performance team. Serving as one of Akamai's chief architects, Dr. Blumofe was instrumental in the early design and development of the Akamai Network, which now handles hundreds of billions of Internet requests daily. He has led all of Networks and Operations since 2004, and most recently held the post of Vice

President of Networks and Operations. Prior to Akamai, Dr. Blumofe was an Associate Professor of Computer Science at the University of Texas at Austin. He is widely published in the areas of algorithms and systems for highly distributed and parallel computing. He holds a Ph.D. in Computer Science from MIT and a Bachelor of Science degree from Brown University.

Panel I: Core Networks—Keeping Pace



Moderator: Karen Liu, *Vice President, Components and Video Technologies, Ovum, USA*

As data-rich applications increasingly permeate people's business and personal lives, the capacity of networks will need to increase. A key challenge is how to support the traffic demand in an economically sustainable way. For thirteen years, the cost per bit per km has been dropping faster than Moore's Law thanks to a series of technological improvements in DWDM transmission. But unlike Moore's Law, there hasn't been a simple rule to point to where the next step function will come from. Recent progress has been more incremental. Is this just a hiccup, a delayed impact of reduced investment or are we reaching the end of the DWDM run?

Come hear how service providers are responding to the need to support ever increasing traffic in the core. Where will greater return be found, CapEx or OpEx? What technology directions promise continued or even greater cost per bit per km improvement? And is it all about lower cost or are there ways to extract more value as well?

Speakers



[Bandwidth Flexibility and High Availability... and ROIC](#)

Stuart Elby, *Vice President, Network Architecture, Verizon, USA*

Dr. Stuart Elby, Vice President of Network Architecture, is responsible for Verizon's network vision and evolution towards this target. Stuart is also responsible for the design and specification of Verizon's metro, regional, and long haul optical transport networks, VoIP and IMS networks, and emerging converged services platforms. Additionally, he is responsible for collaborative R&D activities with universities and government, and the Verizon Interoperability Forum. He has previously held several positions in Verizon including network platform testing, and technical support of product development and sales. Prior to joining the phone company in 1993, Dr. Elby was a Research Associate at the National Science Foundation's Center for Telecommunications Research at Columbia University. There he was responsible for leading research in optoelectronic devices, all-optical networks and developing early ATM/WDM platforms. He was co-director of a multi-university research program on

all-optical packet switched networking, and collaborated with Teachers' College in the development and deployment of a multi-media educational network for primary and secondary schools. In 1985, Dr. Elby was the Manager of Technology in a laser surgery start-up where he was responsible for FDA clinical trials, laser surgery product development, and brought the first ever disposal plastic fiber-optic delivery system to the medical market. In 1982, he was a Staff Engineer at StorageTek, where he contributed to the development of the first commercial optical disk system. Dr. Elby received a B.S. degree in optical engineering from the University of Rochester, NY, in 1982 and received a M.S.E.E. and Ph.D. from Columbia University in 1989 and 1994, respectively.



[Packaged Technology and Services to Retain Revenue and Margins](#)

William Jarr, *Consultant, Diverse Future Consulting, USA*

Networks have opportunities to avoid the price and margin pressures with packaged services. Raw network capacity continues to be commoditized. End-to-end packaged solutions provide a way to maintain revenues and margins, while improving customer loyalty. Past examples and future opportunities will be presented. The attitude and resource commitment will be discussed as well.

Bill has had a career encompassing both network and local television production and operations and domestic and international broadcast. Roles included producer/director and production manager at PBS, ABC and CBS affiliated stations and a 2-year stint in Riyadh, Saudi Arabia running the TV and A/V services at the King Faisal Specialist Hospital and Research Centre. During 14 years at the NBC Television Network in New York, he worked as a Broadcast Manager in network operations, an Operations Producer for NBC Sports, and Director of Operations for NBC News. Operations management included all major events, including the NFL pregame show, Super Bowls, World Series, National Conventions, NCAA tournaments and French Open Tennis. He was also instrumental in the start-up of CNBC and the NBC News Channel affiliate news service. Accomplishments include designing the distribution for the News Channel, building an international satellite teleport in Charlotte, North Carolina, and negotiating major international satellite contracts for NBC. After leaving NBC, Bill worked for major telecommunications and broadcast service providers in Business Development and Sales capacities. This included BT Broadcast services, PVI virtual imaging company, PanAmSat international satellite company, and Vyvx and Level 3 international telecommunications company. He is a member of the National Academy of Television Arts and Sciences Technical Emmy Committee and is a participant in annual judging for Sports Emmy's. Bill has a B.A. degree from the University of Washington with majors in communications and economics. With his years in the broadcasting industry he has maintained close ties with executives at all major

networks, sports leagues and providers of equipment and services to broadcasters.

[Merging A Global Network with An India National Core](#)

Matthew Ma, *Vice President, Transport and Network Engineering, Tata Communications Ltd., USA*

Since 2005 Tata Communications Limited (TCL), formerly VSNL has been expanding aggressively its international footprint. After the acquisition of TGN and Teleglobe, TCL owns one of the largest India domestic networks with 40,000 km optical fiber route and a major global infrastructure with 206,000 km fiber route. Network integration became one of the key challenges. Our customers demand end-to-end service assurance, high service quality and fast service delivery. Those service level requirements become the fundamental objectives for architecting our network integration. The integration is based on the analysis of characterization of each regional network, the connectivity around the globe and different layers of the common transport network.

Matthew Ma is the Vice President of Transport Network Engineering at Tata Communications Limited. He is responsible for planning common transport network globally and in India. Prior to joining TCL, Matthew headed the network engineering of TGN at Tyco International. Matthew started as a researcher specializing in subsea DWDM in Bell Labs in 1995. He has a Ph. D in electrical engineering from Virginia Tech and has many papers and patents.

Panel II: FTTH—Advancing on Many Fronts



Moderator: Chris Pfistner, *Vice President, Product Marketing, NeoPhotonics, USA*

In FTTH Japan is still leading the charge with more than 10M homes connected and a national goal to double that number by the end of 2010. The runner-up is still North America with Verizon's FiOS program accounting for the lion's share. However, other regions of the world, in particular in Europe and East Asia, have started major programs as well. In addition, the FTTH concept is starting to spread outside of the traditional telecom networks into the cable operators around the world. Of course, no FTTH panel would be complete without some discussion of killer applications, the role and challenges of video delivery, and the exploding market of web applications.

Join us in this exciting session during which executives from major service providers will present their views on the opportunities and challenges for FTTx around the world. The individual presentations will be followed by a panel discussion and open Q&A session.

Speakers



[Success Can Be Found In Many Places – Why The MDU Market Can Be A Great Opportunity](#)

Bryan J. Rader, *CEO/Managing Principal, Bandwidth Consulting LLC, USA*

This brief presentation will outline the dynamics of this market segment, including customer preferences/behaviors/profiles, and the opportunities for FTTH deployment in this sector.

Bryan J. Rader is the CEO and Managing Principal of Bandwidth Consulting LLC, a leading consultancy for multi-family technologies. His firm's clients include independent and franchise cable operators targeting this segment and vendors who support applications targeting the multi-dwelling market. Prior to founding his consulting firm in 2007, Mr. Rader founded MediaWorks, the largest private cable company focused on the MDU market in the southeastern U.S. This company was widely recognized as one of the top cable operators in the U.S. during its tenure (1996–2006), and was eventually sold to DirecPath, a newly formed company with Hicks Holdings and DirecTV as its primary partners. Prior to MediaWorks, Mr. Rader worked for two different real estate organizations, including AIMCO, a national publicly-traded real estate investment trust (1994–1996) and HOMECORP, a southeast regional property owner (1991–1994). His career began in marketing research/consulting for national consumer brands and Fortune 500 companies. He writes a monthly column for Broadband Properties magazine called “From The Operator’s Point of View,” and has been the President of the Independent Multi-Family Communications Council (IMCC), the leading trade organization for the industry, based in Washington D.C. He is also a frequent speaker to the multi-family technology industry and has spoken at numerous national events including NMHC Technology, SkyForum, Broadband Summit and ISPCon. Mr. Rader has earned numerous awards including the Cornerstone Award for “Industry Excellence”, National Cable Operator of the Year, and 25 Most Influential People in Real Estate & Technology. Mr. Rader is also active in a number of charity events including the support of autism awareness and research. He earned his degree at the University of Missouri–Columbia in 1988, and resides in Chesterfield, Missouri, with his wife Laura of 18 years and his two children.



[Incredible Economics in FTTH](#)

R. R. Yadava, *Deputy General Manager (Optical Fibre), Bharat Sanchar Nigam Ltd. (BSNL), India*

This presentation will analyze the services offered by FTTH equipment. The power consumption by the various pieces of FTTH equipment is far less than that consumed by conventional equipment (switches and transmission). Similarly, the operation and

maintenance capex are also much less compared to those associated with conventional equipment. In addition, the benefits to the customer using FTTH equipment are far greater. We can call it “real all-in-one-wired-line telecommunication equipment.”

As Deputy General Manager of the Optical Fibre group at BSNL, a position he has held for the past year and a half, R. R. Yadava is involved in the preparation of technical specifications for GPON, GEAPON, other FTTH (PON) equipment and its core networks (VPLS routers/LAN switches). He is involved in planning, tendering, evaluation, guideline preparation and its implementation through different circles of BSNL; as well as OFC tendering and procurement for FTTC, FTTH and long distance. When in charge of Network Operations and Control for the Indian Satellite System Operation, he conducted in-orbit tests for five satellites and helped to resolve unique wide band noise interferences in the satellite system. Mr. Yadava used this experience to author a widely published paper offering guidance to other satellite service providers on how to avoid wide band noise interference in satellite communications. Mr. Yadava received a bachelor’s degree in engineering in 1995.



[Internet Traffic Growth and Implications for Access Technologies](#)

Andrew Odlyzko, *Professor, School of Mathematics and Digital Technology Ctr., Univ. of Minnesota, USA*

Current growth rates of Internet traffic can be maintained without major increases in capital investment and without major technological changes. Optical transport will certainly remain key to telecommunications, but how close to the endpoints it will be pushed will depend largely on future trends in traffic growth.

Andrew Odlyzko has had extensive experience in research and management at Bell Labs, AT&T Labs and the University of Minnesota. He has worked on computational complexity, cryptography, number theory, combinatorics, coding theory, analysis, probability theory, ecommerce and economics of data networks. He may be known best for an early debunking of the myth of Internet traffic doubling every three months and for demonstrating that connectivity has traditionally mattered much more for society than content.

2009 Short Courses

Category A. Fibers and Optical Propagation Effects

SC186 Hands-on Specialty Fiber Splicing, *Clyde J. Troutman; 3SAE Technologies, USA*

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

SC288 Fundamentals of Polarization, PMD and PDL in Lightwave Systems, *Robert Jopson; Bell Labs, Alcatel-Lucent, USA*

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

SC123 Erbium-Doped Fiber Amplifiers and Raman Fiber Amplifiers, *John Zyskind; JDSU, USA*

SC290 High Power Fiber Lasers and Amplifiers, *Johan Nilsson; Univ. of Southampton, UK*

Cancelled SC293 Introduction to Fiber Sensors, *Michel J. F. Digonnet; Stanford Univ., USA*

Cancelled SC312 Parametric Optical Processing and Systems, *Stojan Radic; Univ. of California at San Diego, USA*

Category C. Optical Devices for Switching, Filtering and Signal Compensation

SC265 Passive Optical Components and Filtering Technologies, *Bruce Nyman¹, Christi Madsen²; ¹Princeton Lightwave, USA, ²Texas A&M Univ., USA*

Category D. Optoelectronic Devices

SC125 Tunable Lasers, *Jens Buus; Gayton Photonics Ltd., UK*

SC175 Packaging of Optoelectronic, Photonic and MEMS Components, *Paul Haugsjaa; Polycision Inc., USA*

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

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

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

Cancelled SC319 Quantum Dot Laser Diodes, *Peter Blood; Cardiff Univ., UK. Register for SC319 at CLEO/IQEC 2009.*

NEW! SC325 Photonic Integrated Circuits, *Chris Doerr; Alcatel-Lucent, USA*

Category E. Digital Transmission Systems

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

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

SC203 40 Gb/s Transmission Systems, Design and Design Trade-offs, *Martin Birk¹, Benny Mikkelsen²; ¹AT&T Labs, Res., USA, ²Mintera, USA*

SC210 Hands-on Polarization-Related Measurements Workshop, *Danny Peterson¹, Tasshi Dennis², Ivan T. Lima³, Paul Williams²; ¹Verizon Business, USA, ²NIST, USA, ³North Dakota State Univ., USA*

SC259 Electronic and Optical Impairment Mitigation, *Chris Fludger¹, Seb Savory²; ¹CoreOptics GmbH, Germany, ²Univ. College London, UK*

SC289 Basics of Optical Communication Systems and WDM, *Gerd Keiser; PhotonicsComm Solutions Inc., USA*

SC314 Hands-on Fiber Characterization for the Engineering of Long Haul and Metro Deployments, *Danny Peterson¹, Christine Tremblay²; ¹Verizon Business, USA, ²École de Technologie Supérieure, Univ. du Québec, Canada*

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

Category F. Transmission Subsystems and Network Elements

SC101A Hands-on Workshop on Fiber Optic Measurements and Component Testing, *Lorenz Cartellieri¹, Frank Buchanan², John Kim¹, Caroline Connolly³, Richard Buerli³, Roger Rutz⁴, Anthony Lowe⁴; ¹Experior Photonics, USA, ²Agilent Technologies, Canada, ³OptoTest, USA, ⁴EXFO America Inc., USA*

SC103 Dynamic ROADMs, Switches and Integrated Technologies and Techniques for Dynamically Reconfigurable and Packet Switched Optical Networks, *Daniel Blumenthal; Univ. of California at Santa Barbara, USA*

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

SC141 Combating and Monitoring Data-Degrading Effects in Non-Static WDM Systems, *Alan Willner; Univ. of Southern California, USA*

SC239 Short-Reach Optical Interconnects, *Brian E. Lemoff; West Virginia High-Technology Consortium Foundation, USA*

Category G. Optical Processing and Analog Subsystems

SC160 Microwave Photonics, *Keith Williams; NRL, USA*

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

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

SC266 Quantum Cryptography and Quantum Information, *Richard Hughes¹, Thomas Chapuran²; ¹Los Alamos Natl. Lab, USA, ²Telcordia, USA*

SC315 Recent Advances in Polymer Waveguides, *Paul Ashley; US Army Aviation and Missile Command, Redstone Arsenal, USA*

Category H. Core Networks

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*

Category I. Access Networks

SC114 Passive Optical Networks (PONs), *Paul Shumate; IEEE Lasers & Electro-Optics Society, USA*

SC262 Alternative Broadband Access: Wired and Wireless Technologies for the Last Mile, *Paul Henry; AT&T Labs, Res., USA*

Category J. Network Experiments and Non-Telecom Applications

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

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

NFOEC 1: Optical Networks and Services

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

SC185 Hands-on Polishing, Inspection and Testing of Connectors, *Jason Sloan¹, Steve Baldo², Neal Wagman³; ¹Light Brigade Inc., USA, ²Seikoh Giken Co. Ltd., USA, ³Norland Products, USA*

Cancelled SC268 Hands-on Workshop on Outside Plant Splicing, Testing and Troubleshooting for FTTx Networks, *Larry Johnson; Light Brigade Inc., USA*

NEW! SC328 An Introduction to OTN Networking and Its Role in the Convergence of IP and SONET/SDH Networks, *William A. Thompson; Alcatel-Lucent, USA*

NFOEC 2: Network Technologies

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

SC264 Introduction to Ethernet Technologies, *Jeffrey L. Cox; BT, USA*

Additional Short Course Category: Industry Best Practices

SC133 Reliability Methodologies for Fiber-Optic Components, *David Maack; Reliability Engineer, USA*

SC294 Qualification Programs for Fiber-Optic Components, *David Maack; Reliability*

Engineer, USA

NEW! SC326 Patent Fundamentals, Mohammed N. Islam; *Optics and Photonics and Solid State Electronics Lab, Dept. of Electrical Engineering and Computer Science, Univ. of Michigan, USA*

2009 Tutorial Speakers

Category A. Fibers and Optical Propagation Effects

OMS1, High Speed Transmission over Multimode Fiber, Ronald Freund; *Fraunhofer Heinrich-Hertz-Inst., Germany.*

OTuC1, History and Future of Photonic Crystal Fibers, Philip Russell; *Max Planck Res. Group for Optics, Information and Photonics, Univ. of Erlangen, Germany.*

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

OTuP1, Holographic Bragg Reflectors: Designs and Applications, Thomas Mossberg, C. Greiner, D. Iazikov; *LightSmyth Technologies, Inc., USA.*

OTuU1, Fiber Optics, from Sensing to Non Invasive High Resolution Medical Imaging, Adrian Podoleanu; *Univ. of Kent, UK.*

Category C. Optical Devices for Switching, Filtering and Signal Compensation

OWC1, Photonic Band Gap Materials: Light Trapping Crystals, Sajeev John; *Univ. of Toronto, Canada.*

OTuB5, Complex Component Characterization Based on Elementary Matrices, Douglas Baney; *Agilent Labs, USA.*

Category D. Optoelectronic Devices

OWQ4, High-Power Semiconductor Optical Amplifier, Ken Morito; *Fujitsu Labs Ltd., Japan.*

OWX1, Single Photon Avalanche Photodiodes, Joe Campbell; *Dept. of Electrical and Computer Engineering, Univ. of Virginia, USA.*

Category E. Digital Transmission Systems

OTuL1, Capacity Limits of Fiber-Optic Communication Systems, René-Jean Essiambre, Gerard Foschini, Peter Winzer, Gerhard Kramer; *Bell Labs, Alcatel-Lucent, USA.*

Category F. Transmission Subsystems and Network Elements

OMM4, Modulation Formats Which Approach the Shannon Limit, *Andrew Ellis; Tyndall Natl. Inst., Univ. College Cork, Ireland.*

OTuG5, Principles of Digital Coherent Receivers for Optical Communications, *Joseph Kahn, Ezra Ip; Stanford Univ., USA.*

Category G. Optical Processing and Analog Subsystems

OMI1, Photonic Analog-to-Digital Converters, *George C. Valley; The Aerospace Corp., USA.*

OWP5, Fiber-Wireless Networks and Microwave Photonics Subsystem Technologies, *Christina Lim¹, Thas A. Nirmalathas^{1,2}, Masud Bakaul², Prasanna Gamage¹, Ka-Lun Lee¹, Yizhuo Yang¹, Dalma Novak^{1,3}, Rod Waterhouse^{1,3}; ¹ARC Special Res. Ctr. for Ultra-Broadband Information Networks (CUBIN), Univ. of Melbourne, Australia, ²Natl. ICT Australia, Victoria Res. Lab (NICTA), Dept. of Electrical and Electronic Engineering, Univ. of Melbourne, Australia, ³Pharad, LLC, USA.*

Category H. Core Networks

OWY5, Multilayer Network Resilience, *Andrzej Jajszczyk; AGH Univ. of Science and Technology, Poland.*

Category I. Access Networks

OWR5, 40/100GbE Technologies and Related Activities of IEEE Standardization, *Osamu Ishida; NTT, Japan.*

Category J. Network Experiments and Non-Telecom Applications

OTuI1, Sun's Project Blackbox: A Modular Approach to High Density Datacenters, *Jud Cooley; Sun Microsystems, USA.*

OWK1, Ultra High Definition Media over Optical Networks (CINEGRID), *Cees T. A. de Laat¹, Laurin Herr²; ¹Univ. of Amsterdam, Netherlands, ²Pacific Interface, USA.*

NFOEC 1: Optical Networks and Services

NMD1, ROADM Network Design Issues, *Sorin Tibuleac; ADVA Optical Networking Inc., USA.*

NThC4, 10G-EPON Standardization and Its Development Status, *Keiji Tanaka; KDDI R&D Labs, Japan.*

NFOEC 2: Network Technologies

NThB4, **The Impact and Mitigation of Non-Linear Effects in Coherent Optical Transmission**, *Gabriel Charlet; Bell Labs, Alcatel-Lucent, France.*

2009 Workshops and Panels

Select workshops below are now available to download in PDF format.

OFC/NFOEC workshops provide opportunities to discuss and debate the latest technologies. Many workshops will be highly interactive, among 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, contributed presentations (5 to 10 minutes) from people involved in the field followed by a panel discussion driven by questions from the audience.

The 2009 conference features workshops and panel discussions in current areas of interest in OFC and NFOEC categories alike. All OFC/NFOEC attendees are encouraged to participate. Workshops will be held on Sunday, March 22, 4:30 p.m.–7:30 p.m., and Monday, March 23, 8:00 a.m.–11:00 a.m. The workshops provide an interactive learning environment and are open to all conference registrants.

NEW! Rump Session

Tuesday, March 24, 7:30 p.m.–9:30 p.m.

Participate in this interactive, audience discussion on the challenges of the continuing demand for more capacity.

OFC/NFOEC Workshops

Sunday, March 22, 4:30 p.m.–7:30 p.m.

Category C. Optical Devices for Switching, Filtering and Signal Compensation

OSuE, Can Integrated Photonics Enable Optical Interconnection Networks in Advanced Computing and Network Systems? *Yurii Vlasov¹, Keren Bergman², Ashok Krishnamoorthy³; ¹IBM, TJ Watson Res. Ctr., USA, ²Columbia Univ., USA, ³Sun Microsystems Inc., USA.* With computer systems performance soon to approach Exaflop/s a dramatic increase in communications bandwidth for shuttling ExaBytes/s of data across the system, between the racks, chips and cores is becoming a major challenge. Optical interconnects already started to penetrate the computing communications infrastructure and are destined to make further inroads

at all levels. Within just a few years it is expected that the number of optical links in a single computer system will become comparable with the total number of optical telecommunications links installed all over the world. The workshop will explore how recent advances in nanoscale silicon photonic technologies might be exploited for developing optical interconnection networks that address the critical bandwidth and power challenges presented across several levels of the computing system interconnect.

Questions:

(Systems Perspective)

- What are the major interconnect-centric challenges to future Exascale computer systems?
- What is your vision for how/when optical interconnects may be employed at various levels (system, racks, boards, on-chip)? what are the corresponding relevant benchmarks (Tbp/s, mW/Gbps, \$/Gbps)?
- Are there any architectural or system/applications performance benefits to using optics? what critical challenges must be addressed? how would optical technologies be used in complement to electronics?

(Device Technology Perspective)

- What are the major device integration, packaging, manufacturing, etc. challenges to inserting nanoscale silicon photonic based optical interconnects?
- What is your vision on the optimal level of integration (on-board, on-multi-chip-carrier, on-chip, CMOS integrated)?
- What are the critical engineering constraints and trade-offs of bringing optics to a chip-scale level (temperature, loss, footprint, power, integration level,...)? what are some of the fundamental limitations of nanophotonic components (modulators, receivers, switches, WDM etc.)?

Schedule: 4:30 p.m.-7:30 p.m.

4:30 – 4:40 – Foreword (Yurii Vlasov)

4:40 – 5:00 – Clint Schow (IBM)

5:00 – 5:20 – Moray McLaren (HP)

5:20 – 5:40 – Ron Ho (Sun Microsystems)

5:40 – 6:00 – Vladimir Stojanovic (MIT)

6:00 – 6:20 – Dries van Thourhout (Gent University)

6:20 – 6:40 – David A. B. Miller (Stanford University)

6:40 – 7:10 – Panel discussion

7:10 – 7:20 – Wrap-up (Keren Bergman)

Category E. Digital Transmission Systems

OSuA, **Electronic Signal Processing and the Design of Optical Transport Systems**, *Doug McGhan¹, Peter Winzer²; ¹Nortel, Canada, ²Bell Labs, Alcatel-Lucent, USA*. This workshop will address system-level implications of digital signal processing (DSP) in high bit rate (>40 Gb/s) transponders. Carrier requirements and expectations will be discussed, such as the increasing need for spectral efficiency at sufficient transparent reach and at a reduced cost per bit, line system design and management complexity, implications of fiber quality on route planning,

provisioning, performance monitoring, and expectations on a system's error and outage performance. These carrier views will be contrasted with system vendors' perspectives, including realistic transponder hardware implications (power consumption, footprint, scalability), implications of fiber nonlinearity, aspects of upgradability, and the co-existence of wavelengths at different bit rates. Furthermore, the interface between vendors and carriers regarding performance prediction and verification for systems relying heavily on DSP will be discussed. [Download Workshop Agenda.](#)

Category G. Optical Processing and Analog Subsystems

OSuC, Present and Future Applications of Analogue Microwave Photonics, *Ernesto Ciaramella¹, Idelfonso Tafur-Monroy², Thomas Clark³; ¹Scuola Superiore Sant'Anna, Italy, ²Denmark Technical Univ., Denmark, ³JHU Applied Physics Lab, USA.* Photonics may be even more suited for analog than for digital signal applications. Today, microwave photonics techniques are currently used in radio-over-fibre signal transmission and other commercial applications, but recent advances are widening the scope of application to new areas. The speakers will introduce present and emerging opportunities for analog photonics, among which microwave filters, arbitrary optical waveform control, THz radiation and UWB pulse generation. A panel discussion will contrast different views from company, academy and funding bodies, to identify the most promising ones for commercial applications as well as the challenges and research opportunities to be pursued to make it reality.

A. Seeds, “Photonic synthesis of microwave signals” (4:30-4:50)

J. Capmany, “Photonics for microwave filtering and applications”; (4:50-5:10)

D. Turchinovich , “Photonics for Terahertz Communication Technology” (5:10-5:30)

S. J. Ben Yoo, “High-Fidelity Optical Arbitrary Waveform Generation and Detection” (5:30-5:50)

Break (5:50-6:00)

M. Haney, “Analog photonic initiatives in DARPA” (6:00-6:20)

K.-I. Kitayama, "All-optical ultrafast analog-to-digital conversion and its applications"(6:20-6:40)

A. Weiner, Photonics for UWB Systems”, (6:40-7:00)

All speakers: panel discussion (7:00-7:30)

Category H. Core Networks

OSuB, Energy Footprint of ICT: Forecast and Network Solutions, *Patrick Leisching¹, Mario Pickavet²; ¹Nokia-Siemens Networks, Germany, ²Ghent Univ., Belgium.* ICT provides many energy-saving solutions, but is also responsible for a considerable and quickly increasing energy footprint on its own. Recent surveys estimate that the complete life-cycle of ICT equipment today is responsible for about 4% of the worldwide primary energy consumption. This percentage is expected to double within 10-15 years, if current ICT energy trends are not drastically deviated.

This workshop will provide insight in the main ICT energy consumption factors and their expected future evolution in transport networks, highlighting access, metro and core networks and server farms. Possible research directions and future network paradigms will be outlined, motivated and elaborated by expert speakers from industry and academia. Special attention will be paid to the role of optics. A closing panel discussion will identify key research challenges and action points.

Category I. Access Networks

OSuD, **Migration Scenarios toward Future Access Networks I**, *Leonid Kazovsky¹, Kent G. McCammon²; ¹Stanford Univ., USA, ²Access Technologies, AT&T Labs, USA.*

OMD, **Migration Scenarios toward Future Access Networks II**, *Leonid Kazovsky¹, Kent G. McCammon²; ¹Stanford Univ., USA, ²Access Technologies, AT&T Labs, USA.* Future broadband access networks are likely to be quite different from those we're familiar with today. Most probably, they will consist of a fiber backbone and wireless "end links" to individual users. Thus, realistic, cost-effective migration scenarios for convergence of optical and wireless networks will be needed. The fiber backbone is likely to be highly flexible, dynamic, adaptive to traffic, and based on both TDM and WDM technologies. So, realistic migration scenarios from TDM toward hybrid TDM/WDM or even "pure" WDM will be needed. The wireless "end links" are likely to be based on a derivative of Wi-Fi, Wi-Max, or 3G cellular networks. These networks can evolve through several possible avenues including carrier-based PONs or hybrid fiber/coax networks; cell telephone networks; or their combinations. This evolution will require a significant R&D effort and major intellectual and financial investment, perhaps more significant than the investment that went into wide-area networks. It will also require new components, architectures and algorithms. This workshop will examine possible structure of future broadband access networks, likely evolution scenarios, and R&D issues that will need to be addressed to make the new networks a reality. [Download Workshop I Agenda](#). [Download Workshop II Agenda](#).

For Presentations from Sunday, March 22 [click here](#).

Presentations from Monday, March 23 follow:

[Introduction](#)

[PON Deployment in NTT and Possible Evolution Scenarios](#), Junichi Kani, *NTT Access Network Service Systems Labs, Japan*

[KT FTTH Network Evolution](#), Hosung Yoon, *Korea Telecom, South Korea*

[Preparing the Future of Optical Access at France Telecom](#), Fabrice Bourgart, *France Telecom/Orange Labs, France*

NFOEC 1: Optical Networks and Services

NSuA, **Optical and Packet Control Planes: Convergence or Divergence?** *Lyndon Y. Ong; Ciena Corp., USA.* Two major developments are impacting carrier transport networks: the first is the emergence of the optical control plane, applied initially to TDM and now to all-optical networks. The second is the evolution of packet control planes, especially Ethernet, towards control by routing protocols (PLSB) and towards connection-oriented services (PBB-TE and MPLS-TP). How do these developments compare and what are the key issues? For example,

all-optical networks may require greater complexity and overloading of the control plane – is distributed or centralized path computation the right model? Packet networks are expected to offer multipoint as well as point-to-point services – is the functionality provided by control plane protocols a good fit? Finally, what developments have been made in bodies such as IETF, OIF and ITU-T and in the research community to support interaction between optical and packet layers through a multi-layer control plane? This workshop will explore the current state of work on optical and packet control planes, and the potential for multi-layer convergence.

Verizon Control Plane Market Drivers, Technology Trial Results and Future Plans, Mike Freiburger, Verizon Optical Transport

Recent Work on Wavelength Switched Optical Network Control Plane, Greg Bernstein, Grotto Networking, editor IETF WSON Framework

Directions for Control of Packet Transport - MPLS-TP and PBB-TE, Himanshu Shah, Ciena Transport R&D

Control of Tomorrow's Optical Networks, Jim Jones, Alcatel-Lucent Optical Networking, VP of Marketing of OIF

GMPLS Developments for Multi-layer Networks, Kohei Shiimoto, NTT Laboratories

Simple Unified Control for Packet and Circuit Networks, Saurav Das, Stanford University
OpenFlow program

Monday, March 23, 8:00 a.m.–11:00 a.m.

Category A. Fibers and Optical Propagation Effects

OME, **Fibers for FTTX**, *Xin Chen¹, Tomoharu Hasegawa²; ¹Corning Inc., USA, ²Asahi Glass Co., Japan*. FTTX has attracted significant attention in the past few years. This workshop will explore the applications of novel fibers in the FTTX area with emphasis on the fibers that are used to connected to the end user, such as home and within the home. Specific coverage includes,

- Different designs of bending insensitive fibers (BIFs) and polymer optical fibers (POFs).
- Connectivity and System Aspects.
- Perspective from Service Providers.

Leading researchers, fiber manufacturers and service providers around the world are invited to participate in the workshop.

Speakers:

Pierre Sillard, *Draka Communications*

Olaf Ziemann, *Georg-simon-Ohm-Fachhochschule Nurnberg*

David Peckham, *OFS*

Ming-Jun Li, *Corning Incorporated*

John Lambkin, *Firecomms*
Daiichirou Tanaka, *AFL telecommunications, Japan*

Perspectives from Service Providers

Glenn Wellbrock, *Verizon USA*
Nikolaus Gischen, *Deutsche Telekom*
Kazuhide Nakajima, *NTT, Japan*
Park Hyung Jin, *KT, Korea*

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

OMF, **Size Matters--Breaking the Limits of High-Power Fiber Lasers**, *Johan Nilsson¹, Siddharth Ramachandran²; ¹Univ. of Southampton, UK, ²OFS Labs, USA*. One of the hottest areas of growth in photonics outside of telecom is fiber lasers. This is fueled by diverse applications ranging from the materials processing and defense industries, to biomedical tools. Single-mode Yb-doped fiber lasers are now approaching 10 kW of output power, but recent estimates suggest that we may be running into fundamental scalability limits. This workshop will address this issue, and in particular, explore and debate the path-breaking technologies that fuel the recent dramatic advances in fiber lasers. Specific topics to be addressed include, but are not limited to:

- Why fiber lasers, in the first place? Wavelengths, pulsewidths, linewidths, etc.
- Core area scaling.
- Influence of materials, dopant concentrations, photodarkening, etc.
- Amplifier architectures and coherent combination techniques that enable power scaling.

Robust debate on these topics is anticipated, and potential participants are encouraged to submit ideas for presentation (5-10 min. slots). Such suggestions should be emailed to Johan Nilsson (jn@orc.soton.ac.uk) or Siddharth Ramachandran (sidr@ieee.org) by February 10, 2009.

(1) Introduction and Overview – setting the stage

- (1A) Don Seeley, Deputy Director, Joint Technology Office, Albuquerque, NM
[“HEL-JTO Electric Laser Initiatives”](#)
- (1B) Jay Dawson, Lawrence Livermore National Labs
[“Scaling Limits of High Average Power Fiber Lasers”](#)
- (1C) David Richardson, Optoelectronics Research Centre, Southampton, UK
[“Power Scaling in Pulsed Fiber Laser Systems”](#)

(2) Strategies for Scaling Power – Physical effects & Constraints (08:50 – 09:43 AM)

(2A) Mode size scaling

- (2Ai) Liang Dong, IMRA America, Inc.
[“Recent progress of leakage channel fibers”](#)

- (2Aii) Cesar Jauregui, Frederick-Schiller University Jena
["Rod-type fibers for active core area scaling"](#)
- (2Aiii) Almantas Galvanauskas, University of Michigan,
["Chirally coupled core fibers"](#)
- (2Aiv) Siddharth Ramachandran, Technical University of Denmark
["Scaling area by scaling modes"](#)

(2B) Influence of the material

- (2Bi) Kent Mattson, Crystal Fiber, Denmark
["Photo darkening of high-power fiber lasers"](#)
- (2Bii) Nasser Peyghambarian, University of Arizona
["Multi-component glasses for high power fiber lasers"](#)
- (2Biii) Volker Reichel, IPHT, Jena
["Influence of Al-P codoping on the photodarkening in laseractive fibers"](#)

(3) Strategies for Scaling Power – Laser Designs & Architectures

- (3A) Joshua Rothenberg, North Grumman Space Technology,
["Limits of Power Scaling by Fiber Laser Amplifier Combination"](#)
- (3B) Mike O'Connor, IPG Photonics
"Power Scaling of Broadband and Narrow-line Fiber Lasers"
- (3C) Andrei Starodoumov, Coherent Inc.
["Fiber parameter comparison for pulsed operation and frequency conversion"](#)

Category D. Optoelectronic Devices

OMA, **100 Gb/s for \$100**, Bryan S. Robinson¹, Clint Schow²; ¹MIT Lincoln Lab, USA, ²IBM T.J. Watson Res. Ctr., USA. Performance gains in computer systems are increasingly achieved through interconnecting large numbers of parallel processor nodes. The resulting demands on communication bandwidth are challenging, with the computer backplane or the telecom terminal backplane looming as one of the primary bottlenecks to information transfer. Cost analysis places the break-even point for a compelling business case at \$1 per Gbit/s. This workshop will cover several distinct approaches that address the backplane problem by displacing conventional copper with optical interconnects to meet future inter- and intra-rack bandwidth demands. A panel discussion will contrast the proposed approaches to identify the device technologies with the most promise to enable massive amounts of short-reach interconnect bandwidth at low-cost, with low-power consumption, a high area density, and potential for future scalability.

Category F. Transmission Subsystems and Network Elements

OMB, Single-Carrier Versus Multiple-Carrier Modulation Formats for WDM Systems, *Henning Bülow¹, Sander Jansen²; ¹Alcatel-Lucent, Germany, ²Nokia Siemens Networks GmbH & Co. KG, Germany.* New modulation schemes are being proposed to further mine the transmission bandwidth enabled by optical fiber and increased spectral efficiency. Two broad categories are emerging: single carrier and multiple carrier formats. Currently discussed approaches range from multi-level phase or amplitude modulation to optical OFDM, respectively. This workshop should explore pros and cons of the two approaches, including cost and realization aspects, performance over installed base, operational aspects, network availability, and ultimate spectral efficiency.

8:00 a.m.– 8:14 a.m. Introduction of the Workshop and an Overview on 100GbE Approaches

8:14 a.m.– 8:32 a.m. The "Five Ws" of 100G, *Jim King, AT&T, USA.* This talk will describe a carrier's view of the emerging 100G market, providing answers to the standard "Five W" questions (Who, What, Where, When, and Why) for this technology. The answers will be drawn from parallels learned from AT&T's leadership in 40G development / deployment.

8:32 a.m.– 8:50 a.m. The Strength of One, *Kim Roberts, Nortel, Canada.* One carrier, modulated at the highest baud rate where a CMOS A/D can provide Nyquist sampling, will produce the best cost/performance in spectrally constrained single mode applications. The Optical-OFDM class of processing is better applied to multimode fiber. At the other extreme, myriad parallel incoherent optical carriers per signal are more useful in unamplified fibers where spectral efficiency does not dominate system costs.

8:50 a.m.– 9:08 a.m. No-Guard-Interval Coherent Optical OFDM for High Speed Optical Transport Networks, *Akihide Sano and Yutaka Miyamoto, NTT, Japan.* No-guard-interval coherent optical OFDM transmission scheme is attractive because of its compact signal spectra and high speed operation. We review its system configuration and transmission performances.

9:08 a.m.– 9:28 a.m. Break

9:28 a.m.– 9:46 a.m. O-OFDM Systems, *Fred Buchali, Bell Labs, Alcatel-Lucent, Germany.* OFDM was recently introduced to fiber optical communication and fundamentals and several advantageous characteristics will be demonstrated. Especially the influence of

signals peak to average power ratio on system performance will be discussed in detail leading to a high robustness against fiber nonlinearities in non dispersion managed fiber links.

9:46 a.m.– 10:04 a.m. **Equalizer Complexity in Single and Multi-Carrier Coherent Optical Communications System**, *Bernhard Spinnler, Nokia Siemens Networks, Germany*. Even though high speed electronics has made tremendous progress in terms of available processing power, the speed and implementable amount of digital logic still puts an upper limit on the complexity of digital signal processing algorithms. We investigate options for equalization in coherent optical communications systems and compare them in terms of complexity. We cover both single and multi carrier solutions with training and blind adaptation.

10:04 a.m.– 10:22 a.m. **Key Technologies and Innovations for Next Generation 40G and 100G Optical Interfaces**, *Christoph Schullien, CTO, CoreOptics, Germany*. Next generation electro-optical transmission interfaces for the core network employ higher level modulation formats like QPSK, n-QAM or OFDM in conjunction with polarization multiplexing and coherent detection. The related subsystem architectures require advances on multiple fronts in photonics and high-speed electronics technologies and components. At the same time a minimum amount of standardization will be necessary to justify investment in these technology innovations. This contribution will address these aspects specifically from a subsystem provider's prospective.

10:22 a.m.– 10:40 a.m. **Soft Decision FEC for Single/Multi-Carrier Modulation**, *Takashi Mizuochi, Mitsubishi Electric, Japan*. Codes, OH rate, and expected gain for soft-decision FEC in single-carrier/multiple-carrier modulation are discussed. A trial for hardware emulation of 100Gbps FEC is presented.

10:40 a.m.– 11:00 a.m. **Discussion**

Category J. Network Experiments and Non-Telecom Applications

OMC, Grid vs Cloud Computing and Why This Should Concern the Optical Networking Community, *Chunming Qiao¹, Dimitra Simeonidou², Bill St. Arnaud³, Peter Tomsu⁴*; ¹SUNY at Buffalo, USA, ²Univ. of Essex, UK, ³Canarie Inc., Canada, ⁴Cisco Systems Ltd., USA. Recently, there has been a lot of interests in Cloud, Grid and Utility computing and their influence in

shaping the future network infrastructure. While Grid Computing is geared mainly towards scientific users and Grids, both Cloud and Utility computing are for enterprises. The common point for both approaches is their reliance on high speed optical networks to provide advanced and flexibly reconfigurable infrastructure. Optical network researchers are facing big challenges in delivering the necessary technologies for supporting Cloud, Grid and Utility computing services. Such technologies and services will change the Internet in much the same way as distributed and parallel computing has changed the computation and cyber-infrastructure today. The workshop will discuss various Cloud, Grid and Utility Computing approaches and will present the challenges (research and implementation) for our community. [Download individual speaker presentations.](#)

Welcome/Introduction

Clouds and Optical Networks, Bill St. Arnaud, CANARIE Inc., Canada

Challenges in Enabling Cloud Computing over Optical Networks, Piero Castoldi, Barbara, Martini, Fabio Baroncelli, Scuola Superiore Sant'Anna Univ. Italy

Challenges in Enabling Grid Computing over Optical Networks, Cees de Laat, Univ. of Amsterdam, Netherlands

Virtualizing and scheduling network resource for emerging IT services: the CARRIOCAS approach, Pascale Vicat-Blanc Primet (INRIA) & Dominique Verchère (Alcatel Lucent BellLabs)

Energy / cost benefits of cloud computing, Rodney Tucker, U. Melbourne, Australia

Opportunities in Optical Grid and Clouding Computing, Chunming Qiao, SUNY Buffalo, USA

Panel discussion and Q&A

NFOEC 2: Network Technologies

NMA, Automated Fiber Optic Cross-Connects, *Glenn Wellbrock; Verizon Corporate Network and Technology Organization, USA*. The Advanced Fiber Connectivity and Switching Forum (AFCS) has been created to provide an open and neutral environment to share knowledge and information that can be used to accelerate the adoption and deployment of optical switching and advanced fiber connectivity solutions into networks worldwide. Specific objectives of the forum include 1) Creating industry awareness concerning the readiness and capabilities of key technologies, 2) Developing a stronger understanding of important network applications, 3) Promoting the benefits and value proposition to operators and other users of the technology, 4) Providing input to industry standards bodies, and 5) Resolving obstacles that stand in the way of widespread deployment of technologies for remote fiber management.

Advanced Fiber Connectivity and Switching Forum overview and application introduction by David Rapp, ADC

Carrier Hotel/Peering Exchange application presented by Jim Donnelly, Glimmerglass

Data Center and Lab Physical Layer Automation application presented by Larry Cantwell, OnPath Technologies

Addressing Network Fiber Maintenance application presented by TJ Xia, Verizon

FTTP PON Fiber to the Premises and Passive Optical Networks application presented by Joe Finn, Verizon

MDU Distribution application presented by Sandy Roskes, FiberZone Networks
Transoceanic Cable Landing Site Monitoring application presented by Jim Diestel, Calient Networks
Remote Fiber Test and Monitoring application presented by Troy Veitenheimer, NTest

NFOEC Panels

Tuesday, March 24, 4:30 p.m.–6:30 p.m.

NFOEC 2: Network Technologies

NTuD, Deployment of New Fiber Types, *Sergey Ten; Corning Inc., USA.*

In the last five years the telecommunications industry witnessed the development of new optical fiber types for networks ranging from short distance access networks to transoceanic links. Evolving technical and deployment requirements of modern networks led to the proliferation of fibers with optimized attributes that were later formalized into distinct fiber standards. Will the trend continue or have all of the fiber types needed for the various networks been invented? This workshop will review the drivers for the deployment of new fiber types in the past and will examine the requirements of future networks. It will feature the “cross examination” of the subject by network operators, system houses and fiber manufacturers.

Wednesday, March 25, 1:00 p.m.–3:00 p.m.

NFOEC 1: Optical Networks and Services

NWB, Emerging Carrier Optical Services, *Vishnu S. Shukla; Verizon Communications, USA.* Optical Transport Networks are undergoing a critical transition in which the network is migrating from a static legacy SONET/SDH-based transport to a dynamic intelligent Optical Transport Network (OTN). The driving forces behind this transition are the need to improve operational efficiency and to deploy more cost-effective optical transport than the existing ring-based infrastructure. There is growing customer demands for more bandwidth, faster provisioning, and richer sets of service functionality. In addition, there have been advances in OTN technologies and protocols that have made available a new generation of equipment that features a high degree of functional integration and is capable of supporting an embedded intelligent control plane (CP). This panel will examine the industry trends and deployment of emerging optical services in carrier network.

Thursday, March 26, 1:00 p.m.–3:00 p.m.

NFOEC 2: Network Technologies

NThD, **40G Deployment in Carrier Networks**, *Alan Gibbemeyer; Nokia Siemens Networks, USA.*

40G deployments are growing rapidly driven initially by router interconnectivity with very strong growth projections for the future across the market analyst community. Some analysts are expecting 40G ports to outnumber 10G during this calendar year and bandwidth growth is continuing to exceed expectations at carriers as well as large enterprises. Systems utilizing 10G technology are running out of capacity too quickly forcing the operators to overbuild and procure additional facilities such as fiber and space. New technologies like 100G will still need time to mature meaning that 40G technology will enjoy significant growth for some time to come. We will look at the status of 40G in the carrier DWDM networks, drivers for going to 40G as well as the challenges in rolling out this new generation technology. We will also investigate alternatives to 40G and offer an expert opinion on what to watch for in the near future.

Speakers:

Erwan Pincemin, France Telecom, Orange Labs
Glenn Wellbrock, Verizon Corporate Network and Technology Organization
Masahito Tomizawa, NTT Network Innovation Laboratories, NTT Corporation
Kathy Tse, AT&T Labs
Randy Nicklas, XO
Robert Feuerstein, BT
Michael Howard, Infonetics

Special Symposia

Symposium on the Future Internet and Its Impact on Next-Generation Optical Networks

Select symposia presentations are available for download. Click on the titles below to open a pdf of the presentations.

Tuesday, March 24
2:00 p.m.–6:30 p.m., including a coffee break

Organizers:

Adel A. M. Saleh, *DARPA, USA*
Jane M. Simmons, *Monarch Network Architects, USA*

The Internet continues to evolve with innovative applications, increasing bandwidth requirements, changing traffic and usage patterns, and debates over policy. This evolution is clearly intertwined with the performance and economics of the underlying optical networks. This symposium will explore the future Internet, and how it will impact the architecture and technology of next-generation optical networks, from the backbone core to the access edge. Several leaders in the field will present their visions and predictions; they will then respond to questions and comments from the audience.

Speakers:

Andrew Odlyzko, Ph.D.

Professor, School of Mathematics and Digital Technology Center, University of Minnesota, USA

[Future Internet: Drastic Change, or Muddling Through?](#)

Abstract:

There are glaring deficiencies in the current Internet. On the other hand, this same Internet is still better than any other technology that is widely available, and is still gaining momentum in the marketplace. Whether a drastic reengineering of the Internet will take place will depend on a complex interaction of decision by users and service providers.

Biography:

Andrew Odlyzko has had extensive experience in research and management at Bell Labs, AT&T Labs, and the University of Minnesota. He has worked on computational complexity, cryptography, number theory, combinatorics, coding theory, analysis, probability theory, e-commerce, and economics of data networks. He may be known best for an early debunking of the myth of Internet traffic doubling every three months and for demonstrating that connectivity has traditionally mattered much more for society than content.

Lawrence Roberts, Ph.D.

Chairman, Founder, Anagran, USA

[Internet Evolution into the Future](#)

Abstract:

The Internet traffic has increased by 10^{12} since 1970 and survived with little change. However, to adequately support the current and future applications, substantial improvements are required for QoS, throughput, fairness, and security. The problems will be examined and potential improvements outlined.

Biography:

Dr. Roberts is currently Founder, Chairman and Chief Architect of Anagran Inc. Anagran is currently manufacturing flow rate management network equipment, the first major improvement in packet network technology in the 40 years since Dr. Roberts designed and managed the first packet network, the ARPANET (now the Internet). At that time, in 1967, Dr. Roberts became the Chief Scientist of ARPA taking on the task of designing, funding, and managing a radically new communications network concept (packet switching) to interconnect computers worldwide. The

first for nodes of the ARPANET were installed in 1969 and by 1973 when Dr. Roberts left ARPA to become CEO of Telenet (now part of Sprint), the concept of packet switching had been well proven to the world and the ARPANET had grown to 52 computers including a packet radio subnet and a satellite extension to Europe. Dr. Roberts has BS, MS, and Ph.D. Degrees from MIT and has received numerous awards for his work, including the Secretary of Defense Meritorious Service Medal, the L.M. Ericsson prize for research in data communications, in 1992 the W. Wallace McDowell Award, in 1998 the ACM SIGCOMM Award, in 2000 the IEEE Internet Award, in 2001 the National Academy of Engineering Draper Award, in 2002 the Principe de Asturias Award, and in 2005 the NEC Computer and Communication Award.

Bill St. Arnaud, P.Eng.

Chief Research Officer, CANARIE Inc., Canada

[*Next Generation Internet to Reduce Global Warming \(G-NGI\) using Novel Optical Network Architectures*](#)

Abstract:

One of the major design criteria for next generation Internet networks will be to reduce the carbon footprint of these networks. All optical networks with minimum of electronic switches and routers will have significantly less energy consumption and CO₂ emissions than today's electronic routed networks. New optical Internet architectures such as the PROMPT G-GNI where repeaters and switches are powered by windmills or solar panels with no connection to the electrical grid will allow the deployment of next generation zero carbon Internet networks often referred to as "follow the sun/follow the wind" networks. The advent of 1000G (terabit) and higher speed waves over existing DWDM systems using coherent detection and twisted lighted will also enable the deployment of many virtual optical networks on top of a common "follow the sun/follow the wind" network substrate.

Biography:

Bill St. Arnaud is Chief Research Officer for CANARIE Inc. Canada's Advanced Internet Development Organization. At CANARIE Bill St. Arnaud has been responsible for the coordination and implementation of Canada's next generation optical Internet initiative called CA*net 4. He has also been the principal architect of the concept of Customer Owned Networks and User Controlled Lightpaths (UCLP) allow users to create their own Internet network topologies and peerings. Currently he is leading a Green IT initiative of encouraging carbon rewards rather than imposing carbon taxes to help reduce output of green house gas emissions, through the provision of free fiber to the home and other free Internet services and applications. Bill St. Arnaud is member of various committees and boards. In 2002 he was featured by TIME Magazine Canada as the engineer who is wiring together advanced Canadian science. In 2005 he also won the World Technology Summit award for Communications.

Andrew Houghton, Ph.D.

Deputy Head of Unit, European Commission, Belgium

[*Optical Networks and Future Internet Research in the European Framework Programme 7*](#)

Abstract:

Future Internet services and applications will require major enhancements to the capability and

performance of the underlying optical network infrastructure. In addition to the continuous demand for increased capacity, at lower cost, the Internet is now a critical infrastructure, which must be reliable, secure, energy-efficient and manageable. This presentation reviews the research on future optical networks and packet transport layer integration in the EU FP7, to meet these demanding, and sometimes conflicting, requirements.

Biography:

Andrew Houghton is Deputy Head of the Unit "Future Networks" in the Directorate-General Information Society and Media of the European Commission, in Brussels, Belgium. He received a B.Sc. degree from the University of Sussex, UK, and a Ph.D. from the University of Nottingham, UK. After five years with BT Research Labs, he joined STC /Northern Telecom Optoelectronics, in production of components for optical communications systems. He then joined the European Commission in 1992 as a Project Officer, initially in the area of optical networks and subsequently in the areas of "Broadband for All" and "Mobile and Wireless Beyond 3G". He is currently responsible for projects of the ICT FP7 Research Programme, in the "Network of the Future" Objective.

Tomonori Aoyama, Ph.D.

Professor, Keio University, Japan

[Toward New Generation Network - Beyond Internet and Next Generation Network](#)

Abstract:

This presentation introduces R&D activities in Japan for a new generation network (NWGN) which has clean-slate designed architecture to meet main requirements in 2020s. The fundamental principle for the NWGN architecture and key technologies to realize NWGN are shown.

Biography:

Dr. Tomonori Aoyama joined NTT Public Corporation in 1969, and then had been engaged in research and development on communication networks and systems in the Electrical Communication Laboratories. From 1973 to 1974, he stayed in MIT as a visiting scientist to study digital signal processing technology. In 1994, he was appointed to Director of NTT Opto-Electronics Laboratory, and in 1995 he became Director of NTT Optical Network Systems Laboratory. In 1997, he left NTT, and joined the University of Tokyo as Professor in Graduate School of Information Science and Technology. Since April 2006, he is Professor of Research Institute for Digital Media and Content at Keio University. His research activity covers new generation networking technologies including photonic networking, ubiquitous networking and broadband applications with super high definition images.

He is an IEEE Fellow, IEICE (Institute of Electronics, Information and Communication Engineers, Japan) Fellow, and a member of Science Council of Japan. He is currently the President-elect of IEICE. He serves as Program Coordinator for the new generation network architecture in National Institute of Information and Communications Technology (NICT). He also serves as Chairman of Photonic Internet Forum (PIF), and as Vice-Chair of New Generation Network Promotion Forum and Ubiquitous Networking Forum. He is President of NPO- Digital Cinema Consortium of Japan (DCCJ).

