

7:00 a.m.–8:00 a.m. Morning Technical Briefings, Ballroom B

Service Provider Summit

8:30 a.m.–9:00 a.m.

Keynote Presentation:

Business Models and Services with Managed Broadband Access

Sanghoon Lee, Korea Telecom, Korea

9:15 a.m.–10:45 a.m.

Panel I: FTTx: We Have Lift Off!

Moderator: Frank Effenberger, Huawei Technologies America, USA

Speakers:

FTTH Evolution in Japan, Motoyuki Ii, NTT EAST Corp., Japan

Verizon's Broadband Strategy, Vincent O'Byrne, Verizon Technology Organization, USA

Scaling FTTx Networks for Video, Voice and Data Services, Raj Savoor, AT&T Labs, USA

Next Generation Optical Access Technology Alternatives, David Waring, Telcordia Technologies, USA

11:15 a.m.–12:45 p.m.

Panel II: Emerging Networks

Moderator: George Clapp, Telcordia Technologies, USA

Speakers:

Internet2 Hybrid Networking and the HOPI Project, Rick Summerhill, Internet2, USA

Practical Aspects of Bandwidth on Demand in Optical Networks, Robert Doverspike, AT&T Labs-Res., USA

Optics in the Context of Network Convergence, Andreas Gladisch, Deutsch Telecom, Germany

Title to Be Announced, David Ward, Cisco, USA

Market Watch

2:00 p.m.–4:00 p.m.

Panel II: Opaque vs. Transparent Optical Networks

Moderator: Karen Liu, Ovum RHK, USA

Speakers:

The Strategic Benefits of the Digital Optical Network, David F. Welch, Infinera, USA

The Evolution of Optical Networking Transparency beyond Further, Faster and Cheaper, Thomas A. Strasser, Nistica, Inc., USA

Optimizing the Optical Transport Layer for Packet Traffic, Loukas Parschis, Cisco Systems, USA

Optical Networks in Today's Demand Environment, Robert Feuerstein, Level3 Communications, Inc., USA

Ballroom A

8:00 a.m.–9:30 a.m.

OWA • New Fiber Materials and Active Fibers

Tanya Monro; Univ. of Adelaide, Australia, Presider

OWA1 • 8:00 a.m.

Invited

Optical Materials for Fiber Applications: Past, Present and Future, *Kathleen Richardson; Univ. of Central Florida, USA*. No abstract available.

Ballroom B

8:00 a.m.–10:00 a.m.

OWB • Nonlinear Amplifiers for Signal Processing

Robert Jopson; Lucent Technologies, USA, Presider

OWB1 • 8:00 a.m.

Nearly 100 nm Bandwidth of Flat Gain with a Double-Pumped Fiber Optic Parametric Amplifier, *Jorge D. Marconi¹, Jose M. Chavez Boggio¹, Hugo L. Fragnito^{1,2}, Scott R. Bickham²; ¹Optics and Photonics Res. Ctr., Brazil, ²Corning Inc., USA*. We demonstrate double-pumped fiber-optical parametric amplifiers with flat and broadband gain spectrum. Using specially fabricated highly non-linear fibers having low variations of the zero-dispersion wavelength and low PMD we obtain flat gain (23 ± 1.5 dB) over 95 nm.

OWB2 • 8:15 a.m.

Two Pump Parametric Amplifier with 40dB of Equalized Continuous Gain Over 50nm, *Rui Jiang¹, Nikola Alic¹, Colin McKinstrie², Stojan Radic¹; ¹Univ. of California at San Diego, USA, ²Bell Labs, USA*. A two-pump fiber parametric amplifier was constructed and measured to have record performance. A continuous-wave 40dB gain was equalized over 50nm, covering the extended L-band spectral domain. The experimental measurements matched with the theoretical calculations.

Ballroom C

8:00 a.m.–10:00 a.m.

OWC • OPS/OBS

Chunming Qiao; SUNY, USA, Presider

OWC1 • 8:00 a.m.

Invited

Burst-Switched Metro and Access Networks, *Leonid Kazovsky; Stanford Univ., USA*. Burst mode transmission has become dominant in optical access networks. The evolution of this technology will lead to significant changes in metro and access networks. This talk summarizes recent research results in this area.

Ballroom D

8:00 a.m.–10:00 a.m.

OWD • PON Modulation Schemes

Raghu Ranganathan; Ciena Corp., USA, Presider

OWD1 • 8:00 a.m.

Demonstration of RSOA-Based Remote Modulation at 2.5 and 5 Gbit/s for WDM PON, *Philippe Chanclou¹, Franck Payoux¹, Thomas Soret¹, Naveena Genay¹, R. Brenot², F. Blache², M. Goix², J. Landreau², O. Legouezigou², F. Mallocot²; ¹France Telecom Res. and Development Div., France, ²Alcatel-Thales III-V Lab, France*. This paper investigates the performance of a Reflective Semiconductor Optical Amplifier in a bidirectional wavelength-division multiplexed passive optical network at 2.5 and 5 Gbit/s over 20 and 15 dB link budget.

OWD2 • 8:15 a.m.

A Novel Re-Modulation Scheme to Achieve Colorless High-Speed WDM-PON with Enhanced Tolerance to Chromatic Dispersion and Re-Modulation Misalignment, *Jian Zhao, Lian-Kuan Chen, Chun-Kit Chan; Chinese Univ. of Hong Kong, Hong Kong*. We propose a novel re-modulation scheme using downstream OOK and upstream DPSK. A 30-km-range colorless WDM-PON without dispersion compensation and re-modulation synchronization was demonstrated within 1-dB penalty for both 10-Gbit/s downstream and 10-Gbit/s upstream signals.

Ballroom E

8:00 a.m.–10:00 a.m.

OWE • Ultrahigh Bitrates and FEC

Wilfred Idler; Alcatel-Lucent,

OWE1 • 8:00 a.m.

Invited

Challenges for 100 Gbit/s ETDM Transmission and Implementation, *Eugen Lach¹, Karsten Schuh¹, Bernhard Junginger¹, Gustav Veith¹, Joachim Lutz², Michael Möller^{2,3}; ¹Alcatel Res. & Innovation, Germany, ²MICRAM Microelectronic GmbH, Germany, ³Saarland Univ., Germany*. We review the current status in ultra-high-speed electronics and optoelectronic components and report recent progress in serial ETDM transmission technologies at channel-bitrates of 85...107 Gbit/s. Challenges associated with 100 Gbit/s ETDM transmission and subsystems implementation are addressed.

8:00 a.m.–9:00 a.m.**OWF • SOA-Based All Optical Processing***Dalma Novak; Pharad, USA, Presider***OWF1 • 8:00 a.m.****Tutorial**

SOA-Based All Optical Processing, Alistair J. Poustie; Ctr. for Integrated Photonics, UK. We describe recent progress in SOA devices and their use in all-optical processing applications. High-performance nonlinear SOAs and a range of practical hybrid-integrated SOA-based switching modules are illustrated in high-speed optical network applications.



Alistair Poustie earned a B.Sc. (1986) and Ph.D. (1990) in Physics & Theoretical Physics at the University of St. Andrews in Scotland. He worked for British Telecom Research Laboratories from 1990 to 2000 carrying out a range of optical research, including quantum noise in optical fibres, nonlinear spatial optics and all-optical signal processing using SOAs. From 2000 to 2003 he was employed at the Corning Research Centre in the UK, continuing to focus work on SOA-based processing. In 2003, he was involved in the establishment of the Centre for Integrated Photonics (CIP) and he balances his current activity between SOA-based device research and product development. He has authored or co-authored over 100 journal papers, conference papers and patents and is involved in several collaborative research projects. He is a member of the Optical Society of America and the IEEE, and is a fellow of the Institute of Physics.

8:00 a.m.–9:30 a.m.**OWG • Photonic Wire Based Devices***Haifeng Li; Tyco Telecommunications, USA, Presider***OWG1 • 8:00 a.m.**

Compact Focusing Grating Couplers Between Optical Fibers and Silicon-on-Insulator Photonic Wire Waveguides, Frederik Van Laere, Wim Bogaerts, Dirk Taillaert, Pieter Dumon, Dries Van Thourhout, Roel Baets; Ghent Univ. - IMEC, Belgium. We present compact and broadband grating couplers in Silicon-on-Insulator, between single-mode fiber and nanophotonic waveguides. Curved gratings allow for a very short transition between wide waveguides and photonic wires, resulting in very compact devices.

OWG2 • 8:15 a.m.

Ultra-Compact Wavelength Division Multiplexing Devices Using Silicon Photonic Wires for On-Chip Interconnects, Fengnian Xia, Martin O'Boyle, Lidija Sekaric, Yurii Vlasov; IBM T. J. Watson Res. Ctr., USA. Ultra-compact four-channel wavelength division multiplexing (WDM) devices in add/drop filter and multi-mode interferometer configurations were demonstrated on silicon-on-insulator for future on-chip optical interconnects. Both devices show a crosstalk level ≤ -13 dB and a footprint ≤ 0.006 mm².

8:00 a.m.–10:00 a.m.**OWH • Optical Modulators***Ed Murphy; JDS Uniphase, USA, Presider***OWH1 • 8:00 a.m.**

Millimeter-Wave Electrooptic Polymer-Based Ring Resonator Modulation, Bartosz J. Bortnik¹, Yu-Chueh Hung¹, Hidehisa Tazawa², William H. Steier², Jingdong Luo³, Alex Jen³, Byoung-Joon Seo¹, Harold R. Fetterman¹; ¹Univ. of California at Los Angeles, USA, ²Univ. of Southern California, USA, ³Univ. of Washington, USA. Modulation is demonstrated throughout the W-band and at the 139 GHz and 165 GHz resonances of an electro-optic polymer ring resonator-based modulator. The experimentally validated analysis indicates superior high-frequency performance over a similar Mach-Zehnder modulator.

OWH2 • 8:15 a.m.

Evanescantly-Coupled Dual-Depletion-Region Traveling-Wave Electro-absorption Modulator with High-Speed and Low-Driving-Voltage Performance, Jin-Wei Shi, A.-C. Shiao, C.-C. Chu, Y.-S. Wu; Dept. of EE, Natl. Central Univ., Taiwan. By incorporating dual-depletion-region electroabsorption modulator with an evanescently-coupled waveguide, the demonstrated device can achieve low electrical return-loss (< -22 dB), wide electrical 3-dB transmission-loss bandwidth (~ 70 GHz), wide electrical-to-optical bandwidth (> 45 GHz), and low-driving-voltage (V_{20dB}, 1.65V) with small polarization-dependency.

Ballroom A

OWA • New Fiber Materials and Active Fibers—Continued

OWA2 • 8:30 a.m. Invited
Progress of Chalcogenide Glass Fibers, *Jasbinder Sanghera¹, L. B. Shaw¹, P. Pureza¹, V. Q. Nguyen¹, D. Gibson¹, I. D. Aggarwal¹, C. M. Florea², F. Kung³; ¹NRL, USA, ²SFA, Inc., USA, ³Univ. of Maryland Res. Foundation, USA. High nonlinearity and large IR transparency make these fibers well suited for compact Raman amplifiers, supercontinuum generation and other mid-IR sources. As₂S₃ fiber has record high theoretical gain compared with silica fiber for slow-light applications.*

Ballroom B

OWB • Nonlinear Amplifiers for Signal Processing—Continued

OWB3 • 8:30 a.m.
Suppression of WDM Signal Crosstalk in Fiber Optical Parametric Amplifier by Using RZ-DPSK Modulation Format, *Bill P. P. Kuo, P. C. Chui, Kenneth K. Y. Wong; Univ. of Hong Kong, Hong Kong. We demonstrated crosstalk-free WDM signal amplification by single-pump fiber OPA with RZ-DPSK modulation format. The power penalty of OPA amplified 10Gb/s WDM RZ-DPSK signal was reduced by more than 2dB as compared with OOK counterpart.*

OWB4 • 8:45 a.m.
Simultaneous Slow-Light Delay and Pulse Reshaping of 10Gbps RZ Data in Highly Nonlinear Fiber-Based Optical Parametric Amplifier with Clock-Modulated Pump, *Zhaoyang Hu, Daniel J. Blumenthal; Dept. of Electrical & Computer Engineering, Univ. of California at Santa Barbara, USA. We demonstrate 25ps slow-light delay of 10Gbps RZ data simultaneously with pulsewidth reshaping from 50ps to 20ps using optical parametric amplifier. Error-free operations are achieved for both 10Gbps RZ packets and PRBS data.*

Ballroom C

OWC • OPS/OBS—Continued

OWC2 • 8:30 a.m.
A Fully Functional Application-Aware Optical Burst Switched Network Test-Bed, *Georgios Zervas¹, Reza Nejabati¹, Zhuoran Wang², Dimitra Simeonidou¹, Siyuan Yu², Mike O'Mahony¹; ¹Univ. of Essex, UK, ²Univ. of Bristol, UK. This paper presents an application-aware asynchronous optical burst switched network demonstrator. Fully functional edge and core routers as well as a novel resource discovery signaling protocol is being demonstrated.*

OWC3 • 8:45 a.m.
QoS Differentiation in OBT Ring Networks with Comparison to RPR Networks, *Saurav Das¹, Jaedon Kim¹, David Gutierrez¹, L. G. Kazovsky¹, Ching-Fong Su², Richard Rabba², Takeo Hamada²; ¹Stanford Univ., USA, ²Fujitsu Labs of America, USA. Optical Burst Transport networks employ burst transmission in WDM ring architectures and are promising candidates for MANs. We investigate QoS differentiation in OBT, and compare its performance to IEEE 802.17 Resilient Packet Ring (RPR) Standard.*

Ballroom D

OWD • PON Modulation Schemes—Continued

OWD3 • 8:30 a.m.
Effects of Downstream Modulation Formats on the Performance of Bidirectional WDM-PON Using RSOA, *Sang Yub Kim¹, Eun Seung Son², Sang Bae Jun¹, Yun C. Chung¹; ¹KAIST, Republic of Korea, ²KT, Republic of Korea. We evaluate the effects of downstream modulation formats (NRZ, IRZ, and Manchester) on the performance of RSOA-based bidirectional WDM-PON. By using Manchester format, performances of upstream signals become insensitive to the operating conditions of RSOA.*

OWD4 • 8:45 a.m.
Filter Impact in Spectrally-Broadened Rayleigh Noise Reduction Schemes for DWDM-PONs, *G. Talli, C. W. Chow, P. D. Townsend; Photonic Systems Group, Tyndall Natl. Inst., Ireland. We present the results of a model for phase modulated spectrally-broadened Rayleigh backscattering noise reduction scheme employed in centralized light source DWDM-PONs. Good agreement with experiments is demonstrated, and different optical filtering strategies are investigated.*

Ballroom E

OWE • Ultrahigh Bitrates and FEC—Continued

OWE2 • 8:30 a.m.
Serial 107Gbit/s ETDM NRZ Transmission over 320km SSMF, *Karsten Schuh¹, Bernhard Junginger¹, Eugen Lach¹, Gustav Veith¹, Joachim Lutz², Michael Möller^{2,3}; ¹Alcatel Res. and Innovation, Germany, ²MICRAM Microelectronic GmbH, Germany, ³Chair of Electronics and Circuits, Saarland Univ., Germany. We report on a complete serial 107 Gbit/s ETDM NRZ transmission system and assess system performance in an error free transmission experiment over 320 km SSMF with 3.5 dB OSNR margin.*

OWE3 • 8:45 a.m.
107-Gb/s Full-ETDM Transmission over Field Installed Fiber Using Vestigial Sideband Modulation, *Sander L. Jansen¹, Rainer H. Derksen², Colja Schubert³, Xiang Zhou⁴, Martin Birk³, Claus-Jörg Weiske², Marc Bohm², Dirk van den Borne¹, Peter M. Krummrich², Michael Möller², Folkert Horst⁶, Bert-Jan Offrein⁶, Huug de Waardt¹, Giok-Djan Khoe¹, Andreas Kirstädter²; ¹Eindhoven, Univ. of Technology, Netherlands, ²Siemens Networks GmbH & Co KG, Germany, ³Fraunhofer Inst. for Telecommunications, Germany, ⁴AT&T Labs-Res., USA, ⁵MICRAM Microelectronic GmbH, Germany, ⁶IBM Zürich Res. Lab, Switzerland. 107-Gb/s full-ETDM transmission is shown over a 160-km field installed fiber link. A high tolerance towards narrow-band optical filtering is demonstrated using vestigial sideband modulation to minimize the spectral width.*

OWF • SOA-Based All Optical Processing—Continued**OWG • Photonic Wire Based Devices—Continued****OWG3 • 8:30 a.m.****Invited**

SOI Photonic Wire Based Components with Compact and Efficient Fiber Couplers, Roel Baets, Wim Bogaerts, Dirk Taillaert, Pieter Dumon, Dries Van Thourhout; Ghent Univ. - IMEC, Belgium. We present compact wavelength selective functions based on SOI photonic wires, like AWGs, Mach-Zehnder filters and ring resonators, fabricated with CMOS processes. We couple to single-mode fiber with grating couplers, which also allow polarization-independent behaviour.

OWH • Optical Modulators—Continued**OWH3 • 8:30 a.m.**

10Gb/s Domain Engineered LiNbO₃ Integrated Electro-Optic Modulator for Inexpensive Low Voltage Drivers, Federico Lucchi¹, Michele Belmonte¹, Stefano Balsamo¹, Marco Villa¹, Lorenzo Trevisan¹, Simone Pensa¹, Guido Consonni¹, Chiara Emanuele¹, Paolo Vergani¹, Mario Sottocorno¹, Valerio Pruner²; ¹Avanex Corp., Italy, ²ICFO – Inst. de Ciències Fotòniques, Spain. We report a novel single-drive 10 Gb/s electro-optic Mach-Zehnder modulator in domain inverted LiNbO₃. The low switching voltage, close to 2V, allows the use of inexpensive drivers, such as those for electro-absorption modulators.

OWH4 • 8:45 a.m.

40 Gb/s Low-Drive-Voltage LiNbO₃ Optical Modulator for DQPSK Modulation Format, Masaharu Doi¹, Naoki Hashimoto¹, Tetsu Hasegawa¹, Takehito Tanaka², Kazuhiro Tanaka¹; ¹Fujitsu Labs Ltd., Japan, ²Fujitsu Ltd., Japan. Low-drive-voltage (3.5 V) and uniform modulation characteristics of MZIs were achieved with Z-cut dual-drive nested-MZIs structure and the wide-gap design between signal and ground electrodes, resulting in precise constellation mappings in 43 Gb/s DQPSK modulation.

Ballroom A

OWA • New Fiber Materials and Active Fibers—Continued

OWA3 • 9:00 a.m. Invited
Progress in Active Fibers, *J. K. Sahu, S. Yoo, J. Kim, A. Boyland, A. Webb, J. Nilsson, Y. Jeong, D. J. Richardson, D. N. Payne; Optoelectronics Res. Ctr., UK.* Progress in active fibers for high power fiber sources is discussed. The waveguiding geometry naturally lends itself to high-power diffraction-limited operation. Further refinements allow for the control of nonlinearities and wavelength. Fabrication advances mitigate photodarkening.

Ballroom B

OWB • Nonlinear Amplifiers for Signal Processing—Continued

OWB5 • 9:00 a.m.
Optimal Operating Conditions and Modulation Format for 160 Gb/s Signals in a Fiber Parametric Amplifier Used as a Slow-Light Delay Line Element, *Fangfei Liu¹, Yikai Su¹, Paul L. Voss^{2,3}; ¹State Key Lab of Advanced Optical Communication Systems and Networks, Dept. of Electronic Engineering, Shanghai Jiao Tong Univ., China, ²School of Electrical and Computer Engineering, Georgia Tech, USA, ³European Campus of Georgia Tech, France.* We study optimal operating conditions for 160-Gb/s signals traversing a slow-light delay line based on parametric amplification. Six phase modulated formats are investigated, including CSRZ, PAP-CSRZ, GAP-CSRZ, RZ duobinary, RZ DPSK and RZ.

OWB6 • 9:15 a.m.
PRBS Data Delay in an All Fiber Slow Light System Based on SBS Effect, NRZ vs. RZ, *Shiquan Yang, John Cameron, Jeff Snoddy, Lufan Zou, Xiaoyi Bao; Dept. of Physics, Univ. of Ottawa, Canada.* We study the data delay effect in a fiber SBS slow light system. The results show that, with the same pump configuration, NRZ has a larger delay and better eye opening than RZ format.

Ballroom C

OWC • OPS/OBS—Continued

OWC4 • 9:00 a.m.
Design and Implementation of GMPLS-Based Optical Slot Switching Access-Distribution Network Using PLZT Ultra-High Speed Optical Switch, *Masahiro Hayashitani¹, Teruo Kasahara¹, Daisuke Ishii¹, Yutaka Arakawa¹, Satoru Okamoto¹, Naoaki Yamanaka¹, Naganori Takezawa², Keiichi Nashimoto³; ¹Keio Univ., Japan, ²Nozomi Photonics Co., Ltd., Japan.* We design and implement a GMPLS-based optical slot switching access-distribution network using PLZT switches. Switching speed is better than 10 nsec and the network has a large scalability, 1000 users, compared to PON.

OWC5 • 9:15 a.m.
All-Optical Multiple-Label-Processing Based Optical Packet Switch Prototype and Novel 10Gb Ethernet / 80 (8λ x 10) Gbps-Wide Colored Optical Packet Converter with 8-Channel Array Burst-Mode Packet Transceiver, *Hideaki Furukawa¹, Naoya Wada¹, Hiroaki Harai¹, Makoto Naruse¹, Hideki Otsuki¹, Michiaki Katsumoto¹, Tetsuya Miyazaki¹, Katsuya Ikezawa², Akira Toyama², Naoki Ito², Hiroshi Shimizu², Hiroshi Fujinuma³, Hatsushi Iiduka³, Gabriella Cincotti⁴, Ken-ichi Kitayama⁵; ¹Natl. Inst. of Information and Communications Technology, Japan, ²Yokogawa Electric Co., Japan, ³NTT Electronics Co., Japan, ⁴Univ. Roma Tre, Italy, ⁵Osaka Univ., Japan.* We demonstrate IP-packet/10-Gbit-Ethernet transporting by novel 80-Gbit/s/port optical packet switch prototype with IP/OP converters, packet-transceiver of instantaneous-locking (<1 ns), and multiple-label-processor of ultra-fast processing (<100 ps) to achieve 7.2-Gbps IP-packet throughput with low packet-loss-rate (<10⁻⁶).

Ballroom D

OWD • PON Modulation Schemes—Continued

OWD5 • 9:00 a.m.
Transmission Performance Maximization of Adaptively Modulated Optical OFDM Signals in MMF Based Links Using Optimum Analogue-to-Digital Converters, *Jianming Tang, K. A. Shore; School of Electronic Engineering, Univ. of Wales at Bangor, UK.* It will be shown that 40Gb/s over 220m and 32Gb/s over 300m AMOOFDM signal transmission with loss margins of about 15dB is feasible in installed worst-case MMF IMDD links having 3-dB effective bandwidths of 150MHz/km.

OWD6 • 9:15 a.m.
Spectrally Efficient 10 x 1 Gb/s QPSK Multi-User Optical Network Architecture, *Jin Yong Ha¹, Adrian Wonfor¹, Richard V. Pentyl¹, Ian H. White¹, Pierpaolo Ghiggino²; ¹Univ. of Cambridge, UK, ²Ericsson, UK.* We report theoretical and experimental validation of a 10 x 1 Gb/s multi-user optical network using QPSK coding for good spectral efficiency. Low-penalty-transmission is demonstrated for a proof-of-principle 2 channel system over 25 km SMF.

Ballroom E

OWE • Ultrahigh Bitrates and FEC—Continued

OWE4 • 9:00 a.m.
160 Gb/s RZ-DPSK OTDM-Transmission over 480 km Using 160 km Repeater Spans and Advanced Forward-Error-Correction, *Reinhold Ludwig¹, Stefan Weisser², Carsten Schmidt-Langhorst¹, Lutz Raddatz², Colja Schubert¹; ¹FhG Heinrich-Hertz-Inst., Germany, ²Lucent Technologies, Germany.* The advantages of using RZ-DPSK in combination with advanced forward error correction are shown in an OTDM-transmission experiment of a single-polarization 160 Gbit/s signal over 3x160 km dispersion managed fiber.

OWE5 • 9:15 a.m.
Reduced-Complexity Decoding Algorithm for LDPC Codes for Practical Circuit Implementation in Optical Communications, *Yoshikuni Miyata, Rui Sakai, Wataru Matsumoto, Hideo Yoshida, Takashi Mizuochi; Mitsubishi Electric Corp., Japan.* For superior, practical decoding of LDPC based FEC, a cyclic approximated delta-minimum algorithm is proposed. Simulation shows that 3-bit soft-decision decoding provides a required Q of 6.2 dB at 10⁻⁶ BER with only 16 iterations.

OWG • Photonic Wire Based Devices—Continued**OWG4 • 9:00 a.m.**

Temperature-Insensitive Silicon Nano-Wire Ring Resonator, Jong-Moo Lee, Duk-Jun Kim, Ho-Kyun Ahn, Sang-Ho Park, Junghyung Pyo, Gyungock Kim; ETRL, Republic of Korea. We present a silicon nano-wire ring resonator with a temperature-dependent wavelength shift as low as 0.006 nm/°C by adjusting the mode volume of a SOI-based silicon waveguide covered with a polymeric material.

OWG5 • 9:15 a.m.

Realization of All-Fiber Tunable Filter and High Optical Power Blocker Using Thinned Fiber Bragg Gratings Coated with Carbon Nanotubes, Kien T. Dinh¹, Yong-Won Song¹, Shinji Yamashita¹, Sze Y. Ser²; ¹Univ. of Tokyo, Japan, ²Alnair Labs, Japan. Using thinned FBG coated with carbon nanotubes, we demonstrate that the reflection band can be controlled by in-line the optical power. We then realize an all-fiber tunable filter and a high optical power blocker.

OWH • Optical Modulators—Continued**OWH5 • 9:00 a.m.****Invited**

80-Gb/s DQPSK Modulator, Tetsuya Kawanishi¹, Takahide Sakamoto¹, Tetsuya Miyazaki¹, Masayuki Izutsu², Kaoru Higuma³, Junichiro Ichikawa³; ¹Natl. Inst. of Information and Communications Technology, Japan, ²Natl. Inst. of Information and Communication Technology, Japan, ³Sumitomo Osaka Cement Co., Ltd., Japan. We present high-speed differential quadrature-shift-keying modulators based on LiNbO₃ waveguide device technologies, which can be applicable for over 80 Gb/s transmission systems. Bias condition monitor technique is also investigated for automatic bias stabilization scheme.

Ballroom A

Ballroom B

Ballroom C

Ballroom D

Ballroom E

OWB • Nonlinear Amplifiers for Signal Processing—Continued

OWB7 • 9:30 a.m.
SBS Slow Light in Optical Fibers with 25-GHz-Bandwidth, Kwang-Yong Song, Kazuo Hotate; *Univ. of Tokyo, Japan*. Broadband slow light is demonstrated using stimulated Brillouin scattering in optical fibers based on double Brillouin pump. A 25-GHz bandwidth is achieved resulting in a variable time delay up to 10.9 ps with 37-ps pulses.

OWB8 • 9:45 a.m.
Efficient Stimulated Brillouin Scattering in Single-Mode Tellurite Glass Fiber, Kazi S. Abedin; *Natl. Inst. of Information and Communications Technology, Japan*. A Brillouin gain coefficient of 2.16×10^{-10} m/W, an order of magnitude larger than that of silica fiber, was measured in tellurite fiber. The Stokes shift and linewidth were 7.882 GHz and 23.6 MHz, respectively.

OWC • OPS/OBS—Continued

OWC6 • 9:30 a.m.
TCP-Aware Load-Balanced Routing in Optical Burst-Switched (OBS) Networks, Bharat Komatireddy, Deepak Chandran, Vinod M. Vokkarane; *Univ. of Massachusetts, USA*. TCP-over-OBS is a promising transport paradigm to support next-generation-Internet. Load-balanced OBS improves loss-performance. We identify the ill-effects of load-balancing on TCP-performance due to false-time-outs and false-triple-duplicates. We propose source-ordering to improve TCP-throughput by three-four times.

OWC7 • 9:45 a.m.
On the Upgrade of an Optical Code Division PON with a Code-Sense Ethernet MAC Protocol, B. Huiszoon, H. de Waardt, G.D. Khoe, A.M.J. Koonen; *Eindhoven Univ. of Technology, Netherlands*. We propose, for the first time, optical code-sense multiple access/collision detection to upgrade an optical code division passive optical network with minor modifications to transparently deploy Ethernet (or packet) based services.

OWD • PON Modulation Schemes—Continued

OWD7 • 9:30 a.m. Invited
Multi-User Asynchronous Coherent OCDMA System, Xu Wang¹, Naoya Wada¹, Ken-ichi Kitayama²; ¹*Natl. Inst. of Information and Communications Technology, Japan*, ²*Dept. of Electrical, Electronics and Information Systems, Osaka Univ., Japan*. Key techniques enabling asynchronous coherent OCDMA are discussed: to lower the interference level by ultra-long superstructured FBG encoder/decoder, optical threshold and multi-port encoder/decoder; to enhance system noise tolerance by forward-error-correction and differential-phase-shift-keying with balanced detection.

OWE • Ultrahigh Bitrates and FEC—Continued

OWE6 • 9:30 a.m.
100 Gb/s Transmission Using Bit-Interleaved LDPC-Coded Modulation, Ivan B. Djordjevic¹, Milorad Cvijetic², Lei Xu³, Ting Wang³; ¹*Univ. of Arizona, USA*, ²*NEC America, Inc., USA*, ³*NEC Labs America, USA*. An iterative bandwidth-efficient coded modulation scheme based on bit-interleaving, block-circulant low-density parity-check (LDPC) codes, and M-ary differential phase-shift keying suitable for high-speed transmission at 100 Gb/s (and above) is proposed.

OWE7 • 9:45 a.m.
Soft-Decoding of Low-Density Parity Check Codes for DPSK Signals, Keang-Po Ho^{1,2}, Hsi-Cheng Wang¹; ¹*Natl. Taiwan Univ., Taiwan*, ²*SiBEAM, USA*. The exact log-likelihood ratio for a direct-detection DPSK signal is derived analytically. A 7%-overhead low-density parity check (LDPC) code provides ~9.7 dB net coding gain.

10:00 a.m.–5:00 p.m. Exhibit Hall Open

10:00 a.m.–12:30 p.m. Coffee Break, Exhibit Hall

**OWH • Optical Modulators—
Continued****OWH6 • 9:30 a.m.**

Zero Chirp 10 Gb/s MQW InP Mach-Zehnder Transmitter with Full-Band Tunability, Ian Betty¹, Marcel G. Boudreau¹, Roberto Longone², Robert A. Griffin², Lloyd Langley²; ¹Bookham, Canada, ²Bookham, UK. Zero chirp operation across C-Band is reported for a 10 Gb/s zero-chirp MQW InP Mach-Zehnder modulator. The optimized design ensures low residual chirp over all wavelengths, confirmed by symmetric OSNR penalty measurements.

OWH7 • 9:45 a.m.

Single Chip Quad MZI Array in a 40 Gb/s AOLS Front-End, Panagiotis Zakynthinos¹, Dimitrios Apostolopoulos¹, Olga Zouraraki¹, Dimitrios Petrantonakis¹, George Theophilopoulos², Alistair Poustie³, Graeme Maxwell¹, Hercules Avramopoulos¹; ¹Natl. Technical Univ. of Athens, Greece, ²Res. Academic Computer Technology Inst., Greece, ³Ctr. for Integrated Photonics, UK. We present for the first time a quadruple array of MZI switches hybrid integrated on a single chip and package used to perform error-free clock, data recovery and label extraction for 40 Gb/s packets.

10:00 a.m.–5:00 p.m. Exhibit Hall Open

10:00 a.m.–12:30 p.m. Coffee Break, Exhibit Hall

10:00 a.m.–12:30 p.m.
JWA • Joint Poster Session I

JWA1

Bandwidth Enhanced Multimode Fiber with Multi-Singlemode Cores, Yandong Gong¹, Chao Lu²; ¹Inst. for InfoComm Res., Singapore, ²Hong Kong Polytechnic Univ., Hong Kong. By designing multi-cores across the fiber core area, the fiber only supports fundamental mode or fewer modes propagation. Therefore, the modal dispersion of the fiber has been suppressed and the bandwidth is greatly enhanced.

JWA2

Design Optimization of Trench Index Profile for the Same Dispersion Characteristics with SMF, Shoichiro Matsuo, Tomohiro Nunome, Takeshi Yoshida, Takahiro Hamada, Kuniharu Himeno; Fujikura Ltd., Japan. An optimized design on a trench index profile for bend-insensitive SMF is presented. The same dispersion characteristic with standard SMF with ultra low bending loss has been realized by optimization of trench index profile.

JWA3

Micro-Structured Fiber End Surface Grating for Monitoring Wavelength of Coarse WDM Signals, Woojin Shin, Ik-Bu Sohn, B.-A. Yu, Y. L. Lee, Y. C. Noh, S. C. Choi, J. M. Lee, D. K. Ko; *Advanced Photonics Res. Inst., Republic of Korea*. We propose fiber end-surface grating fabricated by inscribing micro-structure on cleaved surface of thermally expanded core fiber with femtosecond laser pulses. For monitoring of signals, the diffraction patterns according to the input wavelength were investigated.

JWA4

Single-Mode Air-Guiding Photonic Bandgap Fiber with Improved Broadband Transmission Characteristics: The Benefits of an Anti-Resonant Core Design, Tadashi Murao, Kunimasa Saitoh, Nikolaos Florous, Masanori Koshiba; *Div. of Media and Network Technologies, Graduate School of Information Science and Technology, Japan*. The condition for single-mode operation in photonic band-gap fibers (PBGFs) is investigated. If the silica-ring satisfies an anti-resonant condition, the PBGF with a realistic core exhibits a single-mode operation over a wide wavelength range.

JWA5

Ultra-Compact Long-Period Fiber Grating and Grating Pair Fabrication Using a Modulation-Scanned CO₂ Laser, Hon M. Chan, Eric Perez, Fares Alhassen, Ivan V. Tomov, Henry P. Lee; *Univ. of California at Irvine, USA*. A new method to inscribe a long-period grating (LPG) with strong grating (>25dB loss), short grating length (1.2cm) and low insertion loss (<1.0dB) by using a programmable sinusoidal-dithering, linearly scanned CO₂ laser beam is reported.

JWA6

SPM-Induced Spectral Broadening in Bismuth-Based Photonic Crystal Fiber, Tomoharu Hasegawa, Tatsuo Nagashima, Seiki Ohara, Naoki Sugimoto; *Asahi Glass Co., Ltd., Japan*. Self-phase-modulation-induced spectral broadening is observed in a 46 cm-long bismuth-based nonlinear photonic crystal fiber. Numerical consideration of nonlinear pulse propagation verifies that the low dispersion and high nonlinearity are achieved simultaneously.

JWA7

Statistical Study of a Novel Launch Scheme for High-Performance Electronic-Equalized Multimode-Fiber Links, Qing Sun, Jonathan D. Ingham, Richard V. Penty, Ian H. White; *Univ. of Cambridge, UK*. A novel launch scheme is proposed for multimode-fiber (MMF) links. Enhanced performance in 10 Gb/s MMF links using electronic equalization is demonstrated by statistical analysis of installed-base fiber.

JWA8

Polarization Echoes Based on Scatter Decorelation in Polarization Maintaining Fiber, Dawn K. Gifford, Mark E. Froggatt, Stephen T. Kreger, Matt S. Wolfe, Brian J. Soller; *Luna Technologies, USA*. High-resolution optical frequency domain reflectometry is used to observe fading of the polarization beat signature of PM fiber. Through dispersion management, a beat echo is observed at a later point in a fiber under test.

JWA9

Generation of Multi-Channel Short-Pulse Sources Using Nonlinear Optical Loop Mirror Based on Photonic Crystal Fiber, Yi Dong¹, Zhaohui Li², Changyuan Yu^{3,4}, Yang Jing Wen⁴, Yixin Wang⁴, Chao Lu⁵, Weisheng Hu¹, Tee Hiang Cheng²; ¹State Key Lab of Advanced Optical Communication Systems and Networks, Shanghai Jiao Tong Univ., China, ²Nanyang Technological Univ., Singapore, ³Natl. Univ. of Singapore, Singapore, ⁴Inst. for InfoComm Res., A*STAR, Singapore, ⁵Dept. of Electronic and Information Engineering, Hong Kong Polytechnic Univ., Hong Kong. Fourteen C+L-band synchronized multi-channel short pulse sources are generated based on XPM and FWM effects in nonlinear optical loop mirror. Walk-off effect is reduced effectively by using 10m high nonlinear dispersion flattened photonic crystal fiber.

JWA10

A Mode-Locked Bi-Doped Fiber Laser, Alexandr A. Krylov¹, Eugeny M. Dianov¹, Vladislav V. Dvoyrin¹, Peter G. Kryukov¹, Valery M. Mashinsky¹, Oleg G. Okhotnikov², M. Guina²; ¹FORC of RAS, Russian Federation, ²Optoelectronics Res. Ctr., Tampere Univ. of Technology, Finland. Mode-locking is obtained for the first time in Bi-doped fiber laser. Stable 50-ps laser pulses with a pulse repetition rate of 13 MHz are generated at a wavelength of 1161.6nm with 2 mW average power.

JWA11

Turbulent Broadening of a Raman Fiber Laser Spectrum, Sergey A. Babin, Dmitriy V. Churkin, Arsen E. Ismagulov, Sergey I. Kablukov, Evgeny V. Podivilov; *Inst. of Automation and Electrometry, Russian Acad. of Sciences, Russian Federation*. An analytical wave kinetic theory has been developed that describes a Raman fiber laser (RFL) generation spectrum. A four-wave mixing between RFL longitudinal modes in turbulent regime is shown to be the main broadening mechanism.

JWA12

Amplifier Performance of Double-Clad Er/Yb-Doped Fiber with Cross-Section Tailored for Direct Splicing to the Pump and Signal Fibers, Pavel Peterka¹, Ivan Kasik¹, Vlastimil Matejec¹, Miroslav Karasek¹, Jiri Kanka¹, Pavel Honzatko¹, Vaclav Kubecek²; ¹Inst. of Radio Engineering and Electronics, Czech Republic, ²Faculty of Nuclear Sciences and Physical Engineering, Czech Technical Univ., Czech Republic. We present characterization of an optical fiber amplifier based on a newly developed double-clad erbium- and ytterbium-doped fiber and pumping method, where the pump and signal fibers are directly spliced to the gain fiber.

JWA13

SBS Slow Light in High Nonlinearity Photonic Crystal Fiber, Yin Wang, Wei Zhang, Yidong Huang, Jiande Peng; *Dept. of Electronic Engineering, Tsinghua Univ., China*. Up to 14-ns delay is achieved by the SBS slow light in a 25-m long high nonlinearity photonic crystal fiber. The high delay efficiency improves the control rate of SBS slow light systems.

JWA14

Gain-Independent SBS Based Slow Light in Optical Fibers, Thomas Schneider, Markus Junker, Kai-Uwe Lauterbach, Ronny Henker; *Deutsche Telekom AG, Germany*. We show a simple method to decouple the delay in SBS-based slow-light systems from the Brillouin Gain. With this approach the maximum time delay can be enhanced to more than 100ns in one fiber segment.

JWA15

Electronic EDFA Gain Control for the Suppression of Transient Gain Dynamics in Long-Haul Transmission Systems, Stephan Pachnicke¹, Martin Obholz¹, Edgar Voges¹, Peter M. Krummrich², Erich Gottwald²; ¹Univ. of Dortmund, Germany, ²Siemens AG, Com. Fixed Networks, Germany. An electronic feedback gain control for the suppression of transients in EDFA chains is analyzed. It is shown that the optimal parameters for a single amplifier do not lead to optimal results for cascaded EDFAs.

10:00 a.m.–12:30 p.m.
JWA • Joint Poster Session I—Continued

JWA16

A Novel High Frequency Magnetostrictive Composite-Fiber Bragg Grating Sensor, H. I. Liu¹, H. Y. Tam¹, Ching Yin Lo², Siu Wing Or²; ¹Photonics Res. Ctr., Dept. of Electrical Engineering, Hong Kong Polytechnic Univ., China, ²Dept. of Applied Physics, Hong Kong Polytechnic Univ., China. A high frequency magnetostrictive composite-fiber Bragg grating (MC-FBG) sensor using novel epoxy-bonded Terfenol-D particulate magnetostrictive composite is proposed and experimentally demonstrated. The MC-FBG sensor exhibits a high frequency response up to at least 60 kHz.

JWA17

Light-Controlled Reconfigurable Fiber Bragg Gratings Written in Attenuation Fiber, Dragan Coric¹, Rodrigue Chatton¹, Yari Luchessa¹, Hans G. Limberger¹, René Salathé¹, Francois Caloz²; ¹EPFL-APL, Switzerland, ²Diamond SA, Switzerland. A novel type of light controlled fiber Bragg gratings written in attenuation fiber is demonstrated. The spectral reconfiguration can be controlled by the pump power, the pumping configuration, the grating position and the fiber attenuation.

JWA18

Residual Stress Effects on Post-Fabrication Resonance Wavelength Trimming of Long-Period Fiber Gratings, Katsumi Morishita, Akihiro Kaino; Osaka Electro-Communication Univ., Japan. Residual stress effects are examined by heating long-period gratings written in the fibers un-relaxed and relaxed the stress. It becomes evident that the trimming range of resonance wavelengths can be expanded by adjusting heating temperature.

JWA19

Pedestal Free Pulse Compression in Non-Uniform Fiber Bragg Gratings, Krishnamoorthy Senthilnathan¹, Ping Kong Alexander Wai¹, Kaliaperumal Nakkeeran²; ¹Hong Kong Polytechnic Univ., Hong Kong, ²Univ. of Aberdeen, UK. We present the compression of chirped Bragg solitary pulses near photonic band gap of nonlinear fiber Bragg gratings with exponentially decreasing dispersion. Compression factor of the proposed scheme is two times larger than adiabatic compression.

JWA20

An Ultrastable Wavelength Calibration Reference Constructed from an Athermal Mach-Zehnder Interferometer Filter, Jianzhong Hao¹, Chinyi Liaw², Zhaohui Cai¹, T. H. Cheng³, C. Lu⁴; ¹Inst. for Infocomm Res., Singapore, ²DenseLight Semiconductors Pte Ltd, Singapore, ³Nanyang Technological Univ., Singapore, ⁴Hong Kong Polytechnic Univ., Hong Kong. A wavelength reference was constructed by illuminating an athermal silica-based Mach-Zehnder interferometer filter with a broadband light source. The wavelength-voltage response of a Fabry-Perot tunable filter can be calibrated by using the constructed wavelength reference.

JWA21

Inline Cryogenic Temperature Sensors Based on the Excitation of Localized Plasmonic Oscillations in Metallic Nanoparticles Embedded into Photonic Crystal Fibers, Nikolaos J. Florous, Kunimasa Saitoh, Masanori Koshiba; Div. of Media & Network Technologies, Japan. We describe the operation of an inline temperature sensor based on the inclusion of metallic nanoparticles into a photonic crystal fiber. A robust sensing platform for spectroscopy and optical switching applications can be designed.

JWA22

Proposal for Miniaturized Interleaver with Flat-Top Passbands Utilizing Coupled-Resonator Optical Waveguide Rings in Photonic Crystals, Naoya Kono, Nobuhiro Yokoi, Kunimasa Saitoh, Masanori Koshiba; Graduate School of Information Science and Technology, Hokkaido Univ., Japan. The introduction of coupled-resonator optical waveguides to ring resonators in the IIR filter configuration enables a miniaturized interleaver with wide flat-top passbands. A wavelength-insensitive photonic crystal directional coupler with two decoupling points is also presented.

JWA23

Integrated Optical Filter with Fast Electrically Reconfigurable Transfer Function, Poonam Arora¹, Igor V. Il'ichev², Alexander V. Chamray², Alexander S. Kozlov², Victor M. Petrov², Juergen Petter¹, Theo Tschudi¹; ¹Inst. of Applied Physics, TU Darmstadt, Germany, ²A.F. Ioffe Physical Technical Inst., Russian Federation. We demonstrate here an integrated optical filter based on lithium niobate, with fast electrically reconfigurable transfer function. The technique is based on phase-shift keying of the reflection Bragg grating in a waveguide.

JWA24

Multiple Filter Functions Integrated into Multi-Port GFF Components, Rad Sommer^{1,2}, Rance M. Fortenberry¹, Barrie Flinham², Paul C. Johnson²; ¹Bookham, Inc., USA, ²Bookham, Inc, UK. This paper demonstrates integration of multiple filter functions into a single component improving system performance and cost. Designs for producing low gain-ripple EDFAs are introduced integrating novel composite multi-port thin film GFF components.

JWA25

A Novel Approach to Reduce Waveguide Intersection Loss of HIC Materials, Zhonghua Zhu¹, Zhipeng Wang¹, Shih-Jung Chang², Y.J. (Ray) Chen¹; ¹Univ. of Maryland, Baltimore County, USA, ²ITRI, Taiwan. We have demonstrated a novel-universal-design to reduce waveguide-intersection-loss of HIC-material for ultra-compact PLC. It provides better-performance and feature-size-efficiency. We have successfully applied the scheme to $\Delta=1.5\%$, $\Delta=17\%$, and SOI materials and verified experimentally on $\Delta=1.5\%$ -material.

JWA26

Switchable All-Optical 188-ps Delay Line in AlGaAs, Rajiv Iyer¹, Alan D. Bristow¹, Zhenshan Yang¹, J. Stewart Aitchison¹, Henry M. van Driel¹, John E. Sipe¹, Arthur L. SmirF¹; ¹Univ. of Toronto, Canada, ²Univ. of Iowa, USA. An integrated AlGaAs all-optical 188-ps delay line is characterized over the C- and L-bands. Self-switching by input intensity is achieved using a nonlinear directional coupler and a racetrack delay line.

JWA27

Estimation of Absorption Loss in Siloxane-Based Materials Implemented as Passive Optical Interconnects, Dengke Cai¹, Andreas Neyer¹, Rüdiger Kuckuk², Herbert Michael Heise²; ¹Fakultät für Elektrotechnik und Informationstechnik, Arbeitsgebiet Mikrostrukturtechnik (AG MST), Germany, ²ISAS-Inst. for Analytical Sciences, Germany. An empirical equation between integral band strength and intrinsic absorption loss of siloxane-based materials has been derived and loss limits were deduced for their potential implementation in datacom devices with consideration of different transmission distances.

JWA28

Phase-Error-Free, 1023-Chip OCDMA En/De-Coders Based on Reconstruction-Equivalent-Chirp Technology and Error-Correction Method, Yitang Dai¹, Xiangfei Chen¹, Yejin Zhang², Jie Sun², Shizhong Xie²; ¹Microwave Photonics Lab, China, ²Broadband Optical Network Res. Lab, China. Sampled-Bragg-grating-based DS-OCDMA en/de-coders with 1023 chips are demonstrated firstly by the reconstruction-equivalent-chirp (REC) technology. The impacts of different types of phase errors are analyzed. Error-free performance is achieved by REC-based correction method.

JWA29

Tolerance to Optical Feedback of 10 Gbps Quantum-Dash Based Lasers Emitting at 1.55 μm , Shéhérazade Azouigui^{1,2}, Beatrice Dagens³, François Lelarge³, Jean-Guy Provost⁴, Alain Accard⁵, Frédéric Grillo⁶, Anthony Martinez¹, Q. Zou², Abderrahim Ramdane^{1,2}; ¹CNRS/LPN, France, ²Inst. Natl. des Télécommunications, France, ³Alcatel-Thales, France, ⁴Inst. Natl. des Sciences Appliquées, France. 10 Gbps operation of quantum-dash based lasers emitting at 1.55 μm is investigated under optical feedback. -24 dB maximum optical return loss tolerance is achieved, in spite of a relatively high linewidth enhancement factor.

JWA30

Grating Stabilized High Power 980nm Pump Modules, Guowen Yang, Vince Wong, Victor Rossin, Lei Xu, M. Everett, J. Hser, D. Zou, J. Skidmore, Erik Zucker; JDSU, USA. We describe the next generation high power, single-mode 980 nm laser diode for EDFA pumping. The FBG-stabilized pump modules produce 0.7 W kink-free power with superior reliability and performance.

10:00 a.m.–12:30 p.m.
JWA • Joint Poster Session I—Continued

JWA31

High-Speed Wavelength Tuning of Tunable Distributed Amplification DFB-LD in Long Haul Transmission, Kenichi Nakamoto, Satoshi Ide, Kazuyuki Mori, Kazumasa Takabayashi, Shigeaki Sekiguchi, Akinori Hayakawa, Haruhiko Kuwatsuka; Fujitsu Labs Ltd., Japan. We clarified for the first time the influence of tuning current noise on linewidth broadening and transmission for TDA-DFB-LD. Suppressing noise at higher frequencies, we demonstrated 300-ns high-speed wavelength switching without degradations in 80-km transmission.

JWA32

10 Gbit/s 1.55 μ m 25km Transmission at 90°C with New Self Thermally Compensated AlGaInAs Directly Modulated Laser, Christophe Jany, Jean Decobert, Francois Alexandre, Alexandre Garreau, Jean-Guy Provost, Olivier Drisse, Estelle Derouin, Fabrice Blache, Jean Landreau, Nadien Lagay, Florence Martin, Daniele Carpentier, Christophe Kazmierski; Alcatel-Thales III-V Lab, France. Large Positive Detuning is used for self thermal compensation of threshold and power variation in AlGaInAs DFB lasers. 25km uncompensated and non-amplified SMF transmissions are demonstrated at a constant bias current from 20°C to 90°C.

JWA33

Dual-Resonance Frequency Response in Injection-Locked 1.55 μ m VCSELs, Behnam Faraji¹, Lukas Chrostowski¹, Werner Hofmann², Markus-Christian Amann²; ¹Univ. of British Columbia, Canada, ²Technische Univ. Munchen, Germany. In this study, 1.55 μ m VCSELs with slightly detuned polarisation modes are injection-locked with controlled polarisation angles. A dual-resonance frequency response is observed, and is explained with a two polarisation-mode injection-locked rate equation model.

JWA34

Effective Gain Clamping of Semiconductor Optical Amplifiers by Injecting Broad-Band Self-Generated Amplified Spontaneous Emission, Jungmi Oh, Donghan Lee; Chungnam Natl. Univ., Republic of Korea. A conventional SOA is effectively gain-clamped by the injection of self-generated broad-band amplified spontaneous emission. The gain is clamped up to an input power of -2 dBm with an output power in excess of 11dBm.

JWA35

40 Gb/s Both Inverted and Non-Inverted Wavelength Conversion Based on Transient XPM of SOA, Jianji Dong¹, Xinliang Zhang¹, Jing Xu¹, Dexiu Huang¹, Songnian Fu², P. Shum², Liren Zhang², Y. D. Gong³; ¹Wuhan Natl. Lab for Optoelectronics, Huazhong Univ. of Science and Technology, China, ²Network Technology Res. Ctr., Nanyang Technological Univ., Singapore, ³Inst. for InfoComm Res., Singapore. We demonstrate 40 Gb/s inverted and non-inverted wavelength conversion (WC) in the C-band based on a SOA and an filter. The WC is non-inverted regardless if the filter is blue- or red-shifted.

JWA36

All-Optical Multi-Wavelength Conversion with Negative Power Penalty by a Commercial SOA-MZI for WDM Wavelength Multicast, Ni Yan, Hyun-Do Jung, Idelfonso Tafur Monroy, Huug de Waardt, Ton Koonen; TU Eindhoven, Netherlands. WDM wavelength multicast is demonstrated by all-optical multi-wavelength conversion at 10 Gb/s using a commercial SOA-MZI. We report for the first time simultaneous one-to-four conversion with negative power penalty of 1.84 dB.

JWA37

Study of a Multi-Wavelength Regenerative Subsystem Based on Quantum Dot Semiconductor Optical Amplifiers at 40Gbps, Maria Spyropoulou, Stelios Sygletos, Ioannis Tomkos; Athens Information Technology, Greece. For the first time to our knowledge we perform a study related with multi-wavelength 2R regeneration based on cross-gain modulation (XGM) operation at 40Gbps using quantum-dot semiconductor optical amplifiers (QD-SOAs).

JWA38

Novel Si-Based CMOS Optoelectronic Switching Device Operating in the Near Infrared, Ali K. Okyay, Abhijit J. Pethé, Duygu Kuzum, Salman Latif, David A. B. Miller, Krishna C. Saraswat; Stanford Univ., USA. A novel, high performance optoelectronic switch is introduced. The device is a Si-MOSFET with Ge gate that can be fabricated at the nanoscale with very low capacitance. Current gain of up to 1000X is demonstrated.

JWA39

Performance and Design Guidelines for Silicon-Based Micro-Ring Modulators in 10-Gbit/s Systems, Lin Zhang¹, Yunchu Li¹, Jengyuan Yang¹, Bo Zhang¹, Ray Beausoleil², Alan E. Willner¹; ¹Dept. of Electrical Engineering, Univ. of Southern California, USA, ²HP Labs, USA. System effects of three micro-ring modulators are investigated. Dual-waveguide-structure, modulating a RZ signal, is the optimal modulator with 10-dB higher Q-factor. By detuning the modulator and reducing chirp, Q-factor is further increased by 3-dB.

JWA40

Patterning of Errors in 40 Gbit/s WDM RZ-DBPSK SMF/DCF Optical Transmission System, Michail P. Fedoruk¹, Sergei K. Turitsyn², Olga V. Shtyrina¹, Marina V. Zakharyuta¹, Aleksei V. Yakasov¹, Alex Shafarenko³, Steve R. Desbruslais⁴, Ken Reynolds⁴, Robin Webb⁵; ¹Inst. of Computational Technologies, Russian Federation, ²Aston Univ., UK, ³Univ. of Hertfordshire, UK, ⁴Azea Networks, UK, ⁵Cable and Wireless Submarine Systems, UK. Through extensive direct modelling we quantify patterning effects in a WDM RZ-DBPSK fibre link at 40 Gbit/s channel rate. We demonstrate BER improvement through skewed channel pre-encoding reducing the occurrence of the most dangerous triplets.

JWA41

Impact of Walk-off on FWM in RZ-OOK Transmission, Adnan Akhtar¹, Lacro Pavel¹, Shiva Kumar²; ¹Univ. of Toronto, Canada, ²McMaster Univ., Canada. A model for FWM including pulse walk-off is developed to include degenerate and nondegenerate FWM. It is seen that the walk-off contribution is filtered out for typical RZ-OOK systems. Excellent agreement obtained with SSF simulations.

JWA42

2.5-Tb/s (256 x 12.4 Gb/s) Transmission of 12.5-GHz-Spaced Ultra-Dense WDM Channels over a Standard Single-Mode Fiber of 2000 km, Gyo-Sun Hwang¹, Un-Seung Pyun¹, Sung-Ho Kim¹, Youngchul Chung¹, Jae-Seung Lee¹, Byoung-Whi Kim²; ¹Kwangwoon Univ., Republic of Korea, ²WPON Technology Team, BcN Res. Div., Electronics and Telecommunications Res. Inst., Republic of Korea. We present a 2.5-Tb/s transmission of 12.5-GHz-spaced ultra-dense WDM channels over a standard SMF of 2000 km. The channels are NRZ modulated and only C-band EDFAs are used with the repeater spacing of 100 km.

JWA43

Enhanced Self-Coherent Optical Decision-Feedback-Aided Detection of Multi-Symbol M-DPSK/PolSK in Particular 8-DPSK/BPolSK at 40 Gbps, Moshe Nazarathy¹, Yoav Yadin¹, Meir Orenstein¹, Yannick Lize², Louis Christen², Alan Willner²; ¹Technion, Israel, ²Univ. of Southern California, USA. Direct-detection sensitivity for M-DPSK/BPolSK with large M is improved generating self-coherent gain without an actual local oscillator light source by means of a novel Optical Decision-Feedback-Aided Tapped-Delay-Line-Interferometer, along with 90deg optical hybrid, and analog post-processing.

JWA44

Impact of Modulation Format on the Performance of Fiber Optic Communication Systems with Transmitter-Based Electronic Dispersion Compensation, Yihong Mauro, Sergey Lobanov, Srikanth Raghavan; Corning Inc., USA. We analyze the performance of 10.7 Gb/s G.652 fiber optic systems with transmitter-based EDC and advanced modulation formats and find that RZ-type formats offer ~2 dBQ advantage over NRZ-type formats due to their broader spectrum.

JWA45

44 Gb/s WDM Transmission for Transoceanic Distance Using $\pi/2$ Alternate-Phase RZ Modulation Scheme, Abhijeet Shirgurkar, M. I. Hayee; Univ. of Minnesota at Duluth, USA. We have explored the feasibility of 44 Gb/s WDM transmission over a transoceanic distance using $\pi/2$ -Alternate-Phase RZ modulation format. We find that $\pi/2$ -Alternate-Phase RZ performs more than 3dB better than regular RZ or carrier-suppressed RZ.

10:00 a.m.–12:30 p.m.
JWA • Joint Poster Session I—Continued

JWA46

Suppression of ASE Noise in the Signal Band by the Spectral Spread Technique, Koji Igarashi, Kazuhiro Katoh, Kazuro Kikuchi; *Univ. of Tokyo, Japan*. We propose a novel method of suppressing the in-band ASE noise from optical amplifiers by means of the spectral spread technique. The receiver-sensitivity improvement of 1.5 dB is demonstrated experimentally by using our scheme.

JWA47

Design and Performance of High-Rate Irregular LDPC Codes for Turbo Equalization of PMD Channels, Torsten Schorr¹, Wolfgang Sauer-Greff¹, Ralph Urbansky¹, Herbert F. Haunstein^{2,3}; ¹*Univ. of Kaiserslautern, Germany*, ²*Univ. of Erlangen-Nuernberg, Germany*, ³*Lucent Technologies Network Systems, Germany*. Applying LDPC codes to turbo equalization of PMD channels requires them to be adopted to the equalizer. A design using fitted EXIT functions offers improved SNR tolerance of ca. 5dB compared to MLSE equalization.

JWA48

Provision of Independent Services in WDM-Passive Optical Networks Using Closely Separated Dual Baseband Channels, Chien Aun Chan, Manik Attygalle, Thas Nirmalathas; *Natl. ICT Australia, Univ. of Melbourne, Australia*. We demonstrate a simple scheme for the generation and separation of two independent high bandwidth baseband optical channels using a single laser and modulator for provision of independent services in WDM passive optical networks.

JWA49

Optical Phase-Locked Loop for Coherent Transmission over 500 km, Keisuke Kasai, Masato Yoshida, Masataka Nakazawa; *Res. Inst. of Electrical Communication, Tohoku Univ., Japan*. We have realized an optical phase-locked loop for coherent transmission over 500 km using heterodyne detection with a ¹³C₂H₂ frequency-stabilized fiber laser. The phase error variance of the intermediate frequency signal was 7.9x10⁻³ rad.

JWA50

Data-Dependent Effects on Jitter Measurement, Ken Mochizuki, Kazuhiko Ishibe; *Anritsu Corp., Japan*. Data-dependent jitter of transmitter for Non-Framed PRBS and SDH-Framed signal were simulated. The results showed that jitter evaluation for transmitters should be identical to the Framed pattern used at the final equipment testing.

JWA51

Enhanced Tolerance to Demultiplexing Misalignment in an OTDM System with Hybrid RZ-ASK/DPSK Formats, Ning Deng, Chun-Kit Chan; *Chinese Univ. of Hong Kong, Hong Kong*. We propose a novel OTDM scheme with hybrid RZ-ASK/RZ-DPSK formats and investigate its demultiplexing performance. Experiment showed the tolerances to demultiplexing timing misalignment were improved by 180% and 70%, for RZ-ASK and RZ-DPSK channels, respectively.

JWA52

Robust Long-Haul Transmission Utilizing Electronic Precompensation and MLSE Equalization, Yannis Benlachtar, Seb J. Savory, Benn C. Thomsen, Giancarlo Gavioli, Polina Bayvel, Robert I. Killey; *Univ. College London, UK*. We experimentally assess the performance of 11-Gb/s NRZ-OOK transmission systems utilizing both electronic predistortion and MLSE equalization. The required accuracy of the EPD, after 1040km, can be relaxed to +/- 1400ps/nm using an 8-state Viterbi algorithm.

JWA53

Adaptive Pulse Shaping through BER Feedback, Steve Webb¹, Stephen R. Desbruslais¹, Michail P. Fedoruk², Sergei K. Turitsyn³; ¹*Azea Networks Ltd, UK*, ²*Inst. of Computational Technologies, Russian Federation*, ³*Aston Univ., UK*. We propose a simplified approach to optical signal predistortion based on Adaptive Pulse Shaping through unconventional use of a MZ modulator. The scheme allows natural tailoring of transmitted pulses by optimising the received pulse.

JWA54

Bidirectional DFEs for 10Gb/s Ethernet over Multimode Fiber Links: Complexity Reduction and Reach Extension, Kasyapa Balemorthy, Stephen E. Ralph; *Georgia Tech, USA*. We propose a bidirectional DFE (BiDFE) to mitigate ISI in multimode fibers. We demonstrate that a BiDFE with 8 feedforward and 3 feedback taps per DFE can achieve a reach of 350-400m over legacy MMF.

JWA55

Ultra-Wide Band λ -Converter with Regeneration Properties Based on Cross Phase Modulation Effect in Highly Nonlinear Dispersion Flattened Fiber, Davide Massimiliano Forin^{1,2}, Giorgio Maria Tosi Beleffi¹, Franco Curti¹, Stefano Taccheo³, Karin Ennser³, Miroslav Karasek⁴, Antonio Teixeira⁵; ¹*ISCOM, Italy*, ²*Univ. di Roma, Tor Vergata, Italy*, ³*Politecnico di Milano, Italy*, ⁴*Czech Acad. of Sciences, Czech Republic*, ⁵*Inst. de Telecomunicações, Univ. de Aveiro, Portugal*. We experimentally demonstrate and theoretically verify for what is believed to be the first time that an almost unlimited bandwidth λ -conversion can be achieved. 2R-functionality is also reported. Effect is based on cross-phase modulation.

JWA56

Digitally Tunable Optical Frequency Converter Based on Optical SSB Modulators and Mach-Zehnder Interferometers, Katsushi Iwashita, Kimiaki Nakajima; *Kochi Univ. of Technology, Japan*. A digitally tunable optical frequency converter using optical SSB modulators and Mach-Zehnder interferometers has been proposed. The optical frequency up-conversion and down-conversion of this converter is controlled by varying the bias voltage of the modulator.

JWA57

All-Optical Carrier Phase and Polarization Recovery Using a Phase-Sensitive Oscillator, Inwoong Kim¹, Kevin Croussore¹, Xiaoxu Li¹, Guifang Li¹, Tomoharu Hasegawa², Naoki Sugimoto²; ¹*College of Optics and Photonics, CREOL and FPCE, USA*, ²*Asahi Glass Co., Japan*. An all-optical carrier phase and polarization recovery scheme from PSK signals is proposed and demonstrated for the first time. The scheme uses a phase-sensitive optical oscillator with a phase sensitive amplifier as the gain block.

JWA58

Linear-Distortion Compensation Using XPM with Parabolic Pulses, Trina T. Ng, Francesca Parmigiani, Morten Ibsen, Zhaowei Zhang, Periklis Petropoulos, David J. Richardson; *ORC, Univ. of Southampton, UK*. We experimentally demonstrate a novel all-optical, all-fiberized scheme that can eliminate linear perturbations in the time domain. The technique relies on converting these distortions from time to frequency domain using parabolic pulses shaped using SSFBG.

JWA59

An All-Optical PCI-Express Network Interface for Optical Packet Switched Networks, Odile Liboiron-Ladouceur, Howard Wang, Keren Bergman; *Columbia Univ., USA*. We report on the implementation of a power-efficient, low-latency edge node PCI-Express interface to a WDM optical packet switched network. Scalability is examined under the limits set by PCI-Express jitter specification on the packet propagation.

JWA60

Performance Investigation of Tunable Optical Delay for ASK and DPSK Signals Using Four-Wave Mixing Wavelength Conversion in a Bismuth Oxide Highly Nonlinear Fiber, Mable P. Fok, Chester Shu; *Chinese Univ. of Hong Kong, Hong Kong*. A compact fiber-optic approach is demonstrated for an optically controlled variable delay for 10-Gb/s ASK and DPSK signals using four-wave mixing and group velocity dispersion. The measured power penalty is less than 4 dB.

10:00 a.m.–12:30 p.m.
JWA • Joint Poster Session I—Continued

JWA61

Employing VCSELs Injection-Locked and Optoelectronic Feedback Techniques to Setup a Bidirectional Radio-on-DWDM Transport System, Hai-Han Lu, Wen-I Lin, Yao-Wei Chuang, Shah-Jye Tzeng, Wen-Jeng Ho; *Natl. Taipei Univ. of Technology, Taiwan*. A bidirectional radio-on-DWDM transport system based on VCSELs injection-locked and optoelectronic feedback techniques is proposed and demonstrated. Good performances of BER, EVM, and IMD/C were obtained in our proposed bidirectional radio-on-DWDM transport systems.

JWA62

Vector Signal Transmission in ROF System Employing Optical Carrier-Suppressed Modulation Scheme, Kai Wang, Xiaoping Zheng, Hanyi Zhang, Yili Guo; *Tsinghua Univ., China*. For the first time, optical carrier-suppressed modulation scheme is employed to transmit vector signals in ROF system. Advantages of simple structure, doubled radio frequency and dispersion immunity are demonstrated by theoretical analysis and experiments.

JWA63

Suppressed Carrier Optical Transmitter with Intracavity Modulation for Coherent Analog Optical Links, Yu-Chueh Hung¹, Bartosz Bortnik², Harold R. Fetterman¹, Rick Forber², Wen Wang²; ¹*Univ. of California at Los Angeles, USA*, ²*IPITEK Inc., USA*. A suppressed carrier optical heterodyne link was demonstrated with high dynamic range. An efficient laser ring oscillator is proposed where an intracavity modulator outputs a suppressed carrier signal while recirculating the carrier around the ring.

JWA64

Employing Mutually Injection-Locked Fabry-Perot Laser Diodes to Setup a Hybrid WDM Transport System, Hai-Han Lu¹, Wen-I Lin¹, Yao-Wei Chuang¹, Cheng-Ling Ying²; ¹*Natl. Taipei Univ. of Technology, Taiwan*, ²*Jin-Wen Inst. of Technology, Taiwan*. A hybrid WDM transport system based on mutually injection-locked FP LDs for CATV, 256-QAM and OC-48 transmission is proposed and demonstrated. Mutually injection-locked FP LDs as broadband light source could be relatively simple and cost-effective.

JWA65

12 Channels 20GHz Programmable Integrated Optical Analog Receiver for WDM Network, Salah Khodja, Raj Dutt, James Chan; *APIC Corp., USA*. We have designed fabricate and tested a 12x20GHz programmable integrated optical analog receiver for WDM network. The analog receiver is able to receiver any of the 12 WDM channels each with a bandwidth of 20GHz.

JWA66

Demonstration of a Time-Domain Wavelength Interleaved Network Prototype without Optical Buffers and Fast Switches in the Core Nodes, Yikai Su¹, Indra Widjaja², Hao He¹, Xinyu Xu¹, Yue Tian¹, Junming Gao¹, Tong Ye¹; ¹*Shanghai Jiao Tong Univ., China*, ²*Bell Labs, Lucent Technologies, USA*. We demonstrate a packet-switched network prototype without the needs for optical buffers and fast switches in the core. This network architecture is based on time-domain wavelength interleaving of data packets.

JWA67

All-Optical Serial Multicast Mode and Experiment, Xin Liu, Weimin Wang, Hui Feng Bai, Hongxiang Wang, Yuefeng Ji; *Beijing Univ. of Posts and Telecommunications (BUPT), China*. A novel all-optical serial multicast mode is proposed and experimentally researched in this paper. It can implement the storage, duplication, and serial export of the optical multicast packets and increase the multicast success ratio.

JWA68

An Optimal Algorithm to Fairly Distribute WDM Signals Using Finite Combinations of Discrete Optical Splitters, Cedric F. Lam; *OpVista Inc., USA*. I describe a network planning algorithm to distribute multi-wavelength WDM optical signals fairly to receivers of different sensitivities in a broadcast-and-select environment with optimal system performance.

JWA69

Considering Transmission Impairments in RWA Problem: Greedy and Metaheuristic Solutions, Gloria Bogliolo, Vittorio Curri, Marco Mellia; *Politecnico di Torino, Italy*. We face the RWA problem considering physical impairments. After proposing a simple, fast but accurate model for the physical layer that considers dynamic impairments, we devise both greedy and metaheuristic algorithms to solve RWA problems.

JWA70

A Testbed for Multi-Granularity Optical Switching Network, Wu Jia, Song Yu, Jie Zhang, Wanchun Yang, Yuegang Xu, Yongjun Zhang, Wanyi Gu; *Beijing Univ. of Posts and Telecommunications, Key Lab of OCLT, Ministry of Education, China*. This paper presents a novel testbed for Multi-Granularity Optical Switching Network. All the related hardware and protocols are realized. The functions of the testbed are verified via experiment and numerical simulation.

JWA71

Experimental Demonstration of Protection Mechanism in OBT Ring Network, Jaedon Kim¹, Saurav Das¹, Jinwoo Cho¹, Leonid G. Kazovsky¹, Ching-Fong Su², Richard Rabbat², Takeo Hamada²; ¹*Stanford Univ., USA*, ²*Fujitsu Lab of America, USA*. The optical burst transport network is a novel WDM ring network architecture and protocol. In this paper, we investigate network protection of OBT network. The result shows fast link restoration at the OBT ring network.

JWA72

Network Performability Evaluation for Different Routing Schemes, Gaurav Agrawal¹, Kostas N. Oikonomou², Rakesh K. Sinha²; ¹*Univ. of Missouri, USA*, ²*AT&T Labs Res., USA*. We compare the performance of three different schemes for selecting restoration paths in a typical inter-city backbone network under 500,000 single and multiple failure scenarios.

JWA73

Two-Tier Path Based Shared Mesh Restoration, Manish Bhardwaj, Leon McCaughan; *Univ. of Wisconsin at Madison, USA*. We analyze the restoration capacity and time of a two-tier shared mesh restoration scheme. We discuss two different optimization strategies for the two-tier restoration scheme and resulting restoration capacity savings and performance improvements.

JWA74

Applying p-Cycles in Dynamic Provisioning of Survivable Multicast Sessions in Optical WDM Networks, Feng Zhang, Wen-De Zhong; *Nanyang Technological Univ., Singapore*. Network survivability is crucial to multicast traffic. We propose applying p-cycles to dynamic provisioning of survivable multicast traffic. We show that p-cycle-based multicast protection approaches offer better performance compared with other shared multicast protection approaches.

JWA75

On Using Optical-Layer Link Information Parameters in Distributed Impairment Constraint-Based Routing, Carolina Pinart¹, Hiroaki Harai²; ¹*CTC. Tecnologic de Telecomunicacions de Catalunya, Spain*, ²*Natl. Inst. of Information and Communications Technology, Japan*. Impairments are a major issue in transparent networks. Impairment-aware routing (ICBR) proposals require complex analytical models that are unsuitable in distributed environments. We propose an aggregation method to obtain optical-layer link parameters for distributed ICBR.

JWA76

Design and Experimental Demonstration of Novel Optical Router Controller Capable of Asynchronous, Variable-Length Packet Switching and Contention Resolution, Haijun Yang, Zuqing Zhu, Bo Xiang, Wei Jiang, Venkatesh Akella, Chen-Nee Chuah, S.J.B. Yoo; *Univ. of California at Davis, USA*. This paper proposes the efficient design and implementation of a hierarchical optical router controller supporting asynchronous, variable-length optical packets. A network testbed experiment demonstrates very effective switching and contention resolution of asynchronous, variable-length optical packets.

JWA77

A Novel Load Balancing Deflection Routing Strategy in Optical Burst Switching Networks, Yu Du, Chunlei Zhu, Xiaoping Zheng, Yili Guo, Hanyi Zhang; *Dept. of Electronic Engineering, Tsinghua Univ., China*. A novel load balancing deflection routing algorithm is proposed to provide optimized alternative routing path selection. Simulations show that the burst drop probability is significantly reduced compared to traditional deflection routing strategy.

10:00 a.m.–12:30 p.m.
JWA • Joint Poster Session I—Continued

JWA78

Security Enhanced OCDMA System Based on Incoherent Broadband Light Source and Bipolar Coding, HwanSeok Chung, SunHyok Chang, BongKyu Kim, Kwangjoon Kim; ETRI, Republic of Korea. We demonstrate security enhanced OCDMA scheme using incoherent broadband light source and bipolar coding. To guarantee successful transmission of OCDMA signal and to prevent eavesdropping for an authorized user, we also present analytical results.

JWA79

Security-Enhanced SPECTS O-CDMA Demonstration Across 150 km Field Fiber, Nicolas K. Fontaine¹, Chunxin Yang², Ryan P. Scott², Vincent J. Hernandez², Katsu Okamoto¹, David L. Harris³, Jonathan P. Heritage¹, Brian H. Kolner², S. J. Ben Yoo¹; ¹Dept. of Electrical and Computer Engineering, Univ. of California, USA, ²Dept. of Applied Science, Univ. of California, USA, ³Advanced Technology Labs, USA. We demonstrate security-enhanced, multi-user SPECTS O-CDMA transmission across 150 km of field fiber. The testbed incorporates a fully integrated silica AWG spectral phase encoder/decoder, and tunable dispersion slope compensation. Error-free performance is achieved using FEC.

JWA80

A Novel Scalable Multistage DWDM PON Architecture Using Cascaded Optical Interleavers with Increasing Periodicities Controlled in Central Offices, Oladeji B. Akanbi¹, Jianjun Yu², Georgios Ellinas³, Gee-Kung Chang¹; ¹Georgia Tech, USA, ²NEC Labs, USA, ³Univ. of Cyprus, Cyprus. A new multistage scheme for dense wavelength division multiplexed passive optical networks (DWDM PON) is proposed. This scheme is realized by cascading optical interleavers with increasing periodicities.

JWA81

Evolutionary Optical Access Network: Port-Share Based Scalable WDM Based Ethernet PON, NamUk Kim¹, Seung-Jin Lee¹, Minho Kang¹, Tae-Yeon Kim², Jeong-Ju Yoo², Byong-Whi Kim²; ¹Information and Communication Univ., Republic of Korea, ²WDM Passive Optical Network Team, BcN Res. Lab, Republic of Korea. Proposed scalable WDM based Ethernet PON aims to overcome small link capacity and ineffective link utilization of PONs by optimally combining TDM and WDM solutions while guaranteeing high port-share and flexibility required for evolutionary network.

JWA82

Performance Comparison of Directly-Modulated, Wavelength-Locked Fabry-Pérot Laser Diode and EAM-Modulated, Spectrum-Sliced ASE Source for 1.25 Gb/s WDM-PON, Chul Han Kim¹, Ju Han Lee², Dae Kwang Jung³, Young-Geun Han³, Sang Bae Lee²; ¹Univ. of Seoul, Republic of Korea, ²Korea Inst. of Science and Technology, Republic of Korea, ³Samsung Electronics, Republic of Korea. We compare the performance of wavelength-locked FP-LD and spectrum-sliced ASE source for WDM PON applications. The performance comparison is carried out in terms of intensity-noise and dispersion at 1.25 Gb/s over a conventional SMF links.

JWA83

TDM-PON Security Issues: Upstream Encryption Is Needed, David Gutierrez, Jinwoo Cho, Leonid G. Kazovsky; Stanford Univ., USA. TDM-PONs (E/B/GPON) present several security issues that can easily be exploited by malicious users. We summarize these issues and present experimental results to demonstrate that, in particular, upstream encryption is required to prevent eavesdropping.

JWA84

Centralized Wavelength Monitoring/Stabilization Technique by Dithering Temperature of LD in Power-Splitter-Based WDM-PON, Masamichi Fujiwara, Hiro Suzuki, Naoto Yoshimoto, Takamasa Imai; NTT Access Network Service Systems Labs, Japan. This paper proposes a simple and cost-effective wavelength monitoring/stabilization technique for upstream signals in a power-splitter-based dense WDM-PON. We present the concept and experimentally confirm the feasibility of this technique.

JWA85

Performance Analysis of Protection Schemes Compatible with Smooth Migration from TDM-PON to Hybrid WDM/TDM-PON, Jiajia Chen, Lena Wosinska; Royal Inst. of Technology, Sweden. We propose a novel protection scheme compatible with smooth migration from TDM-PON to WDM/TDM-PON. We show that our scheme is very cost-effective while keeping connection availability, recovery time and power budget at the acceptable level.

JWA86

Brillouin Scattering in Radio over Fiber Transmission, Hugues Le Bras, Maryse Moignard, Benoît Charbonnier; France Telecom R&D Division, France. Radio-over-Fiber signal transmission in Stimulated-Brillouin-Scattering (SBS)-limited systems is investigated. We found that SBS threshold is identical for 3G-RoF links and CW transmission and demonstrate that laser current modulation or increased SBS threshold fiber improves performance.

JWA87

Full-Duplex Wireless GbE Field Trial Employing Radio-over-Fiber Technologies, Antonio Ramirez¹, Valentin Polo¹, Miguel Angel Piqueras², Ruben Alemany¹, David Zorrilla², Javier Marti¹; ¹Valencia Nanophotonics Technology Ctr., Univ. Politécnica de Valencia, Spain, ²DAS Photonics S.L., Spain. A full-duplex radio-over fiber system for the transmission of Gigabit Ethernet signals in the mm-wave band has been demonstrated under a field trial, providing redundant connections and point-to-point wireless extension of optical GbE networks.

JWA88

Flexible Capacity Assignment in a Multi-wavelength Radio over Fiber Access Network, Beatriz Ortega, Jose Mora, Gustavo Puerto, Jose Capmany; ITEAM Res. Inst., Univ. Politécnica de Valencia, Spain. We present a novel architecture for radio-over-fiber access networks providing flexible capacity assignment. In a multiwavelength optical fiber network, a foldback AWG incorporating an optical switch enables an experimental demonstration of dynamically allocated multiservice capacity.

JWA89

Diverse Delay-Constrained Restoration Schemes, Ming Gong, Hassan Naser; Lakehead Univ., Canada. We present a novel shared restoration algorithm, called One-step Delay-constrained Pool Sharing algorithm which can avoid the trap-topology problem, minimize the total end-to-end delay along the working and backup paths, and reduce the capacity usage.

JWA90

3 Fiber Line Switched Ring, Praveen Chathmath, Anshuman Manral; Wipro Technologies, India. This paper describes a new optical network ring protection scheme, which leads to increased revenue and flexibility compared to existing protection schemes of 2 Fiber BLSR/MS-Spring and 4 Fiber BLSR/MS-Spring.

JWA91

A Novel, Multi-Service Add-Drop-Multiplexer Architecture for Access and Backhauling Applications with 4.3Gbit/s Line Rate, Henning Hinderthür, Lars Friedrich; ADVA, Germany. An ADM architecture with 4.3Gbit/s interface representing the current cost/band-width optimum for GbE services is presented. It offers high scalability, interface protection, and drop-and-continue support and is thus optimized for GbE access and backhauling applications.

JWA92

Demonstration of 1000km 43Gb/s RZ-DPSK Transmission through a 50GHz Channel Spaced WSS, Mark Zaacks¹, Uri Mahlab¹, Pavel Mamyshev², C. Rasmussen², Joe Calvitti³, Ken Falta³; ¹ECI Telecom, Israel, ²Mintera Corp., USA, ³Capella Photonics, USA. We demonstrate bandwidth-limited 1000km transmission of 43Gb/s RZ-DPSK signals. System bandwidth was limited via a MEMS-based wavelength-selective switch operating at 50GHz channel spacing. The system demonstrates increased tolerance to bandwidth limitation, noise and non-linearity.

JWA93

Measuring Contact Phenomenon in Multi-Fiber Optical Connectors, James Kevern; Tyco Electronics, USA. A novel method to ascertain the gap between fibers in a connector is presented. This information in conjunction with applied load provides a useful tool for investigating positive contact, especially in connectors utilizing MT ferrules.

Exhibit Hall

10:00 a.m.–12:30 p.m.
JWA • Joint Poster Session I—Continued

JWA94

Phase-Modulated Hybrid 40Gb/s and 10Gb/s DPSK DWDM Long-Haul Optical Transmission, *Le N. Binh, Thanh L. Huynh; Monash Univ., Australia*. Transmission of phase modulated 40Gb/s channels over three-span DWDM optically amplified communications systems. Impacts of optical filtering of 10 Gb/s on 40G are given. The mutual impacts of 10G and 40G co-transmission are minimal.

JWA95

Comparison of Sinusoidally Modulated Signal (SM)-SPM with CW-SPM Methods for Nonlinear Constant (n_2/A_{eff}) Measurement of Various Optical Fibers, *Yoshinori Namihira, Kazuya Miyagi, S. M. Abdur Razzak, Feroza Begum; Univ. of the Ryukyus, Japan*. It was found that the sinusoidally modulated signal based on SPM (SM-SPM) method was about 1% more accurate than CW-SPM method. Empirical equation between (n_2/A_{eff}) and A_{eff} for various optical fibers is proposed.

JWA96

EPON Deployment Challenges: Now and in the Future, *Bill McDonald; Centillium Communications, Inc., USA*. Even as several Asian telcos role out EPON en mass, they and other telcos are grappling with a number of challenges that effect their present and future deployments. This paper identifies and examines these challenges.

JWA97

Simply-Structured Optical Terminators Using Adhesive Polymer for Fiber Contact, *Masao Tachikura¹, Masaya Wakasa¹, Tomoyuki Nishio¹, Kanako Suzuki², Yoshihisa Kato², Kazumasa Ohsono², Nobuhiro Hashimoto³, Tomoki Furue³; ¹Advanced Cable Systems, Corp., Japan, ²Hitachi Cable, Ltd., Japan, ³Tomoe-gawa Co., Ltd., Japan*. We have investigated a simple structure for optical terminators. By tuning the refractive index of an adhesive polymer for fiber end contact, high return losses over 50 dB with SPC connectors have been obtained.

JWA98

Design and Fabrication of Ferroelectric All-Polymer Hollow Bragg Fibers for THz Guidance, *Maksim Skorobogatiy, Alexandre Dupuis, Ning Guo; Ecole Polytechnique de Montreal, Canada*. Hollow Bragg fiber operating near ferroelectric resonance of one of its reflector materials is considered. Depending upon operating frequency, lowest loss design is: a band gap fiber, fiber with metamaterial reflector or a ferroelectric tube.

12:30 p.m.–1:30 p.m. Lunch Break (on your own)

Ballroom A

1:30 p.m.–2:45 p.m.

OWI • Novel Fibers

Pauli Kiiveri; Lab of Optoelectronics, Helsinki Univ. of Technolo, Finland, Presider

OWI1 • 1:30 p.m.

Invited

Novel Fibers for Ultra-Short and High-Power Pulses, *Siddharth Ramachandran, Jeffrey W. Nicholson, Man F. Yan; OFS Labs, USA*. Light propagation in higher-order modes of few-mode fibers leads to unique dispersive properties that are challenging or impossible to achieve in conventional fibers. We will describe their application to devices utilising high-peak-power and ultra-short pulses.

Ballroom B

1:30 p.m.–3:30 p.m.

OWJ • Broadband Lasers

Shu Namiki; AIST, Japan, Presider

OWJ1 • 1:30 p.m.

Invited

Tunable Lasers Based on Silica Waveguide Ring Resonators, *Morio Takahashi, Shinya Watanabe, Mitsuru Kurihara, Takeshi Takeuchi, Yukari Deki, Sekizen Takaesu, Mika Horie, Takashi Miyazaki, Kouichi Suzuki, Naoki Sakuma, Asami Kawauchi, Hiroyuki Yamazaki; NEC Corp., Japan*. We developed a hybrid integrated tunable laser based on waveguide ring resonators using passive alignment technology. A compact chip having a wavelength locker, stable high output power and excellent mass-productivity was achieved.

Ballroom C

1:30 p.m.–3:30 p.m.

OWK • Network Control and Management

Neophytos Antoniadis; City Univ. of New York, USA, Presider

OWK1 • 1:30 p.m.

Invited

Techno-Economic Issues in Future Telecom Networks, *Andrew Lord, Martin Wade; British Telecom, UK*. Long-reach access coupled to a large flat all-optical core network via a core node switch is a strong contender for the most economic future network architecture. This paper looks at implications for the core.

Ballroom D

1:30 p.m.–3:30 p.m.

OWL • WDM PON

Soo Jin Park; KT Advanced Tech., Republic of Korea, Presider

OWL1 • 1:30 p.m.

Invited

Recent Research Activities of WDM-PON in Korea, *Hyung-Jin Park, Hosung Yoon, Taesong Park, Soo-Jin Park, Jin Hee Kim; Korea Telecom, Republic of Korea*. WDM-PON is viewed as a suitable next generation access network technology due to its capability of delivering high bandwidth and OPEX saving features. Several research activities and prospects of DWDM-PON are introduced and analyzed.

Ballroom E

1:30 p.m.–3:30 p.m.

OWM • Ultra-Longhaul Transmission

Martin Birk; AT&T Labs - Res., USA, Presider

OWM1 • 1:30 p.m.

A Performance Comparison of Differential and Coherent Detections over Ultra Long Haul Transmission of 10Gb/s BPSK, *Jeremie Renaudier¹, Gabriel Charlet¹, Patrice Tran¹, Massimiliano Salsi², Sebastien Bigo¹; ¹Alcatel Res. and Innovation, France, ²Univ. degli Studi di Parma, Italy*. Differential detection and coherent detection are compared experimentally after Ultra Long Haul transmission of 10Gb/s BPSK signals. Coherent detection is found to be less tolerant to fiber nonlinearities than differential detection one.

OWM2 • 1:45 p.m.

Upgrades of Non-Slope Matched Submarine Transmission Systems Using Differential Phase Shift Keying, *Lutz Molle¹, Christoph Caspar¹, Ronald Freund¹, Stephen Debruslais², Richard Oberland², Joerg Schwartz²; ¹Heinrich-Hertz-Inst., Germany, ²Azea Networks Ltd., UK*. This paper studies the performance of RZ-DPSK at 10, 20 and 40 Gbit/s for application on legacy, NZ-DSF based submarine systems. The study compares the up-graded performance regarding the originally provided modulation formats and bitrates.

Room 304 A/B

1:30 p.m.–3:30 p.m.

OWN • Microwave Photonics I*Thomas E. Darcie; Univ. of Victoria, Canada, Presider***OWN1 • 1:30 p.m.****Invited**

Technologies for Fiber Fed 60 GHz Wireless Systems, *Woo-Young Choi, Jae-Young Kim; Yonsei Univ., Republic of Korea*. We have investigated 60GHz-band optoelectronic-mixers for realizing cost-effective fiber-fed 60GHz wireless systems. Two types of optoelectronic-mixers are reviewed: one based on cascaded semiconductor optical amplifier and electro-absorption modulator, and the other heterojunction bipolar transistors.

Room 303 A

1:30 p.m.–3:15 p.m.

OWO • Wavelength Switching*Myo Ohn; Avanex Corp., USA, Presider***OWO1 • 1:30 p.m.****Invited**

Different Aspects and Design Considerations of PLC Based ROADM/WSS, *Yung Jui (Ray) Chen; Univ. of Maryland, Baltimore County, USA*. ROADM and WSS are key network elements in intelligent network. PLC plays an essential role in providing either integrated or hybrid solutions. We will examine the trade-offs and challenges between monolithically integrated and hybrid systems.

Room 303 B

1:30 p.m.–3:30 p.m.

NWA • Electronic Processing of Optical Signals*E. Bert Basch; Verizon Labs, USA, Presider***NWA1 • 1:30 p.m.****Tutorial**

Electronic Signal Processing for Optical Systems, *John Sitch; Nortel, Canada*. The intersect of Moores law for silicon and optical transmission needs has fostered new applications of electronic signal processing at the highest transmission rates. We survey present methods and opine on future directions.



John Sitch was born in London, and graduated in Engineering Science from the University of Oxford. After working as a radio systems development engineer at Plessey Co. for two years he returned to university, receiving the M.Eng. and Ph.D. Degrees from Sheffield University. His thesis topics were 'Microwave MESFET Mixers' (M.Eng) and 'Noise in Transferred-Electron Amplifiers' (Ph.D.). For the next ten years he taught, first at Nottingham University, and then at Sheffield University, with research interests in the areas of semiconductor and electromagnetic device modeling. Since 1984 Dr. Sitch has been with Nortel Networks, Ottawa, working on various aspects of III-V & Si integrated circuits, and optical systems, where he is currently a manager in systems design. The recipient of a 1996 R&D100 award, John Sitch is an IEEE member and was the Chairperson of the 2001 IEEE GaAs IC Symposium.

Room 303 C

1:30 p.m.–3:30 p.m.

NWB • Optical Network Management*Andreas Gladisch; Deutsche Telekom, Germany, Presider***NWB1 • 1:30 p.m.**

Telcordia OSS Support Enhancements for Multi-Degree ROADM, *Dean Rader; Telcordia, USA*. This paper will discuss the recent and emerging Telcordia OSS solutions to support evolving WDM architectures driven by the demand for new high speed access technologies and the maturity of wavelength switching components.

NWB2 • 1:50 p.m.

Packet Transport OAM: Service Provider Alternatives, *Don O'Connor; Fujitsu Network Communications, USA*. This paper compares the alternatives for MPLS OAM implementation. It describes the ways that Ethernet, MPLS, and other layer OAM tools can be used in network applications, and details the service management alternatives and tradeoffs.

Notes

Ballroom A

OWI • Novel Fibers—Continued

OWI2 • 2:00 p.m.

A Novel Lensed Fiber with a Focused Spot Diameter as Small as the Wavelength, Kazuo Shiraiishi¹, Nobuyuki Kawasaki¹, Masato Umetsu¹, Hidehiko Yoda¹, Haruhiko Tsuchiya¹, Kenji Watanabe², S. Shikano²; ¹Utsunomiya Univ., Japan, ²Moritex, Japan. A lensed fiber with a focused spot diameter as small as 1.6 μm at the wavelength 1.55 μm has been obtained. An aspherically-ended graded-index fiber chip coated with a high-index layer is employed.

OWI3 • 2:15 p.m.

Optimal Design of Intermediate Fibers, Andrew D. Yablon, Misha Sumetsky; OFS Labs, USA. The optimum intermediate fiber design for reducing interconnection loss between guided modes of any two dissimilar fibers is rigorously derived. Total interconnection loss is reduced by ≥50%. Results are also generalized for N intermediate fibers.

Ballroom B

OWJ • Broadband Lasers—Continued

OWJ2 • 2:00 p.m.

Multi-Wavelength Laser Source for Dense Wavelength Division Multiplexing Networks, Paraskevas Bakopoulos¹, Efstratios Kehayas¹, Andreas E. H. Oehler^{2,3}, Thomas Sudmeyer³, Kurt J. Weingarten², Kim P. Hansen⁴, Christos Bintjas¹, Ursula Keller³, Hercules Avramopoulos⁴; ¹Natl. Technical Univ. of Athens, Greece, ²Time Bandwidth Products, Switzerland, ³Swiss Federal Inst. of Technology, Switzerland, ⁴Crystal Fibre A/S, Denmark. We propose and demonstrate an ITU-T grid compatible DWDM laser source with 50 GHz channel spacing. It consists of a passively mode-locked laser, supercontinuum-generating photonic crystal fiber and fiber Fabry-Perot filter for spectral selection.

OWJ3 • 2:15 p.m.

3.5-THz Wide, 175 Mode Optical Comb Source, Ryan P. Scott, Nicolas K. Fontaine, Jonathan P. Heritage, Brian H. Kolner, S. J. Ben Yoo; Univ. of California at Davis, USA. A stable 3.5-THz wide (175 modes x 20 GHz) optical comb source with nearly flat spectral phase is demonstrated. Adjustable mode spacing and wavelength tunability across the C-band are maintained.

Ballroom C

OWK • Network Control and Management—Continued

OWK2 • 2:00 p.m.

Advance Reservation-Based Network Resource Manager with Adaptive Path Discovery Scheme for SOA-Based Networking, Michiaki Hayashi, Takahiro Miyamoto, Hideaki Tanaka; KDDI R&D Labs Inc., Japan. Latency-aware adaptive path discovery scheme with optimized scheduling mechanism were proposed for advance reservation-capable SOA-based networking architecture. Using proposed techniques, advance reservations and reservation modifications invoked from Web-services interface were demonstrated for the first time.

OWK3 • 2:15 p.m.

Feasibility of Flow-Based Optical Provisioning in GÉANT, Marco Ruffini, Donal O'Mahony, Linda Doyle; CTVR, Univ. of Dublin, Ireland. We present a novel network architecture that establishes dynamic optical paths by analyzing local network traffic. We demonstrate its feasibility and effectiveness through a network analysis using real traces collected from the pan-European GÉANT network.

Ballroom D

OWL • WDM PON—Continued

OWL2 • 2:00 p.m.

A Hybrid-Amplified PON with 75-nm Downstream Band-Width, 60 km Reach, 1:64 Split and Multiple Video Services, Han Hyub Lee¹, Kenneth C. Reichmann¹, Patrick P. Iannone¹, Xiang Zhou¹, Bera Pálsdóttir²; ¹AT&T Labs-Res., USA, ²OFS Fitel Denmark, Denmark. We demonstrate an upgraded PON providing symmetric 2.488-Gb/s services and three downstream enhancement bands over 60 km to 64 customers. The system uses a SOA-Raman hybrid amplifier and a conventional SOA in an “extender box.”

OWL3 • 2:15 p.m.

A Cost-Effective WDM-PON Configuration Employing Innovative Bi-Directional Amplification, Ming Fang Huang^{1,2}, Jianjun Yu³, Jason (Jyehong) Chen², Ge-Kung Chang¹, Sien Chi^{2,4}; ¹Georgia Tech, USA, ²Natl. Chiao-Tung Univ., Taiwan, ³NEC Lab America, USA, ⁴Yuan Ze Univ., Taiwan. Novel bi-directional amplifier is employed in a WDM-PON system to increase power margin for both downstream and upstream signals. After 100-km SSMF transmission, the power-penalty for all channels at 10Gbit/s is less than 0.8 dB.

Ballroom E

OWM • Ultra-Longhaul Transmission—Continued

OWM3 • 2:00 p.m.

Long-Haul 40 Gb/s RZ-DPSK Transmission over 4,450 km with 150-km Repeater Spacing Using Raman Assisted EDFAs, Jin-Xing Cai, Dmitri G. Foursa, Alan J. Lucero, Morten Nissov, William T. Anderson, Alexei N. Pilipetskii, Will W. Patterson, Patric C. Corbett, Neal S. Bergano; Tyco Telecommunications, USA. 40Gb/s RZ-DPSK signals were successfully transmitted over 4450km with 150km repeater-spacing (33dB span-loss) using Raman-assisted EDFAs. The performance was compared with EDFA only amplification and 110km repeater-spacing. Long-term Q-factor fluctuations were quantified for Raman-assisted amplification.

OWM4 • 2:15 p.m.

Transmission of Multilevel 60 Gbit/s Polarization Multiplexed RZ-D8PSK Using only 10 Gbit/s Equipment, Jesper B. Jensen, Torger Tokle, Christophe Peucheret, Palle Jeppesen; COM-DTU, Denmark. By combining differential 8-ary phase shift keying with polarization multiplexing, we present transmission of multilevel modulation with 6 bits per symbol through a 100 km fiber span with a received bit-error-ratio better than 10⁻⁹.

Room 304 A/B

OWN • Microwave Photonics I—Continued**OWN2 • 2:00 p.m.**

Optically-Controlled Beam Forming Technique for 60 GHz-ROF System Using Dispersion of Optical Fiber and DFWM, Masashi Tadokoro, Tomohiro Taniguchi, Naoya Sakurai; NTT Corp., Japan. We present an optically-controlled beam forming technique that uses true-time-delay phase shift of millimeter-wave signals imposed by wavelength dispersion as they traverse the transmission fiber; DFWM multi-wavelength light source that uses HNLF is introduced.

OWN3 • 2:15 p.m.

Millimetre-Wave Gigabit/s Wireless-over-Fibre Transmission Using Low Cost Uncooled Devices with Remote Local Oscillator Delivery, Tabassam Ismail, Chin-Pang Liu, Alwyn J. Seeds; Univ. College London, UK. We demonstrate the first gigabit/s modulated wireless data transmission using uncooled directly modulated lasers for low cost solution with remote millimetre-wave 40 GHz LO. Error free transmission ($BER < 10^{-9}$) is achieved for downlink and uplink.

Room 303 A

OWO • Wavelength Switching—Continued**OWO2 • 2:00 p.m.****Invited**

Highly Integrated PLC-Type Devices with Surface-Mounted Monitor PDs for ROADMs, Ikuo Ogawa, Hiroshi Yamazaki, Akamasa Kaneko; NTT Photonics Labs, NTT Corp., Japan. We developed a 32ch reconfigurable optical add multiplexer that incorporates inline tap-monitors fully integrated on a silica-PLC chip by using a surface-mounting technique for the monitor-PD. This paper outlines the technology and the developed module.

Room 303 B

NWA • Electronic Processing of Optical Signals—Continued

Room 303 C

NWB • Optical Network Management—Continued**NWB3 • 2:10 p.m.**

Next Generation Optical Network: Enabling Dynamic Bandwidth Services, Vishnu Shukla¹, David A. Brown², Christopher J. Hunt², Thomas Mueller², Eve Varma²; ¹Verizon, USA, ²Lucent Technologies, USA. Optical Transport Networks are transitioning to an intelligent Next-Generation Optical Transport Network (NG-OTN) to improve operational efficiency, deploy more cost-effective optical transport, and enable dynamic bandwidth services.

Notes

Ballroom A

OWI • Novel Fibers—Continued

OWI4 • 2:30 p.m.

Visible Wavelength Emission in the Silica Glass Fiber Doped with Silicon Nano-Particles, *Songbae Moon, Pramod R. Watekar, Bok Hyeon Kim, Won-Taek Han; Gwangju Inst. of Science and Technology, Republic of Korea*. We report realization of a novel optical fiber incorporated with Si nano-particles and its emission in the visible wavelength upon pumping at 512nm. Enhancement in 1550nm emission of the Si/Er³⁺ co-doped fiber was also found.

Ballroom B

OWJ • Broadband Lasers—Continued

OWJ4 • 2:30 p.m.

Invited

Ultrafast Wavelength-Swept Lasers, *Seok-Hyun (Andy) Yun; Harvard Medical School and Wellman Ctr. for Photomedicine, MGH, USA*. Recent advances in swept lasers with scan speeds >1000 nm/ms, repetition rates >20 kHz, and tuning ranges >50 nm, primarily driven by new applications, are discussed.

Ballroom C

OWK • Network Control and Management—Continued

OWK4 • 2:30 p.m.

Invited

Carrier-Grade Ethernet for Core Networks, *Andreas Kirstaedter, Claus Gruber, Johannes Riedl, Thomas Bauschert; Siemens AG, Germany*. This paper considers the functionality and standards required to enable carrier-grade core networks based on Ethernet-over-WDM. Possible Ethernet backbone network architectures will be discussed followed by an evaluation of the CAPEX and OPEX performance.

Ballroom D

OWL • WDM PON—Continued

OWL4 • 2:30 p.m.

Experimental Upstream Demonstration of a Long Reach Wavelength-Converting WDM-PON with DWDM Backhaul, *Darren P. Shea, John E. Mitchell; Univ. College London, UK*. We present experimentally a wavelength converting-WDM-PON which uses multiple PONs of similar specification to GPON, with wavelength conversion to provide 38.8 Mbit/s per user to potentially 1280 users over a distance of 120 km.

OWL5 • 2:45 p.m.

42dB Loss Budget Hybrid WDM-CDM-PON without Optical Amplifier, *Hideyuki Iwamura, Gyaneshwar C. Gupta, Masayuki Kashima, Hideaki Tamai, Ryoichi Watanabe, Takashi Ushikubo, Takeshi Kamijoh; OKI Electric Industry Co., Ltd., Japan*. 42dB loss budget was realized by hybrid DWDM-CDM (Code Division Multiplexing)-PON without optical amplifier. Experimentally demonstrated 100km 16λ-DWDM-CDM-PON bidirectional transmission with 62.5Mbpsx32 users/λ symmetry guaranteed bandwidth. Long reach PON expected to reduce CapEx, OpEx cost.

Ballroom E

OWM • Ultra-Longhaul Transmission—Continued

OWM5 • 2:30 p.m.

Tutorial

D(Q)PSK Transmission Technologies for ULH Systems, *Stuart Abbott; Tyco Telecommunications, USA*. This tutorial addresses the impact of DPSK and related transmission formats on system design for ultra-long-haul and long-reach-repeaterless transmission systems. We will review principles, challenges, progress, and potential for improved system design.

Stu Abbott is the Managing Director for Undersea Development at Tyco Telecommunications, Eatontown, NJ, with responsibility for electro-optic design of optical paths, repeaters, and branching units for undersea transmission systems. He has worked in the development of optical undersea transmission system development since joining the Undersea Laboratory of Bell Telephone Laboratories in 1980. After faith and family, Stu's proudest moments have been seeing the successful deployment of major undersea networks he helped design, including TAT-8 thru TAT-13, TPC-3, -4, and -5, and the Tyco Global Network. Before joining the undersea system design team, Stu spent four years in the Guided Wave Research Laboratory of Bell Telephone Laboratories. He has degrees in Physics and EE from Washington University, St. Louis, and Masters and PhD in EE from the University of Illinois, Urbana.

OWN • Microwave Photonics I—Continued**OWN4 • 2:30 p.m.**

Optical Interface for IMD Reduction in Fiber-Radio Systems with Simultaneous Baseband Transmission for Heterogeneous Access Networks, Christina Lim¹, Ka-Lun Lee¹, Ampalavanapillai Nirmalathas^{1,2}, Dalma Novak^{1,3}, Rod Waterhouse^{1,3}; ¹Univ. of Melbourne, Australia, ²Natl. ICT Australia, Victoria Res. Lab, Australia, ³Pharad, LLC, USA. We propose an optical interface incorporating an arrayed waveguide grating (AWG) that simultaneously reduces intermodulation distortion (IMD) and multiplexes DWDM fiber-radio channels while supporting multiple baseband transmission in a heterogeneous access environment.

OWN5 • 2:45 p.m.

Realization of RF Phase Shift on Amplitude Modulated Data for Smart Antenna in Wireless Access Networks, Zhaohui Li¹, Yi Dong², Yang Jing Wen³, Yixin Wang³, Tee Hiang Cheng¹, Chao Lu⁴, Weisheng Hu²; ¹Nanyang Technological Univ., Singapore, ²State Key Lab of Advanced Optical Communication Systems and Networks, Shanghai Jiao Tong Univ., China, ³Inst. for Infocomm Res., A*STAR, Singapore, ⁴Dept. of Electronic and Information Engineering, Hong Kong Polytechnic Univ., Hong Kong. Realization of RF phase shift on amplitude modulated wireless data based on single-sideband modulation and nonlinear optical loop mirror is demonstrated for smart antenna in wireless access networks. Linear tunable phase-shift with $0\sim\pi$ is achieved.

OWO • Wavelength Switching—Continued**OWO3 • 2:30 p.m.**

Optical Bandpass Filter with Tunable Chromatic Dispersion and Optical Bandwidth Using a Variable MEMS Reflector, Kyoungsik Yu¹, Hansuek Lee², Namkyoo Park², Daesung Lee³, Olav Solgaard²; ¹Korea Electrical Engineering & Science Res. Inst., Republic of Korea, ²Seoul Natl. Univ., Republic of Korea, ³Stanford Univ., USA. We report on a grating-based tunable optical filter employing a MEMS reflector with variable curvature and aperture size. The chromatic dispersion, bandwidth, and center wavelength of the optical passband can be controlled continuously and independently.

OWO4 • 2:45 p.m.

Silica PLC-VOA Using Suspended Narrow Ridge Structures and Its Application to V-AWG, Yasuaki Hashizume, Kei Watanabe, Yusuke Nasu, Masaki Kohtoku, Shin Kamei, Tsutomu Kitoh, Yasuyuki Inoue; NTT Photonics Labs, Japan. We fabricated a silica PLC-VOA using suspended narrow ridge structures and reduced the power consumption to 20 mW/channel. Using the proposed structures, we demonstrated a 16-channel V-AWG with a compact size and a low consumption.

NWA • Electronic Processing of Optical Signals—Continued**NWA2 • 2:30 p.m.****Invited**

Recent Progress of EDC Commercialization in Addressing Datacom and Telecom Challenges to Enable High-Speed Optical Enterprise, Metro and Long-Haul Networks, Frank Chang; Vitesse Semiconductor Corp., USA. We present performance overview of state-of-the-art FFE/DFE-based EDC implementation on optical impairments mitigation. The applications cover 10Gb/s modal-dispersion-limited enterprise system with >300m legacy MMFs, and metro and long-haul SMF systems for chromatic-dispersion, and/or PMD compensation.

NWB • Optical Network Management—Continued**NWB4 • 2:30 p.m.**

Multi-Layer Network Management System Integrated with a Network Planning Tool for IP/Optical Integrated Network, Masanori Miyazawa, Kenichi Ogaki, Shuntaro Kashihara, Nagao Ogino, Hiroki Furuya, Hajime Nakamura, Tomohiro Otani; KDDI R&D Labs Inc., Japan. A multi-layer NMS was successfully developed to manage the optical network and the MPLS network. The integrated network-planning tool could appropriately provide the optimized routes for a new LSP and all the existing LSPs.

NWB5 • 2:50 p.m.

Design and Implementation of a Network Node Management System for a Large-Scale ASON Test-Bed, Nan Hua, Xiaoping Zheng, Hanyi Zhang, Bingkun Zhou; Tsinghua Univ., China. This paper presents the node management system of a large-scale ASON test-bed constructed by Tsinghua University. This developed system was successfully demonstrated in terms of functions such as node operation and some basic network management.

Ballroom A

Ballroom B

Ballroom C

Ballroom D

Ballroom E

OWJ • Broadband Lasers—Continued

OWJ5 • 3:00 p.m.

Continuously FSR Tunable All Fiber Fabry-Perot Filter and Its Application to Tunable Multiwavelength SOA Ring Laser, *Young-Geun Han^{1,2,3}, Francesco Fresi³, Luca Poti³, Antonella Bogoni³, Ju Han Lee¹, Sang Bae Lee¹; ¹KIST, Republic of Korea, ²Caltech, USA, ³CNIT, Pisa, Italy.* We investigate a simple and flexible scheme of all-fiber Fabry-Perot filter with continuous free spectral range tunability and its application to a multiwavelength SOA laser with eleven lasing channels at room temperature.

OWJ6 • 3:15 p.m.

Dual-Wavelength Brillouin Fiber Laser for Microwave Frequency Generation, *Michael L. Dennis, Raymond M. Sova, Thomas R. Clark; JHU Applied Physics Lab, USA.* We demonstrate generation of RF/microwave frequencies using a dual-wavelength Brillouin fiber laser. We propose this device as a potential source of low phase noise, tunable frequencies into the millimeter wave regime compatible with RF-photonics systems.

OWK • Network Control and Management—Continued

OWK5 • 3:00 p.m.

Multiple Path Computation Element (PCE) Cooperation for Multi-Layer Traffic Engineering, *Filippo Cugini¹, Alessio Giorgetti², Nicola Andrioli², Francesco Paolucci², Luca Valcarengh², Piero Castoldi²; ¹CNIT, Italy, ²Scuola Superiore Sant'Anna, Italy.* The inefficiencies that affect current PCE cooperation based on PCE communication Protocol (PCEP) in multi-layer networks are presented. A Vertical Approach is proposed to guarantee effective TE solutions while limiting the amount of exchanged information.

OWK6 • 3:15 p.m.

Implementing a Path Computation Element (PCE) to Encompass Physical Impairments in Transparent Networks, *Filippo Cugini¹, Francesco Paolucci², Luca Valcarengh², Piero Castoldi²; ¹CNIT, Italy, ²Scuola Superiore Sant'Anna, Italy.* A PCE implementation is presented and evaluated in single-Area, multi-Area, and multi-layer networks. The proposed implementation provides not only efficient bandwidth utilization with good scalability performance but it allows also to encompass physical impairment constraints.

OWL • WDM PON—Continued

OWL6 • 3:00 p.m.

Optical VPN Connecting ONUs in Different PONs, *Yue Tian¹, Xiangqing Tian¹, Lufeng Leng², Tong Ye¹, Yikai Su¹; ¹Shanghai Jiao Tong Univ., China, ²City Univ. of New York, USA.* We demonstrate optical-layer virtual private networking in a new super-PON architecture using a dynamic wavelength reflector. The optical VPN enables communications among different PONs.

OWL7 • 3:15 p.m.

Economic Evolution from EPON to WDM-Overlaid PON Employing a Wavelength Conversion Node, *Jae-Myoung Hyun¹, Wonkuk Cho¹, Youngil Park¹, Byoung-ghi Kim²; ¹Kookmin Univ., Republic of Korea, ²Electronics and Telecommunications Res. Inst., Republic of Korea.* Cost-effective evolution architecture from EPON to WDM-overlaid PON is proposed. To maintain the colorless characteristics of ONUs, a wavelength-conversion node is employed. Appropriate structures for a Remote node and a WCN are suggested and analyzed.

3:30 p.m.–4:00 p.m. Coffee Break, Exhibit Hall

OWN • Microwave Photonics I—Continued**OWN6 • 3:00 p.m.**

Millimeter-Wave Harmonic Frequency Up-Conversion Using Selective Sideband Brillouin Amplification, Kwang Hyun Lee, Woo Young Choi; Yonsei Univ., Republic of Korea. Using selective sideband Brillouin amplification induced in standard single-mode fiber, we successfully demonstrate harmonic frequency up-conversion of 10Mbit/s QPSK data carried by 1.55GHz intermediate frequency into 30GHz band with larger than 20dB RF gain.

OWN7 • 3:15 p.m.

Millimeter-Wave Generation via Frequency Quadrupling in an Optically-Injected Optoelectronic Oscillator, Myunghun Shin, Prem Kumar; Northwestern Univ., USA. We demonstrate cascaded electroabsorption-modulator-based optoelectronic oscillators (EAM-OEOs) for generating millimeter-wave signals. Low phase-noise frequency quadrupling is achieved by optically injecting 10-GHz-rate pulses from a master EAM-OEO to a 40 GHz slave EAM-OEO.

OWO • Wavelength Switching—Continued**OWO5 • 3:00 p.m.**

Three-Dimensional Switch Matrix Based on Polymer Optical Waveguides, Pak L. Chu¹, Kaixin Chen², Hau Ping Chan², Kin S. Chiang²; ¹Cotco Holdings Ltd, Hong Kong, ²City Univ. of Hong Kong, Hong Kong. A three-dimensional 1x4 switching matrix based on polymer optical waveguides is reported. Its features are: compactness, small switching electric power, and wavelength independent. This structure can be readily generalized to a mxn matrix.

NWA • Electronic Processing of Optical Signals—Continued**NWA3 • 3:10 p.m.**

Transmission Performance Evaluation of 43Gb/s RZ-DPSK Transponder Using Electrical Equalizer, Toshiharu Ito¹, Kiyoshi Fukuchi¹, Morihiko Ohta¹, Keiichi Yamada¹, Kumi Omori¹, Makoto Ishiguro¹, Tadashi Koga¹, Tsutomu Tajima¹, Yoshihisa Inada¹, Lei Xu²; ¹NEC Corp., Japan, ²NEC Labs America, USA. We have experimentally confirmed that 43Gb/s RZ-DPSK transponder using electrical equalizer could provide good transmission performances for various applications. By optimizing the equalizer setting, it suppressed the main degradation factor effect in each system application.

NWB • Optical Network Management—Continued**NWB6 • 3:10 p.m.**

Use of Remote Software Download to Improve Operation Efficiency of Next-Generation Optical Transport Networks (NG-OTN), Nee Ben Gee, Peter E. Phillips, Lily F. Chen, Michael F. Lane, E. E. (Bert) Basch, Vishnu Shukla; Verizon Labs, USA. This paper presents the use of remote software download, upgrade, memory backup and restoration processes to improve operational efficiencies of NG-OTN. Network Element requirements, test results in a multi-vendor environment, and evolutionary considerations are presented.

3:30 p.m.–4:00 p.m. Coffee Break, Exhibit Hall

Ballroom A

4:00 p.m.–6:00 p.m.

OWP • Photonic Integrated Circuits and Quantum Dots

Charles Joyner; Infinera, USA, Presider

OWP1 • 4:00 p.m.

Invited

Ultra-High-Capacity WDM Photonic Integrated Circuits, Fred A. Kish, Radhakrishnan Nagarajan, Masaki Kato, Richard P. Schneider, Jacco L. Pleumeekers, Peter W. Evans, Sheila K. Hurtt, Andrew Dentai, Damien J. H. Lambert, Mark J. Missey, Jonas Webjorn, Vincent G. Dominic, Mike Kauffman, Atul Mathur, Randal A. Salvatore, Mehrdad Ziari, Ranjani Muthiah, Sanjeev Murthy, Charles H. Joyner, Jeffrey S. Bostak, Timothy Butrie, Richard H. Miles, Matthew L. Mitchell, Stephen C. Pennypacker, Rory Schlenker, Robert B. Taylor, Huan-Shang Tsai, Michael F. Van Leeuwen, Stephen G. Grubb, Michael Reffle, David G. Mehuys, David F. Welch; *Infinera, USA*. Design, performance of large scale, dense wavelength division multiplexed InP transmitter, receiver photonic integrated circuits (PICs) reviewed. PICs are capable of transmitting, receiving up to 40 wavelengths at data rates up to 40Gbits per channel.

Ballroom B

4:00 p.m.–6:00 p.m.

OWQ • Optical Parametric Amplifiers

Peter Andrekson; Chalmers Univ. of Technology, Sweden, Presider

OWQ1 • 4:00 p.m.

All-Optical Wavelength Conversion Using Multi-Pump Raman-Assisted Four-Wave Mixing, Shaohao Wang¹, Lixin Xu^{1,2}, P. K. A. Wai¹, H. Y. Tam¹; ¹Hong Kong Polytechnic Univ., Hong Kong, ²Univ. of Science and Technology of China, China. We reported all-optical wavelength conversion using multi-pump Raman-assisted four-wave mixing. All-optical wavelength conversion with 10 nm bandwidth of flat conversion efficiency is achieved. The measured power penalty is ~1 dB for 10 Gb/s down-converted signals.

OWQ2 • 4:15 p.m.

Fiber Optical Parametric Amplifier Based on a Novel LiNbO₃ Synchronized Double Phase Modulator, Armand A. Vedadi¹, Jean-Charles Beugnot¹, Eric Lantz¹, Hervé Maillotte¹, Jérôme Hauden², Thibaut Sylvestre¹; ¹Dept. d'Optique PM Duffieux, Inst. Femto-ST, Univ. de Franche-Comté, CNRS UMR 6174, France, ²PHOTLINE Technologies, France. We report the fabrication of a novel LiNbO₃-based phase modulator that allows for the simultaneous achievement of synchronous high-speed counter-phase modulation and coupling of two optical channels for fully transparent two-pump fiber optical parametric amplifier.

Ballroom C

4:00 p.m.–6:00 p.m.

OWR • Cross-Layer Design

Suresh Subramaniam; George Washington Univ., USA, Presider

OWR1 • 4:00 p.m.

Invited

Impairment Constraint Based Routing in Mesh Optical Networks, Ioannis Tomkos, Stelios Sygletos, Anna Tzanakaki, George Markidis; *Athens Info. Tech., Greece*. We present a framework for the alleviation of the main problems induced due to optical transparency based on the use of advanced optical performance monitoring, physical layer modeling tools, and new algorithms for routing.

Ballroom D

4:00 p.m.–6:00 p.m.

OWS • Future PON Technology

Shoichi Hanatani; Hitachi, Ltd., Japan, Presider

OWS1 • 4:00 p.m.

Bidirectional Amplifier for Standard PON Architecture in Burst Mode Configuration with Class B+ Attenuation Range, Zineb Belfqih, Fabienne Saliou, Philippe Chanclou, Thomas Soret, Naveena Genay; *France Telecom Div. Res. & Development, France*. A single bidirectional semiconductor optical amplifier is introduced in a Passive Optical Network system. An extended optical budget of 14 dB has been measured for a bidirectional transmission with class B+ specification.

OWS2 • 4:15 p.m.

Measurement of Tolerance to Non-Uniform Burst Powers in SOA Amplified GPON Systems, Shamil Appathurai, Derek Nettet, Russell Davey; *BT, UK*. We investigate the performance of an amplified GPON system under conditions of unequal burst powers from ONTs. Successful operation is shown for power differences up to 14dB as might be expected in a deployed system.

Ballroom E

4:00 p.m.–5:45 p.m.

OWT • Quantum Communications

Matthew Goodman; Telcordia Technologies, USA, Presider

OWT1 • 4:00 p.m.

Tutorial

Introduction to Quantum Communications, Yoshihisa Yamamoto; *Stanford Univ., USA*. No abstract available.

Room 304 A/B

4:00 p.m.–5:45 p.m.
OWU • Microwave Photonics II

Gregory Abbas; Eospace, USA, Presider

OWU1 • 4:00 p.m. **Invited**
RF-over-Fiber and Optical Processing for Navy Applications, Everett W. Jacobs; SSC San Diego, USA. RF-over-fiber technology for military antenna remoting is discussed including system level metrics and examples of deployed systems. The design of a compact RF spectrum analyzer based on optical domain RF channelization is introduced.

Room 303 A

4:00 p.m.–6:00 p.m.
OWV • Wavelength Switching/OCDMA

Paul Colbourne; JDS Uniphase, Canada, Presider

OWV1 • 4:00 p.m. **Invited**
Addressing Manufacturability and Reliability of MEMS-Based WSS, Steve de Hennin, Pierre Wall, Steven H. Moffat, Barrie Keyworth, Paul Colbourne; JDSU, Canada. Initial design-in of WSS-based modules posed many uncertainties due to several technology firsts. Presentation will discuss key challenges and steps taken to successfully complete qualification and validation and will demonstrate the level of stability achieved.

Room 303 B

4:00 p.m.–6:00 p.m.
NWC • Optical Test and Measurement

Mei Du; OFS Labs, USA, Presider

NWC1 • 4:00 p.m.
Measuring the Optical Signal-to-Noise Ratio in Agile Optical Networks, Wolfgang Moench¹, Julia Y. Larikova²; ¹JDSU, Germany, ²Tellabs, USA. Agile Optical networks using ROADMs present a challenge for OSNR testing. The paper explores how this challenge is addressed using improved polarization nulling techniques and the influence of polarization effects at ultra high speeds.

NWC2 • 4:20 p.m.
Fault Location for Branched Optical Fiber Networks Based on OFDR Technique Using FSF Laser as Light Source, Nianyu Zou^{1,2}, Yoshinori Namihira¹, Chcik Ndiaye², Hiromasa Ito²; ¹Univ. of the Ryukyus, Japan, ²Tohoku Univ., Japan. A new fault location method for passive branched optical fiber networks is proposed, which bases on OFDR technique using FSF laser source, and the fault in fiber branches are located according to the heterodyne detection.

Room 303 C

4:00 p.m.–5:40 p.m.
NWD • Networks with an Optical Dynamic Core

Alysha Godin; Nortel, Canada, Presider

NWD1 • 4:00 p.m. **Invited**
ROADM Deployment, Challenges and Applications, Ron Bernhey, Muzaffer Kanaan; Verizon, USA. We discuss deployment challenges for ROADMs. After an overview of the architecture, we discuss issues experienced in the course of our deployments. We end with recommendations for those planning to deploy ROADM in the future.

Notes

Ballroom A

OWP • Photonic Integrated Circuits and Quantum Dots—Continued

OWP2 • 4:30 p.m.

35 Gb/s Monolithic All-Optical Clock Recovery Pulse Source, *Brian R. Koch, Jonathan S. Barton, Milan L. Masanovic, Zhaoyang Hu, John E. Bowers, Daniel J. Blumenthal*; Univ. of California at Santa Barbara, USA. We demonstrate clock recovery at 35 Gb/s from the first mode-locked laser integrated on-chip with input and output SOAs. Tuning one DBR mirror can change the output pulsewidth between 6.7 and 9.3 ps.

OWP3 • 4:45 p.m.

Optical Equalizer Monolithically Integrated with a Semiconductor Optical Amplifier, *Ashish Bhardwaj, Nicholas Sauer, Lawrence Buhl, Weiguo Yang, Liming Zhang, David T. Neilson*; Bell Labs, Lucent Technologies, USA. We present the first optical equalizer monolithically integrated with a semiconductor optical amplifier. We show that the device can mitigate the Inter-Symbol Interference arising from narrow-band optical filtering on 40 Gb/s Non-Return to Zero data.

OWP4 • 5:00 p.m.

Cascaded Operation of a 2R Burst-Mode Regenerator with Data Exhibiting 6 dB Power Variation, *George T. Kanellos¹, Dimitris Klonidis², Nikos Pleros¹, Panagiotis Zakyntinos¹, Dimitris Apostolopoulos¹, Alistair Poustie³, Graeme Maxwell¹, Hercules Avramopoulos¹, Ioannis Tomkos²*; ¹Natl. Technical Univ. Athens, Greece, ²Athens Information Technology Ctr., Greece, ³Ctr. for Integrated Photonics (CIP) Ltd, UK. Cascaded operation of a single SOA-MZI 2R burst-mode regenerator is demonstrated using a novel loop configuration that induces a per-loop 6dB power variation on the recirculating data. Error-free operation is achieved for four successive loops.

Ballroom B

OWQ • Optical Parametric Amplifiers—Continued

OWQ3 • 4:30 p.m.

Fiber Optical Parametric Oscillator with 560 nm Tuning Range Using Dispersion-Shifted Fiber, *Gordon K. L. Wong¹, Stuart G. Murdoch¹, Rainer Leonhardt¹, John D. Harvey¹, Virgile Marie²*; ¹Univ. of Auckland, New Zealand, ²INSA de Rennes, France. A fiber optical parametric oscillator based on modulation instability in the normal dispersion regime is described. A tuning range of over 560 nm with high conversion efficiencies has been experimentally achieved.

OWQ4 • 4:45 p.m.

Gbps-Rate Channel Translation from Near-Infrared to Visible Band, *Rui Jiang¹, Nikola Alic², Joseph E. Ford¹, Colin J. McKinstrie², Stojan Radic¹*; ¹Univ. of California at San Diego, USA, ²Bell Labs, USA. We demonstrate Gbps channel translation from conventional communication band to visible band. Signal channel is converted over 1000nm using four-photon-process in photonic crystal fiber. An error-free received performance was measured in the target visible band.

OWQ5 • 5:00 p.m.

Tutorial

Fiber Parametric Amplifiers: Physics and Applications, *Stojan Radic*; Univ. of California at San Diego, USA. In contrast to conventional fiber devices, parametric processors are used to manipulate amplitude, phase and quantum state of the communication channel. The tutorial describes multiple-pump parametric devices and their use in advanced network and signal-processing applications.

Ballroom C

OWR • Cross-Layer Design—Continued

OWR2 • 4:30 p.m.

Impairment-Aware Waveband Switching in Optical Networks, *Hong-Hsu Yen¹, Steven S. W. Lee², Biswanath Mukherjee³*; ¹Dept. of Information Management, Shih-Hsin Univ., Taiwan, ²Information and Communications Res. Labs, Industrial Technology Res. Inst., Taiwan, ³Dept. of Computer Science, Univ. of California at Davis, USA. We consider optical impairment and investigate wavelength grooming strategies in multi-granular WDM networks. The strategy that allows lightpaths to share waveband paths holds better call blocking and port usage performance than that without sharing.

OWR3 • 4:45 p.m.

Moving Towards Upgradeable All-Optical Networks through Impairment-Aware RWA Algorithms, *Nadiatulhuda Zulkifli, Ken Guild*; Univ. of Essex, UK. We propose an impairment-aware RWA algorithm that allocates a lightpath for services with different interface requirements at 10Gb/s and 40Gbit/s across a common transparent optical network. Significant benefits are demonstrated when compared with existing techniques.

OWR4 • 5:00 p.m.

Provisioning in Ultra-Long-Haul Optical Networks, *Smita Rai¹, Biswanath Mukherjee², Ching-Fong Su³, Takeo Hamada³*; ¹Univ. of California at Davis, USA, ²Univ. of California at Davis, USA, ³Fujitsu Labs of America, USA. We present a new approach to provision connections in ultra-long-haul optical networks with physical impairments. Our cross-layer approach finds paths satisfying impairment constraints while taking into account regenerators (3R) present in the network.

Ballroom D

OWS • Future PON Technology—Continued

OWS3 • 4:30 p.m. Invited

Key Technologies of GE-PON Burst-Mode Receivers and Future PON Systems, *Junichi Nakagawa*; Mitsubishi Electric Corp., Japan. The demand for high bandwidth access has spurred the development of high-speed Passive Optical Networks (PONs) with their cost-effective user-shared system infrastructure. This paper reviews advanced key technologies for high-speed PON systems beyond 1Gb/s.

OWS4 • 5:00 p.m.

A Novel WDM-PON Architecture with Centralized Lightwaves in the OLT for Providing Triple Play Services, *Jianjun Yu¹, Oladeji Akanbi², Yuanqiu Luo¹, Lei Zong¹, Zhensheng Jia², Ting Wang¹, Gee Kung Chang²*; ¹NEC Lab America, USA, ²Georgia Tech, USA. A novel WDM-PON architecture with centralized lightwave source in the optical line terminal (OLT) for providing triple play services has been proposed and demonstrated.

Ballroom E

OWT • Quantum Communications—Continued

OWT2 • 5:00 p.m. Invited

Differential-Phase-Shift Quantum Key Distribution Using Single-Photon Detectors, *Kyo Inoue¹, Hiroki Takesue², Toshimori Honjo³*; ¹Osaka Univ., Japan, ²NTT Basic Res. Labs, Japan. A novel type of quantum key distribution (QKD) protocol called differential-phase-shift QKD is described. It uses a weak coherent pulse train, and features simple configuration and efficient use of the time domain.

OWU • Microwave Photonics II—Continued**OWU2 • 4:30 p.m.**

A Novel Gb/s Transceiver with OTDR Built-in-test (BIT) for Health Monitoring of Local Area Newark, Eric Y. Chan¹, Mark W. Beranek², Daniel N. Harres¹; ¹Boeing Phantom Works, USA, ²Naval Air Systems Command, USA. We have successfully demonstrated the first prototype Gb/s transceiver with integrated built-in 10-cm resolution OTDR capability. The transceiver performs excellently over 2 Gb/s; it is very beneficial for cable plant fault detection and isolation applications.

OWU3 • 4:45 p.m.

Fast Switching and Wideband Photonic Beamformer with Flat RF Response and Squitless Scan Performance, Oded Raz, Sharon Barzilay, Ruth Rotman, Moshe Tur; Tel Aviv Univ., Israel. A wideband (>10GHz) beamformer, based on a photonic true-time-delay, with sub-microsecond angle switching is reported. The smooth microwave transmission (ripples <0.5dB & <3o) and superb uniformity among the elements (<0.1dB & <0.5o) result in excellent RF performance.

OWU4 • 5:00 p.m.

High-Performance Passive Microwave-Photonic Link for Antenna Remoting Using Truncated Single-Sideband Optical Phase Detection, Jinye Zhang¹, Thomas E. Darcie¹, Jae Jeong Eun²; ¹Univ. of Victoria, Canada, ²Changwon Natl. Univ., Republic of Korea. A passive analog link is presented for antenna remoting using phase modulation and a fiber-Bragg-grating phase detector with high frequency selectivity. Carrier suppression and cancellation of 3rd-order distortion provide high dynamic range (114.4 dB·Hz^{2/3}).

OWV • Wavelength Switching/OCDMA—Continued**OWV2 • 4:30 p.m.**

Integrated 8x8 Electro-Optic High-Speed Switch for Optical Burst Transport Networks, Akio Sugama^{1,2}, Tomoyuki Akahoshi^{1,2}, Keisuke Sato^{1,2}, Shigenori Aoki^{1,2}, Yutaka Kai^{1,2}, Yutaka Takita^{1,2}, Masayuki Kato^{1,2}, Hiroshi Onaka^{1,2}; ¹Fujitsu Ltd., Japan, ²Optoelectronic Industry and Technology Development Association (OITDA), Japan. We developed 8x8 beam-deflecting optical switch with a switching speed within one microsecond utilizing electro-optic effect of PLZT. A newly-developed radial optical path design and putting-in packaging structure with a monolithic PLC platform were applied.

OWV3 • 4:45 p.m.

Wavelength Selective Switches Based on Grating Assisted Mode Coupling, Ming Xu¹, Peiching Ling¹, Wayne Lui¹, Gian-Luca Bona², Rene Beyeler², Folkert Horst², Bert Offrein²; ¹Integrated Optics Communications Corp., USA, ²IBM Zurich Res. Lab, Switzerland. A novel grating-assisted Wavelength Selective Switch (WSS) is proposed. Its operating principle is experimentally confirmed with strong coupling strength, negligible birefringence, and low channel crosstalk. A WSS-based cross-connect device is demonstrated.

OWV4 • 5:00 p.m.

Advances in Liquid Crystal on Silicon Wavelength Selective Switching, Steven Frisken; Optium Australia Pty Ltd., Australia. Liquid Crystal on Silicon is employed as the active switching element for wavelength routing and attenuation in a Wavelength Selective Switch. Additional functionalities such as power sharing, monitoring and channel contouring are demonstrated.

NWC • Optical Test and Measurement—Continued**NWC3 • 4:40 p.m.**

Standards Compliance Testing of Optical Transmitters Using a Software-Based Equalizing Reference Receiver, Norman L. Swenson, Paul Voois, Tom Lindsay, Steve Zeng; ClariPhy Communications, Inc., USA. Incorporation of EDC technology in optical networking presents new challenges in developing tests for transmitter standards compliance. This paper describes the 10GBASE-LRM TWDP test, recently adopted for 10Gbps Ethernet links over dispersive multimode fiber.

NWC4 • 5:00 p.m.

A Temporally Interleaved Technique for Simultaneously Measuring Diagnostic Spectral Parameters and Link Performance in Active Optically Amplified Systems, Alexey V. Turukhin¹, Enrico Gonzales¹, Brandon C. Collings¹, Vincent Lecoeuche²; ¹JDSU, USA, ²JDSU, France. We present a novel measurement technique for spectral measurements of optically amplified systems that enables simultaneous measurement and therefore correlation of a diagnostic parameter and the performance of the link.

NWD • Networks with an Optical Dynamic Core—Continued**NWD2 • 4:40 p.m.**

Centralized Resource Management in WSS-Based Wavelength Cross-Connect Nodes, Lei Zong¹, Ting Wang¹, Philip Ji¹, Jianjun Yu¹, Osamu Matsuda², Milorad Cvijetic³; ¹NEC Labs America, USA, ²NEC Corp., Japan, ³NEC America, Inc., USA. We analyze the applications of centralized resource management for transponder sharing and regenerator assignment in wavelength selective switch based wavelength cross-connect nodes. We also propose a novel solution to realize centralized transponder management.

NWD3 • 5:00 p.m.

Design and Implementation of an Optical Dynamic Core Network: Engineering Considerations, Kim Papakos, Mark Boduch, Julia Larikova; Tellabs, USA. Issues and solutions associated with the design and implementation of “multi-degree ROADM-based” mesh optical networks. Compensation methods used to combat the effects of CD, PMD, and ASE noise for both 10 and 40 Gig.

Ballroom A

OWP • Photonic Integrated Circuits and Quantum Dots—Continued

OWP5 • 5:15 p.m. Invited
Do Quantum Dots or Quantum Wire Based Devices Offer a Practical Advantage in Producing Semiconductor Optical Amplifiers over Conventional 2-D Active Media? *Gadi Eisenstein, Technion, Israel.* Basic properties of nano-structure semiconductor gain media such as an inhomogeneously broadened gain, a fast response time, a low α -parameter and complex carrier dynamics yield amplifiers which are far superior to conventional quantum well amplifiers.

OWP6 • 5:45 p.m.
Monolithic Add-Drop Quantum Dot Switch Exhibiting Ultra-Low Cross-Wavelength Distortion, *Xuesong Hu¹, Shidai Liu¹, Yuanliang Chu¹, Xin Zhao¹, Mark G. Thompson¹, Adrian Welford¹, Roman L. Sellin¹, Richard V. Penty¹, Ian H. White¹, Alexey R. Kovsh²; ¹Univ. of Cambridge, UK, ²NL Nanosemiconductor GmbH, Germany.* A monolithic 2x2 switch incorporating an InGaAs quantum-dot active layer is presented, and 10Gb/s dual wavelength data transmission is demonstrated. No impairment in device performance is observed as a result of cross wavelength interference.

Ballroom B

OWQ • Optical Parametric Amplifiers—Continued



Stojan Radic has graduated from The Institute of Optics and has served as a Senior Scientist with Corning and a Member of Technical Staff at Bell Laboratories. He is Professor and Director of Optical Networking Laboratory at University of California San Diego and California Institute for Telecommunications and Information Technology. His research contributions include bidirectional and interleaved transmission, four-photon mixing in quasidistributed architectures and multiple-pump parametric signal processing in fiber. He presently serves as a Program Chair of Coherent Optical Technologies and Application conference and as an Editor with Optics Express Journal. Dr. Radic is Fellow of the Optical Society of America.

Ballroom C

OWR • Cross-Layer Design—Continued

OWR5 • 5:15 p.m.
QoS-Aware RWA Algorithms for Path-Protected DWDM Networks, *Yuxiang Zhai¹, Yvan Pointurier², Suresh Subramaniam¹, Maite Brandt-Pearce²; ¹George Washington Univ., USA, ²Univ. of Virginia, USA.* We investigate novel RWA algorithms in the context of all-optical networks with various path protection schemes. Our algorithms exhibit low blocking probabilities and are less computationally intensive than previously proposed algorithms.

OWR6 • 5:30 p.m.
Enabling ASON Routing via Novel Signal Quality Metrics, *Jonathan C. Li¹, Kerry Hinton², Sarah D. Dods¹, Peter M. Farrell¹; ¹Natl. ICT Australia, Australia, ²ARC Special Ctr. for Ultra-Broadband Information Networks, Australia.* We propose a new algorithm for path selection in Automatically Switched Optical Networks (ASONs), based on eye closure penalty, Q-factor and a modified OSPF protocol. We demonstrate the technique for a nine node network.

OWR7 • 5:45 p.m.
Scheduling and Routing of Sliding Scheduled Lightpath Demands in WDM Optical Networks, *Chava Vijaya Saradhi¹, Mohan Gurusamy²; ¹Inst. for Infocomm Res., Singapore, ²Natl. Univ. of Singapore, Singapore.* We develop a time conflict resolving window division algorithm which places a given set of sliding scheduled lightpath demands within their allowed interval and two routing and wavelength assignment (RWA) algorithms, and study their performance.

Ballroom D

OWS • Future PON Technology—Continued

OWS5 • 5:15 p.m.
Video Overlay in Next Generation Passive Optical Networks, *Paparao Palacharla, Martin Bouda, Youichi Akasaka, Alexander Umnov, Takao Naito; Fujitsu Labs of America Inc., USA.* We propose and demonstrate a novel PON architecture to increase bandwidth per user and to alleviate degradation of analog video due to Raman crosstalk. Measurements of carrier-to-spur ratio of analog video overlay are presented.

OWS6 • 5:30 p.m.
WDM Passive Optical Network with Parallel Signal Detection for Video and Data Delivery, *Yuanqiu Luo¹, Jianjun Yu¹, Junqiang Hu¹, Lei Xu¹, Philip N. Ji², Ting Wang¹, Milorad Cvijetic²; ¹NEC Labs America, USA, ²NEC America, USA.* We demonstrate a WDM-PON architecture, which delivers data and video by using subcarrier modulation and parallel signal detection. Results show that it is capable of providing triple play services in the access network.

OWS7 • 5:45 p.m.
Broadcast Transmission in WDM-PON Using a Broadband Light Source, *Jimwoo Cho, Jaedon Kim, David Gutierrez, Leonid G. Kazovsky; Stanford Univ., USA.* A novel method to broadcast a video stream to all subscribers in WDM-PON is proposed and experimentally implemented. Using a broadband light source, we have achieved successful transmission performance with our proposed method.

Ballroom E

OWT • Quantum Communications—Continued

OWT3 • 5:30 p.m.
Quantum-Noise-Randomized Data Encryption: Comparative Analysis of M-ary PSK and M-ary ASK Protocols for Long-Haul Optical Communications, *Vladimir S. Grigoryan, Gregory S. Kanter, Prem Kumar; Northwestern Univ., USA.* An M-ary PSK protocol for quantum-noise randomized encryption enables 10Gb/s encrypted data transmission over 5000km in dispersion-compensated fiber links, which is 7 times longer than using an equivalent ASK protocol in the same data links.

OWU • Microwave Photonics II—Continued**OWU5 • 5:15 p.m.**

Tunable Complex-Coefficient Incoherent Microwave Photonic Filters Based on Optical Single-Sideband Modulation and Narrow-Band Optical Filtering, *Mikel Sagues¹, Alayn Loayssa¹, Jose Capmany², David Benito¹, Salvador Sales², Raimundo García-Olcina²*; ¹Univ. Publica de Navarra, Spain, ²Univ. Politecnica de Valencia, Spain. We introduce a novel scheme to implement tunable incoherent microwave-photonic filters with complex coefficients using optically-induced RF phase shift. A two-tap filter is experimentally demonstrated to highlight its enhanced tuning performance.

OWU6 • 5:30 p.m.

Photonic Microwave Filter with Negative Coefficients Based on Cross Polarization Modulation in a Semiconductor Optical Amplifier, *Yu Yan, Fei Zeng, Qing Wang, Jianping Yao*; Univ. of Ottawa, Canada. A novel approach to implementing a photonic microwave filter with negative coefficients based on cross polarization modulation in a semiconductor optical amplifier is proposed. A two-tap microwave bandpass filter with one negative coefficient is demonstrated.

OWV • Wavelength Switching/OCDMA—Continued**OWV5 • 5:30 p.m.**

Integrated Photonic Decoder with Complementary Code Processing and Balanced Detection for Two-Dimensional OCDMA, *Koichi Takiguchi¹, Hiroshi Takahashi¹, Osamu Moriwaki¹, Masayuki Okuno²*; ¹NTT Photonics Labs, NTT Corp., Japan, ²NTT Electronics Corp., Japan. We propose a novel integrated-photonic decoder for two-dimensional (time/wavelength) OCDMA, which processes complementary codes and utilizes balanced detection to reduce unwanted cross-correlation interference. We successfully carried out a 10 Gbit/s transmission that demonstrated its effectiveness.

OWV6 • 5:45 p.m.

Reduction of Multiple Access Interference in a DS-OCDMA System via Two-Photon Absorption, *Paul J. Maguire¹, Krzysztof Bondarczuk¹, Liam P. Barry¹, Chun Tian², Z. Zhang², M. Ibsen², David J. Richardson², Periklis Petropoulos²*; ¹Dublin City Univ., Ireland, ²Optoelectronics Res. Ctr., Univ. of Southampton, UK. We demonstrate a technique to suppress multi-access interference in an OCDMA system by using the nonlinear process of Two-Photon Absorption. This allows the extinction ratio to be improved by 5dB when compared to linear detection.

NWC • Optical Test and Measurement—Continued**NWC5 • 5:20 p.m.**

Network Link Readiness for 40-Gbit/s Transport, *André Girard¹, Åke Sundström², Dan Kallgren³, Mikael Söderberg²*; ¹EXFO, Canada, ²Metric Industrial AB, Sweden, ³TeliaSonera AB, Sweden. Detailed description and analysis of test results for chromatic and polarization-mode dispersions are presented for evaluating the readiness of a TeliaSonera network link to be upgraded at 40-Gbit/s line rate. Conclusions and recommendations are provided.

NWC6 • 5:40 p.m.

Distribution of Embedded DWDM Channel Monitors in Pass-through Node Limited Transmission Links, *Michael Cahill, Glenn D. Bartolini*; Aegis Semiconductor, USA. A transmission model is used to derive requirements for distributing DWDM optical channel monitors in transmission links. It is shown that as the number of spans increase, DWDM channel monitors must be distributed more frequently.