OFC Postdeadline Papers
Thursday, 23 March 2017

Room 403A
18:00 -- 19:45
Th5A • Postdeadline Session I
Presider: Sheryl Woodward; AT&T Labs, USA

Th5A.1 • 18:00
SDN-Controlled 400GbE end-to-end service using a CFP8 client over a deployed, commercial flexible ROADM system, Lynn E. Nelson[1], Guodong Zhang[1], Narayan Padi[1], Craig Skolnick[1], Kathleen Benson[1], Troy Kaylor[1], Satoshi Iwamatsu[2], Robert Inderst[2], Fabio Marques[3], Daniel Fonseca[3], Mei Du[4], Terry Downs[4], Thor Scherer[4], Christopher Cole[5], Y Zhou[5], Paul Brooks[6], Andreas Schubert[6]; *[1]AT&T Labs, USA; [2]Coriant, R&D GmbH, Germany; [3]Coriant, Portugal; [4]Coriant USA, USA; [5]Finisar Corp, USA; [6]Viavi Solutions, Germany.* We demonstrated a 400Gb/s Ethernet end-to-end circuit, inclusive of 400GbE client card with CPF8 interface and dual-carrier 16QAM line-side, on a production 100G core network segment between New York City and Washington DC. During the field trial, we demonstrated the feasibility of SDN-enabled creation, deletion, and re-routing of the 400G service.

Th5A.2 • 18:15
Transparent Software-Defined Exchange (tSDX) with Real-Time OSNR-Based Impairment-Aware Wavelength Path Provisioning across Multi-Domain Optical Networks, Yao Li[1], Weiyang Mo[1], Shengxiang Zhu[1], Yiwen Shen[2], Jiakai Yu[1], Payman Samadi[2], Keren Bergman[2], Daniel C. Kilper[1]; *[1]College of Optical Sciences, Univ. of Arizona, USA; [2]Department of Electrical Engineering, Columbia Univ., USA.* End-to-end, impairment-aware wavelength path provisioning is experimentally realized in a multi-domain network using a transparent software-defined exchange (tSDX) with real-time OSNR monitoring as an SLA guarantee for 100Gbps PM-QPSK DWDM transmission.

Th5A.3 • 18:30
First Experimental Demonstration of Autonomic Slice Networking, Luis Velasco[1], Lluis Gifre[4], Francesco Paolucci[3], Filippo Cugini[2]; *[1]Universitat Politecnica de Catalunya, Spain; [2]Consorzio Nazionale Interuniversitario per le Telecomunicazioni (CNIT), Italy; [3]Scuola Superiore Sant'Anna, Italy; [4]Universidad Autonoma de Madrid, Spain.* An architecture to enable autonomic slice networking is presented. Extended nodes make local decisions, whereas domain systems collate and export metered data transparently to customer controllers. Discovered knowledge is experimentally used for network slice reconfiguration.

Th5A.4 • 18:45
Bi-directional 25G/50G TDM-PON with Extended Power Budget using 25G APD and Coherent Amplification, Dora van Veen[1], Vincent Houtsma[1]; *[1]Nokia Corporation, USA.* We demonstrate 50G duobinary PON transmission using a commercial 25G APD-based receiver. To extend the power budget we used simplified coherent amplification achieving -35 dBm sensitivity at 25G, enabling 40 dB optical power budget.

Th5A.5 • 19:00
Quasi frequency drift suppression for burst mode operation in low-cost thermally-tuned TWDM-PON, helene debregeas[2], Romain Brenot[2], jean-guy provost[2], sophie barbet[2], Wolfgang Poehlmann[1], Robert Borkowski[1], Rene Bonk[1], thomas pfeiffer[1]; *[1]Nokia Bell Labs, France; [2]III-V Lab, France.* To solve the problem of thermally-induced frequency drift in burst-mode transmitters for TWDM access networks,

we propose a laser with reduced self-heating, and a simple counter-heating method that demonstrates clear improvement in burst-mode BER measurements.

Th5A.6 • 19:15
200 Gbps OOK Transmission over an Indoor Optical Wireless Link Enabled by an Integrated Cascaded Aperture Optical Receiver, Zizheng Cao[1], Longfei Shen[1], Yuqing Jiao[1], Xinran Zhao[1], A. Koonen[1]; *[1]Eindhoven Univ. of Technology, Netherlands.* Enabled by an integrated InP membrane cascaded aperture optical receiver with flexibly-designed light collection aperture and >67 GHz bandwidth, the record-breaking 200 Gbps (5λ×40 Gbps) OOK data transmission is achieved over a 2 meter indoor optical wireless link.

Th5A.7 • 19:30
Bidirectional Delivery of 54-Gbps 8QAM W-Band Signal and 32-Gbps 16QAM K-Band Signal over 20-km SMF-28 and 2500-m Wireless Distance, Xinying Li[1,2], Jianjun Yu[1,2], Kaihui Wang[1], Yuming Xu[1], Long Chen[1], Li Zhao[1], Wen Zhou[1]; *[1]Key Laboratory for Information Science of Electromagnetic Waves (MoE), Fudan Univ., China; [2]ZTE (TX) Inc., USA.* We experimentally demonstrate photonics-aided bidirectional delivery of 54-Gbps 8QAM W-band signal and 32-Gbps 16QAM K-band signal over 20-km SMF-28 and 2500-m wireless distance with BER under 3.8×10^{-3}, employing antenna MIMO and advanced DSPs.

Room 403B
18:00 -- 19:45
Th5B • Postdeadline Session II
Presider: Leif Oxenlowe; DTU Fotonik, Denmark

Th5B.1 • 18:00
1-Pb/s (32 SDM/46 WDM/768 Gb/s) C-band Dense SDM Transmission over 205.6-km of Single-mode Heterogeneous Multi-core Fiber using 96-Gbaud PDM-16QAM Channels, Takayuki Kobayashi[1], Masanori Nakamura[1], Fukutaro Hamaoka[1], Kohki Shibahara[1], Takayuki Mizuno[1], akihide sano[1], Hiroto Kawakami[1], Akira Isoda[1], munehiko nagatani[7], Hiroshi Yamazaki[7], Yutaka Miyamoto[1], Yoshimichi Amma[2], Yusuke Sasaki[2], Katsuhiro Takenaga[2], Kazuhiko Aikawa[2], Kunimasa Saitoh[3], Yong-min Jung[4], David J. Richardson[4], Klaus Pulverer[5], Marc Bohn[5], Md. Nooruzzaman[6], Toshio Morioka[6]; *[1]NTT Network Innovation Laboratories, Japan; [2]Fujikura Ltd., Japan; [3]Hokkaido Univeristy, Japan; [4]Univ. of Southampton, UK; [5]Coriant R&D GmbH, Germany; [6]Technical Univ. of Denmark, Denmark; [7]NTT Device Technology Laboratories, Japan.* We demonstrate the first 1-Pb/s unidirectional inline-amplified transmission over 205.6-km of single-mode 32-core fiber within C-band only. 96-Gbaud LDPC-coded PDM-16QAM channels with FEC redundancy of 12.75% realize high-aggregate spectral efficiency of 217.6 b/s/Hz.

Th5B.2 • 18:15
70.4 Tb/s Capacity over 7,600 km in C+L Band Using Coded Modulation with Hybrid Constellation Shaping and Nonlinearity Compensation, Jin-Xing Cai[1], Hussam G. Batshon[1], Matt Mazurczyk[1], Oleg V. Sinkin[1], Ding Wang[1], Milen Paskov[1], Will Patterson[1], Carl Davidson[1], Pat Corbett[1], Greg wolter[1], Tim Hammon[1], Maxim A. Bolshtyansky[1], Dmitri Foursa[1], Alexei Pilipetskii[1]; *[1]TE SubCom, USA.* We demonstrate 70.4 Tb/s transmission over 7,600 km with C+L band EDFAs using coded modulation with hybrid probabilistic and geometrical constellation shaping. We employ multi-stage nonlinearity compensation including DBP, fast LMS equalizer and generalized filter.

Th5B.3 • 18:30
Trans-Atlantic Field Trial Using Probabilistically Shaped 64-QAM at High Spectral Efficiencies and Single-Carrier Real-Time 250-Gb/s 16-QAM, Junho Cho[1], Xi Chen[1], Sethumadhavan Chandrasekhar[1], Gregory Raybon[1], Ronen Dar[1], Laurent Schmalen[4], Ells Burrows[1], Andrew Adamiecki[1], Steve Corteselli[1], Yan Pan[3], Diego Correa[3], Brad McKay[3], Szilard Zsigmond[3], Peter Winzer[1], Stephen Grubb[2]; *[1]Nokia Bell Labs, USA; [2]Facebook, USA; [3]Nokia, USA; [4]Nokia Bell Labs, Germany.* We transmitted probabilistically shaped 64-QAM at 7.46 b/s/Hz over a 5,523-km in-service EDFA-only amplified trans-Atlantic cable (5.68 b/s/Hz over a looped-back 11,046 km). Using real-time processing we achieve single-carrier 250-Gb/s 16-QAM at 4 b/s/Hz.

Th5B.4 • 18:45
Entropy-Loading: The Multi-Carrier Constellation-Shaping for Colored-SNR Optical Channels, Di Che[1], William Shieh[1]; *[1]Univ. of Melbourne, Australia.* We propose the multi-carrier entropy-loading as a capacity-approaching modulation for colored-SNR optical channels. A 400-Gb/s constellation-shaped 64-QAM experiment reveals >0.3 bits/symbol mutual information or >2 dB OSNR sensitivity advantage over single-carrier systems.

Th5B.5 • 19:00
Single Carrier 1.2 Tbit/s Transmission over 300 km with PM-64 QAM at 100 GBaud, Karsten Schuh[1], Fred Buchali[1], Wilfried Idler[1], Tobias A. Eriksson[1], Laurent Schmalen[1], Wolfgang Templ[1], Rolf Schmid[2], Lars Altenhain[2], Michael Moeller[2], Klaus Engenhardt[3]; *[1]Nokia Bell Labs, Germany; [2]MICRAM Microelectronic GmbH, Germany; [3]Tektronix, Germany.*
We experimentally demonstrate Dual Polarization 64 QAM at 100 GBaud performing below the 20% soft FEC threshold of 4×10^{-2} over 300 km of ultra large effective area fiber at a record line rate of 1.2-Tbit/s.

Th5B.6 • 19:15
218-Gb/s Single-Wavelength, Single-Polarization, Single-Photodiode Transmission Over 125-km of Standard Singlemode Fiber Using Kramers-Kronig Detection, Xi Chen[1], Cristian Antonelli[2], Sethumadhavan Chandrasekhar[1], Gregory Raybon[1], Jeffrey sinsky[1], Antonio Mecozzi[2], Mark Shtaif[3], Peter Winzer[1]; *[1]Nokia Bell Labs, USA; [2]Univ. of L'Aquila, Italy; [3]Tel Aviv Univ., Israel.* We demonstrate a 218-Gb/s direct detection receiver using Kramers-Kronig optical phase reconstruction and chromatic dispersion compensation based on a single photodiode and achieve single-span transmission over 125 km of standard singlemode fiber at 1550 nm.

Th5B.7 • 19:30
First 400GBASE-LR8 interoperability using CFP8 modules, Martin Birk[1], Lynn E. Nelson[1], Guodong Zhang[1], Christopher Cole[2], Chengpin Yu[2], Mitsuo Akashi[3], Kiyohisa Hiramoto[3], X Fu[3], Paul Brooks[4], Andreas Schubert[4], Thananya Baldwin[5], Robert Luking[5], G Pepper[5]; *[1]AT&T Labs, USA; [2]Finisar, USA; [3]Oclaro, USA; [4]Viavi, Germany; [5]Ixia, USA.* We demonstrate interoperability of 400GBASE-LR8 for the first time between different modules suppliers and test sets using CFP8 alpha production pluggable modules. Error-free operation was measured with 10km of fiber and additional attenuation.

Th5B.8 • 19:45
Record High Capacity (6.8 Tbit/s) WDM Coherent Transmission in Hollow-Core Antiresonant Fiber, Zhixin Liu1, Lidia Galdino1, John R. Hayes2, Domanic Lavery1, Boris Karanov1, Daniel Elson1, Kai Shi1, Benn C. Thomsen1, Marco Petrovich2, David J. Richardson2, Francesco Poletti2, Radan Slavík2, Polina Bayvel1; 1Dept. of Electronic and Electrical Engineering, UCL, United Kingdom; 2ORC, University of Southampton, United Kingdom. The first multi-terabit/s WDM data transmission through anti-resonant

hollow-core fiber is demonstrated. 16×32-GBd dual-polarization Nyquist-shaped 256QAM channels propagated through a 270-m long fiber. No non-linearity penalty was observed for powers up to 1W.

Room 408A
18:00 -- 19:45
Th5C • Postdeadline Session III
Presider: Benjamin Lee; IBM TJ Watson Research Center, USA

Th5C.1 • 18:00
Silicon-Organic Hybrid (SOH) IQ Modulator for 100 GBd 16QAM Operation, Stefan Wolf[1], Heiner Zwickel[1], Clemens Kieninger[1], Yasar Kutuvantavida[1], Matthias Lauermann[1], Joachim Lutz[2], Lars Altenhain[2], Rolf Schmid[2], Wolfgang Freude[1], Christian Koos[1], Sebastian Randel[1]; *[1]Karlsruher Institut für Technologie, Germany; [2]Micram Microelectronic GmbH, Germany.* We generate record-high line rates of 400 Gbit/s (100 GBd 16QAM) using a silicon-based IQ modulator. With a BER=1.9×10^{-2} we transmit a net data rate of 333 Gbit/s, the highest value for a semiconductor-based modulator.

Th5C.2 • 18:15
Multi-Channel, Widely-Tunable Coherent Transmitter and Receiver PICs Operating at 88Gbaud/16-QAM, Matthias Lauermann[1], Ryan Going[1], Robert Maher[1], Mingzhi Lu[1], Wilson ko[1], pavel studenkov[1], James Ferrara[1], Amir Hosseini[1], Scott Corzine[1], Jeff Rahn[1], Matthias Kuntz[1], Huan-Shang Tsai[1], Andy Karanicolas[1], Peter Evans[1], Vikrant Lal[1], David Welch[1], Frederick A. Kish[1]; *[1]Infinera Corporation, USA.* We demonstrate 2-channel Tx and Rx PICs capable of delivering >700Gbps per channel (via 88Gbaud, 16-QAM dual-polarization modulation) over an 80km unamplified link with per channel extended C-band tunability.

Th5C.3 • 18:30
32QAM WDM Transmission Using a Quantum-Dash Passively Mode-Locked Laser with Resonant Feedback, Juned N. Kemal[1], Pablo Marin-Palomo[1], Kamel Merghem[2], Aubin Guy[2], cosimo calo[3], Romain Brenot[3], Francois Lelarge[3], Abderrahim Ramdane[2], Sebastian Randel[1], Wolfgang Freude[1,4], Christian Koos[1,4]; *[1]Inst. of Photonics and Quantum Electronics (IPQ), Karlsruher Institut für Technologie, Germany; [2]Center for Nanosciences and Nanotechnologies (CNRS - C2N), France; [3]III-V Lab, France; [4]Inst. of Microstructure Technology (IMT), Karlsruher Institut für Technologie, Germany.* We demonstrate coherent WDM transmission using a quantum-dash mode-locked laser diode with resonant feedback. We report a line rate of 12 Tbit/s (32QAM 60×20 GBd PDM) over 75 km SMF. The spectral efficiency is 7.5 bit/s/Hz.

Th5C.4 • 18:45
First Real-Time 100-Gb/s NRZ-OOK Transmission over 2 km with a Silicon Photonic Electro-Absorption Modulator, jochem verbist[1], Michiel Verplaetse[1], Ashwyn Srinivasan[2], Peter De Heyn[2], Timothy De Keulenaer[3,1], Ramses Pierco[3,1], Renato Vaernewyck[3,1], Arno Vyncke[3,1], Philippe Absil[2], Guy Torfs[1], Xin Yin[1], Gunther Roelkens[1], Joris Van Campenhout[2], Johan Bauwelinck[1]; *[1]Ghent Univ., Belgium; [2]imec, Belgium; [3]BiFast, Belgium.* We demonstrate the first real-time, serial 100 Gb/s NRZ-OOK transmission with an integrated GeSi EAM implemented on a silicon photonics platform. Transmission over 500m of SSMF and 2 km of dispersion shifted fiber is presented.

Th5C.5 • 19:00

100 GBd Intensity Modulation and Direct Detection with an InP-based Monolithic DFB Laser Mach-

Zehnder Modulator, Sophie Lange[1], Stefan Wolf[2], Joachim Lutz[3], Lars Altenhain[3], Rolf Schmid[3], Ronald Kaiser[1], Christian Koos[2], Sebastian Randel[2], Martin Schell[1]; *[1]Fraunhofer Heinrich Hertz Inst., Germany; [2]Karlsruhe Inst. of Technology, Germany; [3]Micram Microelectronic GmbH, Germany.* We demonstrate, for the first time with a DFB-MZM at 1550 nm, 100-GBd NRZ and PAM4 transmission over up to 1.2 km due to close-to-zero chirp. At 100-GBd PAM4, the DFB-MZM consumed only 0.85 pJ/bit.

Th5C.6 • 19:15
Integrated ultra-wide band wavelength-tunable hybrid external cavity silicon-based laser, Guilhem de Valicourt[1], Agnes Verdier[2], Romain Brenot[2], Young-Kai Chen[1], Po Dong[1]; *[1]Nokia Bell-Labs, USA; [2]III-V Lab, France.* We demonstrate a novel hybrid III-V/Si laser, which exhibits high fiber-coupled output power without booster SOA (up to +13 dBm at certain wavelengths) and a record tuning range (95nm) over the C and L band with side mode suppression ratio greater than 35 dB.

Th5C.7 • 19:30
Integrated Ferroelectric Plasmonic Optical Modulator, Andreas Messner[1], Felix Eltes[2], Ping Ma[1], Stefan Abel[2], Benedikt Baeuerle[1], Arne Josten[1], Wolfgang Heni[1], Daniele Caimi[2], Jean Fompeyrine[2], Juerg Leuthold[1]; *[1]ETH Zurich, Switzerland; [2]IBM Zurich, Switzerland.* An integrated ferroelectric plasmonic Mach-Zehnder modulator is demonstrated to work in a direct-detection setup with a 72 Gbit/s NRZ modulation format. The device works reliably beyond 130°C with an extinction ratio beyond 15 dB.

Room 408B
18:00 -- 19:45
Th5D • Postdeadline Session IV
Presider: Francesco Poletti; Univ. of Southampton, UK

Th5D.1 • 18:00
Lowest-Ever 0.1419-dB/km Loss Optical Fiber, Yoshiaki Tamura[1], Hirotaka Sakuma[1], Keisei Morita[1], Masato Suzuki[1], Yoshinori Yamamoto[1], Kensaku Shimada[1], Yuya Honma[1], Kazuyuki Sohma[1], Takashi Fujii[1], Takemi Hasegawa[1]; *[1]Sumitomo Electric Industries Ltd, Japan.* Lowest-ever 0.1419-dB/km loss at 1560-nm wavelength was realized in a silica-core fiber with 1290-°C low fictive temperature, 147-μm^2 large effective area and low microbending loss due to soft primary coating.

Th5D.2 • 18:15
Endlessly adiabatic fibre, Kerrianne Harrington[1], Stephanos Yerolatsitis[1], Dennis Van Ras[2], Tim A. Birks[1]; *[1]Univ. of Bath, UK; [2]Specialty Department, Draka Comteq Fiber BV, Netherlands.* An optical fibre with a logarithmic index profile can be adiabatically tapered over any length, no matter how short. We report an experimental approximation to such a fibre.

Th5D.3 • 18:30
Coupled-Core Optical Amplifier, Nicolas K. Fontaine[1], Jose Antonio-Lopez[2], Haoshuo Chen[1], roland ryf[1], David T. Neilson[1], Axel Schulzgen[2], Juan Carlos Alvarado Zacarias[2], Rene-Jean J. Essiambre[1], Hirotaka Sakuma[3], Takemi Hasegawa[3], Testuya Nakanishi[3], Tetsuya Hayashi[3], Rodrigo Amezcua Correa[2]; *[1]Nokia Corporation, USA; [2]CREOL, UCF, USA; [3]Sumitomo Electric Industries, Ltd., Japan.* We demonstrate a 4-core fiber amplifier that has strongly coupled cores at both the pump and signal wavelengths. Strong mode-coupling minimizes the mode dependent loss and simplifies requirements on the spatial uniformity of the pump.

Th5D.4 • 18:45

MCF-enabled Ultra-High-Density 256-core MT Connector and 96-core Physical-Contact MPO Connector, Tetsu Morishima[1], Jun Ito[1], Takayuki Shimazu[1], Hajime Arao[1], Osamu Shimakawa[1], Toshihisa Yokochi[1], Fumiya Uehara[1], Masaki Ohmura[1], Tetsuya Nakanishi[1], Tomomi Sano[1], Tetsuya Hayashi[1]; *[1]Optical Communications Laboratory, Sumitomo Electric Industries, Ltd., Japan.* Ultra-high-density multi-MCF connectors were realized with the insertion loss of <1 dB by 125-µm-cladding single-mode 8-core fibers and a newly developed simple rotational alignment method using MT-insertable V-groove array with the MT-standard 250-µm fiber pitch.

Th5D.5 • 19:00
Silicon Photonics Coherent Transceiver in a Ball-Grid Array Package, Christopher R. Doerr[1], John Heanue[1], Long Chen[1], Ricado Aroca[1], Saeid Azemati[1], Gaz Ali[1], Greg McBrien[1], Li Chen[1], Binbin Guan[1], Hongbin Zhang[1], Xingyu Zhang[1], Torben Nielsen[1], Habib Mezghani[1], Momchil Mihnev[1], Chiwai Yung[1], Michelle Xu[1]; *[1]Acacia Communications, Inc., USA.* We demonstrate a silicon photonics coherent transceiver in a ball-grid-array package. It can be handled like a conventional surface-mount-technology component, surviving pick-and-place and 260C reflow. It saves cost, size and provides enhanced thermals and bandwidth.

Th5D.6 • 19:15
8-channel 448 Gbit/s Hybrid Silicon Photonic Multi-Chip PSM Transmitter Enabled by Photonic Wire Bonding, Muhammad Rodlin Billah[1], Matthias Blaicher[1], Juned N. Kemal[1], Tobias Hoose[1], Heiner Zwickel[1], Phillip-Immanuel Dietrich[1], Ute Troppenz[2], Martin Möhrle[2], Florian Merget[3], Andreas Hofmann[1], Jeremy Witzens[3], Sebastian Randel[1], Wolfgang Freude[1], Christian Koos[1]; *[1]Karlsruher Institut für Technologie, Germany; [2]Fraunhofer Inst. for Telecommunications, Germany; [3]Integrated Photonics Laboratory, RWTH Aachen, Germany.* We demonstrate an eight-channel hybrid multi-chip module comprising hybrid-integrated 8ch-PSM transmitter comprising InP lasers, connected to Si silicon photonic pn-modulators, and parallel single-mode fibers, all connected via photonic wire bonds (PWB). We transmit 28 GBd PAM-4 signals at a total data rate of 448 Gbit/s over 2 km.

Th5D.7 • 19:30
High Density Optical Packaging of High Radix Silicon Photonic Switches, Tae Joon Seok[1,2], Victor I. Kopp[3], Dan Neugroschl[3], Johannes Henriksson[2], Jianheng Luo[2], Ming C. Wu[2]; *[1]Gwangju Inst. of Science and Technol, Korea (the Republic of); [2]EECS, Univ. of California, Berkeley, USA; [3]Chiral Photonics, Inc., USA.* We report on high density optical packaging of high radix (64x64) silicon photonic MEMS switches using pitch-reducing optical fiber array. The footprint of 61-channel optical I/O is as small as 330µm x 280µm.