OFC/NFOEC'11 Review

Access, ROADM, miscellaneous

Prepared by Richard Wang

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Sessions

- OMP — WDM PON
- NTuB — WDM PON Technology
- OThK — Access Systems and Subsystems
- OWK — New Approaches in Access
- OTuD — ROADM Technologies I
- OTuM — ROADM Technologies II
- OThZ — Short Reach Enabling Technologies

Code	Title	Author/Affiliation	Topic
OMP1	Maximum Reach of Long-Reach RSOA-Based WDM PON Employing Remote EDFA	U. H. Hong, K. Y. Cho, Y. Takushima, and Y. C. Chung ***KAIST***	Effects of the gain and position of the remote EDFA on the RB-induced degradations in a long-reach RSOA-based WDM PON
OMP2	Demonstration of 25.78-Gb/s, 20-km Reach WDM PON Using Directly-Modulated Bandwidth-Limited RSOA	K. Y. Cho, J. H. Chang, B. S. Choi, Y. Takushima, and Y. C. Chung ***KAIST, ETRI***	Demonstration of a 20-km transmission of 25.78-Gb/s signal obtained from a directly-modulated RSOA

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OMP3	Reduction of Back-Reflection induced Power Penalty by means of Coherent Seeding Source with Optical Feedback in a Loop-Back WDM-PON	Seung-Hyun Cho, Han Hyub Lee, Jie Hyun Lee, and Sang Soo Lee ***ETRI***	A DFB-LD (distribution feedback laser-diode) with optical feedback as a seeding source in a loop-back WDM-PON based on RSOA
OMP4	Stable self-seeding of R-SOAs for WDM-PONs	Marco Presi, Ernesto Ciaramella ***Scuola Superiore Sant'Anna – CEIICP***	Demonstration of a 20-km transmission of 25.78-Gb/s signal obtained from a directly-modulated RSOA

Code	Title	Author/Affiliation	Topic
OMP5	Line Coding for Downlink DML Modulation in λ-Shared, RSOA-based Asymmetric Bidirectional WDM PONs	Zaineb Al-Qazwini, Hoon Kim ***National University of Singapore***	Various line codes used to suppress interference between the downstream and upstream signals
OMP7	Bidirectional WDM PON Enabled by Reflective ONUs and a Novel Overlapped-Subcarrier Multiplexing Technique	Ziad A. El-Sahn, Jonathan M. Buset, David V. Plant ***McGill University***	Overlapped subcarrier multiplexing (O-SCM) technique
OMP8	10-Gbps Upstream Transmission for WDM-PON Using RSOA and Delay Interferometer	Hoon Kim ***National University of Singapore***	A delay interferometer (DI) used to compensate bandwidth limitation of RSOA

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Code	Title	Author/Affiliation	Topic
NTuB1	Tuning Methods for Uncooled Low-Cost Tunable Lasers in WDM-PON	Markus Roppelt, Felix Pohl, Klaus Grobe, Michael Eiselt, Jörg-Peter Elbers ***ADVA AG***	Tuning of uncooled low-cost lasers without an integrated wave locker via a shared, centralized wave locker
NTuB2	System Impairments and Performance Implications of ASE Seeded WDM PON Systems	Ning Cheng, Frank Effenberger ***Huawei***	System performances are analyzed in ASE (amplified spontaneous noise) seeded WDM PONs

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NTuB3	Experimental Demonstration of a Cost-Effective Broadcast Overlay for a Commercial WDM PON	P. P. Iannone, K. C. Reichmann, J. Pastor, C.G. Brinton, C-H. Lee, H-Y. Rhy, Y-L. Lam ***AT&T Labs – Research, LG-Ericsson***	A practical low-cost broadcast overlay for WDM PON using a high-power SLED transmitter is demonstrated
NTuB4	32-Channel, Injection-Locked WDM-PON SFP Transceivers for Symmetric 1.25 Gbps Operation	H. L. Zhang, G. W. Pickrell, Z. Morbi, Y. Wang, M. Ho, K. A. Anselm, W. -Y. Hwang ***Applied Optoelectronics, Inc.***	A 32-channel, WDM-PON SFP transceiver is demonstrated at 1.25 Gbps with C-band transmit and L-band receive functionality

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NTuB5	20 Gb/s WDM-PON System with 1 GHz RSOA using Partial Response Equalization and Optical Filter Detuning	Qi Guo, An V. Tran, Chang-Joon Chae ***Victoria Research Laboratory, NICTA Ltd. University of Melbourne***	High speed operation in WDM-PON with low-bandwidth RSOA using partial response equalization and optical filter detuning techniques
NTuB6	"Real World" FTTH Optical-to-Radio Interface Performance for Bi-directional Multi-Format OFDM Wireless Signal Transmission	Maria Morant, Terence Quinlan, Stuart Walker, Roberto Llorente ***Universidad Politécnica de Valencia, Spain, University of Essex, UK***	The optical-to-radio and radio-to-optical interfaces in fiber-to-the-home access networks were evaluated for LTE, WiMAX and UWB simultaneous distribution.

Code	Title	Author/Affiliation	Topic
NTuB7	Future bandwidth demand favors TDM PON, not WDM PON	Ed Harstead ***Alcatel-Lucent***	There is no bandwidth-based argument for an operator to pay a premium for WDM PON
NTuB8	300 Mbps Transmission with 4.6 bit/s/Hz Spectral Efficiency over 50 m PMMA POF Link Using RC-LED and Multi-Level Carrierless Amplitude Phase Modulation	M. Wieckowski, J. B. Jensen, I. Tafur Monroy, J. Siuzdak, J. P. Turkiewicz ***Warsaw University of Technology, Technical University of Denmark***	Successful transmission of up to 300 Mbps over a 50 m long POF link using a commercially available Fast Ethernet capable RC-LED

Arguments that TDM PON is favored

- For almost two decades the TDM PON downstream line rate is doubling every 2 years. Therefore a putative 40G (TDM) PON would be predicted in 2016.
- In a triple play access network, the source of largest bandwidth demand is streaming video.
- Enough headroom to accommodate bursty traffic, which is the only kind of traffic capable of filling such large pipes in this decade. Compared to dedicated WDM PON system, TDM PON is more efficient to carry bursty traffic.
- An aggregate of 32 such households on a PON is unlikely to consume more than a few hundred Mb/s.

In conclusion, there is no bandwidth-based argument for an operator to pay a premium for WDM PON.

Challenges with WDM PON

- Rayleigh backscattering
- RSOA low bandwidth upstream

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Code	Title	Author/Affiliation	Topic
OThK1	SOA/REAM as Vector Modulator for QAM Upstream	Bernhard Schrenk, Josep M. Fabrega, ChristopheKazmierski, Jose A. Lazaro, Josep Prat *Universitat Politecnica de Catalunya, Jordi Girona* *Centre Tecnològic de Telecomunicacions de Catalunya (CTTC)* *Alcatel-Thales III-V labs*	Simultaneous encoding of information in the optical phase and amplitude for upstream transmission
OThK2	First Demonstration of Symmetric 10-Gb/s Access Networks Architecture based on Silicon Microring Single Sideband Modulation for Efficient Upstream Signal Re-modulation	Lin Xu, Kishore Padmaraju, Long Chen, Michal Lipson, Keren Bergman ***Columbia University*** ***Cornell University***	Downstream silicon microring single-sideband modulation and upstream phase-remodulation of a centrally distributed carrier

Code	Title	Author/Affiliation	Topic
OThK3	Upstream Multi-Wavelength Shared PON with Wavelength-Tunable Self-seeding Fabry-Perot Laser Diode	Min Zhu, Shilin Xiao, Zhao Zhou, Wei Guo, Lilin Yi, He Chen, Jie Shi, Weisheng Hu ***Shanghai Jiao Tong University***	(1) Upstream Multi-Wavelength Shared PON using a tunable self-seeding FP-LD at ONU (2) effect of channel switch latency (SL) in multi-wavelength IPACT
OThK4	Time-Interleaved Phase Remodulation to Enable Broadcast Transmission in Bidirectional WDM-PONs without Additional Light Sources	Jing Xu, Zhixin Liu, Lian-Kuan Chen, Chun-Kit Chan ***CUHK***	Time-interleaved phase remodulation to realize broadcast transmission in WDM-PONs

Code	Title	Author/Affiliation	Topic
OThK5	Next-generation Components for Optical Access Networks	David Piehler ***NeoPhotonics***	Core to access technology not feasible due to different economics, cost limits higher integration, electronic component availability limits speed
OThK6	A Survivable Protection and Restoration Scheme using Wavelength Switching of Integrated Tunable Optical Transmitter for High Throughput WDM-PON System	Arshad Chowdhury, Hung-Chang Chien, Shu-Hao Fan, Cheng Liu, Charles Su, Gee-Kung Chang ***GIT*** ***AOC Inc.***	Wavelength switching of low-cost integrated tunable laser assembly to protect multiple fiber failures in a high capacity colorless WDM-PON

Code	Title	Author/Affiliation	Topic
OThK7	1.3 μm all-VCSEL low complexity coherent detection scheme for high bit rate and high splitting ratio PONs	Roberto Rodes, Jesper Bevensee Jensen, Antonio Caballero, Idelfonso Tafur Monroy ***Technical University of Denmark***	Full 1.3 μm VCSEL-based simplified coherent detection receiver is demonstrated at 5 Gbps

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Code	Title	Author/Affiliation	Topic
OWK1	Universal Gigabit Optical Access	James F. Kelly ***Google***	Next slide
OWK2	Transmission of Multi-Band OFDM-UWB Signals along NG-FTTH Networks using Directly Modulated Lasers	Daniel D. Fonseca, José A. P. Morgado, Adolfo V. T. Cartaxo ***Nokia Siemens Networks, Instituto Superior Técnico***	Transmission of multi-band OFDM-UWB signals along FTTH networks using directly modulated lasers is experimentally evaluated

Google's vision

- FTTH Operators where possible deploy dedicated fibers to each user for future-proof and security concerns.
- Symmetric gigabit access will enable new forms of Web content caching, potentially enabling a greater proportion of content serving from distributed caching systems.
- any mobile device within range of a FTTH Network optical network terminal (ONT) should be able to route data over the Fiber network to save RF resources.
- Cost effective integrated fault location and in service diagnosis of FTTH Networks
- Higher densities for both fiber termination and optical equipment, and lower power consumption are imperative to lower the capital and operational cost of gigabit symmetric access

Code	Title	Author/Affiliation	Topic
OWK3	Performance evaluation and improvement methods for low-driving voltage transmitters in long reach PONs	Sotiria Chatzi, Christos P. Tsekrekos, Dimitrios Klonidis, Ioannis Tomkos ***AIT centre*** ***Universitat Polytècnica de Catalunya***	Two common low-driving voltage (low-ER) sources is experimentally evaluated for long reach PON applications
OWK4	On the Interest of Chirped Lasers for AMOOFDM Transmissions in Long Distance PON Networks	***Orange Labs, France,*** ***Université de Limoges,*** ***Lab-STICC,*** ***GET / Télécom Paris***	Chirped laser in IMDD-based transmissions for long distance PONs using OFDM
OWK5	Demonstration of Converged Bidirectional OFDM-m-QAM RoF and WDM-OFDM-PON Access Networks	Yu-Ting Hsueh, Ming-Fang Huang, Shu-Hao Fan, Gee-Kung Chang ***GIT***	Lightwave centralized hybrid bidirectional WDM-OFDM-PON and OFDM-m-QAM RoF network

Code	Title	Author/Affiliation	Topic
OWK6	Noise Suppression for Fiber Radio Transmission on Spectrum-Sliced WDM-PONs Employing Interferometric Structures	Xiaoxiao Xue, Xiaoping Zheng, Hanyi Zhang, Bingkun Zhou ***Tsinghua University***	Multiple low-noise windows with equal frequency spacing are created using the interferometric cancellation of the beat noise.
OWK7	Phase Modulated Optical Millimeter Wave Generation Based on Externally Injected Gain Switched Laser	H. Shams, P. Perry, P. M. Anandarajah, L.P. Barry ***Dublin City University (DCU)***	Generating phase modulated millimeter-waves using an externally injected gain switched laser.

Visions – Access Network

- Loopback RSOA enabled WDM PON
- Hybrid TDM/WDM PON
- Dynamic capacity assignment in WDM PON
- Wireless/optical transmission system integration

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Code	Title	Author/Affiliation	Topic
OTuD1	ROADM Switching Technologies (tutorial)	Paul Colbourne, Brandon Collings ***JDSU***	(1) WSS ROADM technologies, (2) CDC ROADM architecture
OTuD2	Multi-degree ROADM based on massive port count WSS with integrated Colorless ports	***NTT***	A simple multi-degree ROADM architecture based on a massive port count WSS with integrated colorless ports is proposed

Code	Title	Author/Affiliation	Topic
OTuD3	Compact PLC-based Transponder Aggregator for Colorless and Directionless ROADM	***NTT***	A CDC multi-degree ROADM node implementation using compact transponder aggregator comprising splitter-switch/tunable filter array based on PLC
OTuM1	Fast Remotely Reconfigurable Wavelength Selective Switch	A. Rohit, A. Albores-Mejia, N. Calabretta, X. J. M. Leijtens, D. J. Robbins, M. K. Smit, K. A. Williams ***COBRA Research Institute, Eindhoven University of Technology, Netherlands***	Fast nanosecond-speed, on-the-fly reconfiguration using monolithically integrated label readers and channel selectors

Code	Title	Author/Affiliation	Topic
OTuM2	Wavelength selective switching with one-chip silicon photonic circuit including 8 x 8 matrix switch	Shigeru Nakamura, Shigeki Takahashi, Masahiro Sakauchi, Tomoyuki Hino, Ming-Bin Yu, Guo-Qiang Lo ***NEC Corporation***	Polarization-independent wavelength path switching demonstrated with one-chip silicon photonic circuit
OTuM3	Flexible and Grid-less Wavelength Selective Switch using LCOS Technology	Steve Frisken, Glenn Baxter, Dmitri Abakoumov, Hao Zhou, Ian Clarke, Simon Poole ***Finisar Australia***	Intrinsic Grid-free capabilities of LCOS and how it can be used practically in a flexible Grid architecture to maximize total fiber capacity

Code	Title	Author/Affiliation	Topic
OTuM4	LCOS-Based 4x4 Wavelength Cross-Connect Switch For Flexible Channel Management in ROADMs	***SANTEC CORPORATION***	Integrated 4x4 wavelength cross-connect switch utilizing an LCOS based 12 port counts wavelength blocker array
OTuM5	PDL and PMD Emulation with Control of Amplitude and Spectral Dependence to a Sub-Channel Level across the C-Band	Ian G. Clarke, Dmitri Abakoumov, J.A. Bolger, Hao Zhou, Steve Frisken, Simon Poole, Glenn Baxter ***Finisar Australia***	Polarization diverse LCoS wavelength processor

Visions – ROADM

- Colorless, Directionless, Contentionless
  - Add/drop route any wavelength from any fiber to any
- Various architectures and building technologies are under evaluation
- Abstract networking layer model of ROADM

Industry Perspective

- NTuB7 Industry favors TDM over WDM PON
- OThK5 Dynamics of access network component evolution
- OWK1 Gigabit access
- OTuD1 ROADM Switching Technologies (tutorial)