

Advance Program

Signal Processing in Optical Communications

Monday, 20 July 2009

ALL SESSIONS WILL BE HELD IN SALON 5

9:00 AM - 10:00 AM

Session MC1: OFDM

Session Chair: John C. Cartledge, *Queen's University, Kingston, ON, Canada*

MC1.1 9:00 AM - 10:00 AM (Tutorial)

OFDM, F. Buchali, *Alcatel-Lucent, Stuttgart, Germany*

ABSTRACT NOT AVAILABLE

10:00 AM – 10:30 AM

COFFEE BREAK

10:30 AM - 12:00 PM

Session MC2: OPTICAL SIGNAL PROCESSING I

Session Chair: Fred Buchali, *Alcatel-Lucent, Stuttgart, Germany*

MC2.1 10:30 AM - 11:00 AM (Invited)

Nonlinearity Compensation in WDM Systems Through Digital Backward Propagation, G. Li, G. Goldfarb, X. Li, E. Mateo, F. Yaman, L. Zhu, *University of Central Florida, Orlando, FL, USA* and X. Zhou, *AT&T, Middletown, NJ, USA*

Simulation and experimental results on compensating fiber transmission impairments including inter and intra-channel nonlinearity using digital backward propagation will be presented for WDM systems and polarization-division multiplexed WDM systems.

MC2.2 11:00 AM - 11:15 AM

Impact of Non-Uniform Span Length Distribution on Coherent 100G PM-QPSK Transmission, X. Pan, *Opnext, Inc., Los Gatos, CA, USA*

We investigate the effect of non-uniform span length and dispersion compensation on the performance of 100G coherent PM-QPSK DWDM links. Optimal pre-compensation values are shown to vary greatly for the span length distributions studied.

MC2.3 11:15 AM - 11:30 AM

Polarization-Insensitive Wideband Wavelength Conversion for DSPK Signal by Dual-Pump Four-Wave Mixing in a Photonic Crystal Fiber, Y. Dai and C. Shu, *Chinese University of Hong Kong, Shatin, NT, Hong Kong*

Nondegenerate four-wave mixing is used in high- nonlinearity photonic crystal fiber with residual birefringence to achieve polarization-insensitive wideband wavelength conversion. The output power variation is below 0.2 dB and the conversion bandwidth is over 22 nm

MC2.4 11:30 AM - 12:00 PM (Invited)

Ultrafast Transmission Technology using Time-Domain Optical Fourier Transformation Technique, T. Hirooka and M. Nakazawa, *Tohoku University, Sendai, Miyagi, Japan*

Ultrahigh-speed OTDM transmission using time-domain optical Fourier transformation (OFT) is described. 320 Gbit/s-525 km transmission and 160 Gbit/s-200 km field transmission over an installed fiber link were successfully demonstrated with improved PMD tolerance using OFT.

12:00 PM – 1:30 PM

LUNCH BREAK

1:30 PM - 2:45 PM**Session MC3: DIGITAL SIGNAL PROCESSING I****Session Chair:** Lawrence R. Chen, *McGill University, Montréal, QC, Canada***MC3.1 1:30 PM - 2:00 PM (Invited)****Network Implications of Optical Compensation and Digital Signal Processing for Coherent and Non-Coherent Receiver Design,** M. Frankel, *Ciena Corporation, Linthicum, MD, USA*

Fiber-optic industry is increasingly using CMOS DSPs to satisfy WDM channel rate increases. CMOS works best in high volume applications for dynamic impairment compensation. Optical approaches may be more appropriate for dealing with static impairments.

MC3.2 2:00 PM - 2:30 PM (Invited)**Algorithms for Optical QAM Detection,** T. Pfau and R. Noé, *University of Paderborn, Paderborn, Germany*

This paper presents a linewidth-tolerant carrier phase estimation algorithm for synchronous optical QAM transmission systems. The 2-stage structure of the algorithm allows a flexible and hardware-efficient implementation for arbitrary QAM constellations.

MC3.3 2:30 PM - 2:45 PM**Assessment of Parallel Equalizer/Phase Estimation Algorithms in Coherent Optical Systems,** L. S. Pessoa, H. M. Salgado, *Instituto de Engenharia de Sistemas e Computadores, Porto, Portugal* and I. Darwazeh, *University College London, London, UK*

The options to implement a coherent optical system employing a phase estimation algorithm combined with adaptive linear equalization are investigated. Several carrier phase estimator strategies are discussed, in terms of parallelization, performance and implementation complexity.

3:00 PM – 3:30 PM**COFFEE BREAK****3:30 PM - 5:00 PM****Session MC4: MODULATION****Session Chair:** John C. Cartledge, *Queen's University, Kingston, ON, Canada***MC4.1 3:30 PM - 4:00 PM (Invited)****Comparison of High Order Modulation Formats for 40Gb/s and 100Gb/s,** K.-T. Wu, H. Sun, *Nortel Networks, Ottawa, ON, Canada*, C. Laperle, *Nortel Networks, Nepean, ON, Canada*, A. Borowiec, *Nortel Networks, Ottawa, ON, Canada*, D. J. Krause, *Nortel Networks, Nepean, ON, Canada*, K. Roberts, *Nortel Networks, Ottawa, ON, Canada* and M. O'Sullivan, *Nortel Networks, Nepean, ON, Canada*

Modulation formats for 40 and 100 Gb/s transmission are compared based on OSNR tolerance. Implementation considerations are highlighted. Propagation penalty as a function of optical dispersion compensation is studied for 112 Gb/s DP-QPSK.

MC4.2 4:00 PM - 4:30 PM (Invited)**Nonlinear Limits for High Bit-Rate O-OFDM Systems,** F. Buchali, *Alcatel-Lucent, Stuttgart, Germany*

Optical OFDM's high PAPR values limit the systems nonlinear tolerance (NLT). A 2.6-dB improvement in NLT has been found by peak clipping. Towards higher bit rates above 50 Gb/s, we observe an additional NLT increase of 8 dB per 10x increase in signal bit rate.

MC4.3 4:30 PM - 5:00 PM (Invited)**Adaptive Weighted Channel Equalizer for Direct-Detection Optical OFDM Transmission Systems,** M. E. Mousa Pasandi, J. Haghghat, and D. V. Plant, *McGill University, Montréal, QC, Canada*

We study the performance of an adaptive weighted channel equalizer for non-compensated OFDM transmission systems and show that it improves the BER and can reduce the overhead and sensitivity to drifts in the optical channel.

Tuesday, 21 July 2009

9:00 AM - 10:00 AM

Session TuC1: NETWORK EVOLUTION

Session Chair: Fred Buchali, *Alcatel-Lucent, Stuttgart, Germany*

TuC1.1 9:00 AM - 10:00 AM (Tutorial)

Network Evolution, L. Paraschis, *Cisco Systems, Inc., San Jose, CA, USA*

ABSTRACT NOT AVAILABLE

10:00 AM – 10:30 AM

COFFEE BREAK

10:30 AM - 12:00 PM

Session TuC2: SIGNAL CONVERTERS AND EQUALIZERS

Session Chair: John C. Cartledge, *Queen's University, Kingston, ON, Canada*

TuC2.1 10:30 AM - 11:00 AM (Invited)

CMOS ADC and DAC for 100G and Beyond, I. Dedic, *Fujitsu Microelectronics Europe GmbH, Langen, Germany*

100G coherent systems need high speed low power ADC and DAC, especially if these are used for serial interfaces like CEI-28G. How can we achieve these performance levels, with future scaling to 400G and beyond?"

TuC2.2 11:00 AM - 11:15 AM

Application of MLSE Technology in Optical Communication Systems and Performance Evaluation in 10Gbit/s Field Trials, D. Fritzsche, *Dresden University Of Technology, Dresden, Germany*, D. Breuer, *Deutsche Telekom AG, Berlin, Germany*, L. Schuerer, A. Ehrhardt, *Deutsche Telekom Netzproduktion GmbH, Berlin, Germany*, H. Oeruen, *CoreOptics GmbH, Nuremberg, Germany* and C. G. Schaeffer, *Dresden University Of Technology, Dresden, Germany*

In this paper we analyze the effort of realizing advanced MLSE digital equalizer technology in optical 10Gbit/s systems and evaluate its performance for ISI compensation in field applications by comparing 4-state vs. 16-state Viterbi decoders.

TuC2.3 11:15 AM - 11:45 AM (Invited)

Comparison of Electronic Pre-Compensation and Post-Compensation for Cascaded Optical Filtering of 10 Gb/s NRZ-OOK Signals, Y. Jiang, *Queen's University, Kingston, Canada*

Using a recirculating loop, the performance improvement for cascaded optical filtering by using pre-compensation at the transmitter and post-compensation at the receiver is compared.

TuC2.4 11:45 AM - 12:00 PM

Electronic Equalization with Dual VSB Filtering for RZ-OOK and DB Signals, M. Li, F. Zhang, *Peking University, Beijing, China*, Z. Chen, *Shanghai Jiao Tong University, Beijing, China* and A. Xu, *Peking University, Beijing, China*

We show by simulation that for chromatic dispersion compensation of RZ-OOK and DB signals, the performance of electronic equalization can be significantly enhanced with dual-vestigial-sideband filtering and joint equalization.

12:00 PM – 1:30 PM

LUNCH BREAK

1:30 PM - 3:00 PM

Session TuC3: DIGITAL SIGNAL PROCESSING II

Session Chair: Yannick K. Lize, *Opnext, Inc., Los Gatos, CA, USA*

TuC3.1 1:30 PM - 2:00 PM (Invited)

How Will Coherent Receivers Change the Network Design of DWDM Transmission Systems?, P. Magill, *AT&T, Middletown, NJ, USA*

ABSTRACT NOT AVAILABLE

TuC3.2 2:00 PM - 2:30 PM (Invited)

Optical Performance Monitoring using a 43Gb/s Realtime Coherent Receiver, J. Geyer, C. R. S. Fludger, T. Duthel, C. Schulien, *CoreOptics GmbH, Nuremberg, Germany* and B. Schmauss, *University of Erlangen-Nuremberg, Erlangen, Germany*

We present Optical Performance Monitoring from the equalizer filter setting of an FPGA-based Realtime 43Gb/s Polarization Diverse Coherent Receiver. Chromatic Dispersion and Polarization Mode Dispersion are independently estimated from the blindly adapted equalizer filter. The accuracy of the estimates is demonstrated based on measurements.

TuC3.3 2:30 PM - 3:00 PM (Invited)

Differential Phase Compensated Constant Modulus Algorithm for Phase Noise Tolerant Coherent Optical Transmission, M. El-Darawy, T. Pfau, S. Hoffmann and R. Noe, *University of Paderborn, Paderborn, Germany*

We extend a non-data-aided constant modulus algorithm (CMA) by a differential phase compensation (DPC-CMA) and simulate its polarization demultiplexing performance in a digital coherent QPSK receiver against that of the standard CMA.

3:00 PM – 3:30 PM

COFFEE BREAK

3:30 PM - 5:00 PM

Session TuC4: REGENERATION

Session Chair: Lawrence R. Chen, *McGill University, Montréal, QC, Canada*

TuC4.1 3:30 PM - 4:00 PM (Invited)

Multi-Wavelength All-Optical Regeneration Techniques, F. Parmagiani, *University of Southampton, Southampton, UK*

We review the progress on the various existing fibre-based solutions proposed to extend all-optical 2R regeneration to multi-channel operation. Our emphasis is on a bi-directional architecture based on offset filtering of an SPM-broadened spectrum.

TuC4.2 4:00 PM - 4:15 PM

40 Gb/s Wavelength Preserving Polarization Insensitive All-Optical 3R Regenerator Utilizing Raman Amplification, Cross- and Self-Phase Modulation, and Offset Filtering, S. H. Chung, X. Tang and J. C. Cartledge, *Queen's University, Kingston, ON, Canada*

All-optical 3R regeneration is demonstrated at 40 Gb/s that is wavelength-preserving and insensitive to the state of polarization of the input signal. The regenerator consists of retiming and reshaping stages that must be carefully co-designed.

TuC4.3 4:15 PM - 4:30 PM

Experiment of DPSK Signal Regeneration using Fiber Nonlinearity, M. Matsumoto and Y. Morioka, *Osaka University, Osaka, Japan*

All-optical regeneration of DPSK signals using fiber nonlinearity is reported. BER measurements for a two-span system where the regenerator is inserted in between shows that the regenerator is effective in suppressing phase-noise accumulation.

TuC4.4 4:30 PM - 4:45 PM

All-Optical Regeneration of Time-Interleaved Multi-Wavelength Signals based on Higher-Order Four-Wave Mixing, N. S. Mohd Shah and M. Matsumoto, *Osaka University, Osaka, Japan*

Dual-channel all-optical 2R regeneration based on higher-order four-wave mixing in a nonlinear fiber is presented. A single fiber and a pump are shared by the time-interleaved two wavelength channels.

TuC4.5 4:45 PM - 5:00 PM

Small-Signal Analysis of SOA-MZI and Applications in Nonlinear Signal Processing, N. Pleros, *Aristotle University of Thessaloniki, Thessaloniki, Macedonia, Greece*

For the first time, we derive the frequency-domain transfer function of SOA-based MZI configurations based on small-signal gain analysis using simplified analytical expressions for the SOAs response, providing qualitative insight for various non-linear optical applications.

Wednesday, 22 July 2009

9:00 AM - 10:00 AM

Session WC1: CODING

Session Chair: Fred Buchali, *Alcatel-Lucent, Stuttgart, Germany*

WC1.1 9:00 AM - 9:30 AM (Invited)

Soft-Decision FEC for 100 Gb/s DSP based Transmission, T. Mizuochi, *Mitsubishi Electric Corporation, Kamakura, Japan*

Recent progress in soft-decision based FECs for 100 Gb/s class optical communications is reviewed. High speed 2-bit soft-decision LSI made with SiGe BiCMOS technology is introduced. The implementation of softdecision based 100 Gb/s FEC is discussed.

WC1.2 9:30 AM - 9:45 AM

Adaptive LDPC-Coded Multilevel Modulation with Coherent Detection for High-Speed Optical Transmission, I. B. Djordjevic, *University of Arizona, Tucson, AZ, USA*

We propose an adaptive LDPC-coded multilevel-modulation scheme, suitable for use in future 100Gb/s and 1Tb/s Ethernet technologies. In proposed scheme, codeword length and column-weight of a parity-check matrix H are kept constant while code-rate adaptation is performed by varying column-weight and permutation-block size of H.

WC1.3 9:45 AM - 10:00 AM

Multi-Dimensional LDPC-Coded Modulation for High-Speed Optical Communication Systems, H. G. Batshon, I. B. Djordjevic, *University of Arizona, Tucson, AZ, USA*, L. Xu and T. Wang, *NEC Laboratories America, Inc., Princeton, NJ, USA*

We propose a multi-dimensional LDPC-coded modulation scheme to achieve high transmission rates of 320 Gb/s and beyond. This scheme utilizes currently available commercial components operating at 40 Giga symbols/s, and can reach 400 Gb/s aggregate rate with a coding gain of 10.75 dB.

10:00 AM – 10:30 AM**COFFEE BREAK****10:30 AM - 12:00 PM****Session WC2: OPTICAL SIGNAL PROCESSING II****Session Chair:** Lawrence R. Chen, *McGill University, Montréal, QC, Canada***WC2.1 10:30 AM - 11:00 AM (Invited)**

OTDM/WDM using Optical Signal Processing, H. Sotobayashi, *Aoyama Gakuin University, Sagami-hara, Japan*, K. Akahane and N. Yamamoto, *National Institute of Information and Communications Technology, Koganei, Tokyo, Japan*

Hierarchical OTDM/WDM system based on a waveband concept is demonstrated by use of an optical signal processing. Demonstrated key technologies are C- and L-waveband generation, waveband conversion, and 1- μ m waveband transport for a new wavelength resource.

WC2.2 11:00 AM - 11:15 AM

All-Optical Demultiplexing of Quaternary Amplitude Signals with Fiber-Based Optical Gates, E. A. de Mello Fagotto and M. L. Francisco Abade, *Pontifical Catholic University of Campinas, Campinas, Brazil*

We propose an all-optical demultiplexing scheme for quaternary amplitude signals which employs fiber-based optical gates and we test it by simulations. Results suggest this scheme is suitable to be applied in metropolitan area networks.

WC2.3 11:15 AM - 11:30 AM

Secure Sensor Data Transmission Channel Overlay on Passive Optical Networks, Z. Wang, *Princeton University, Princeton, NJ, USA*

An independent channel is overlaid on a gigabit passive optical network to carry data collected from sensor networks. The GPON experiences minimal performance degradation due to the channel overlay, indicating the feasibility of this approach.

WC2.4 11:30 AM - 11:45 AM

In-Service Monitoring of PMD Induced Optical Signal Degradation using SOP Vector Trajectory on the Poincare Sphere, H. Takeshita, K. Fukuchi, S. Shioiri and E. L. T. de Gabory, *NEC Corporation, Kawasaki, Kanagawa, Japan*

The performance of signal monitoring was studied to estimate signal degradation by processing data obtained from SOP measurement. Good correlation between measured Q-value and estimation from SOP data was observed under the existence of SOPMD.

WC2.5 11:45 AM - 12:00 PM

Full PMD Vector Measured Directly from Modulated Data Using Linear Optical Sampling, P. A. Williams and T. Dennis, *National Institute of Standards and Technology, Boulder, CO, USA*

We demonstrate a new technique to monitor the polarization-mode dispersion in a fiber communication channel by analyzing the modulated data at the fiber output measured with Polarization-Sensitive Linear Optical Sampling (PS-LOS).

END OF PROGRAM