The implementation of optical networks is considered to be the only solution to meet the future demands in the communications area. Despite the economic downturn, we received an encouraging level of submissions for this special section. Some of the papers included here were initially presented in the SPIE Information Technologies and Communications (ITCOM) conference on active and passive components and also in the optical computing algorithms and architecture conference. This special section is comprised of 14 papers in the areas of wavelength-division multiplexing (WDM) components, systems and optimization, and applications.

Between the source and the detector of an optical network, there are a number of important components technologies that make up the optical WDM network. The WDM components papers included in this special section are on interconnections, waveguides, fiber amplifiers, dispersion compensators, switching, add-drop multiplexers, clock recovery circuits, and detectors. In the first paper of this series, Kawai discusses interconnections between vertical-cavity surface emitting lasers (VCSEL) sources and fibers. Various alignment and packaging issues for developing interconnections between VCSEL sources and fiber waveguides are addressed in this paper. Waveguides consisting of heterostructured photonic crystals are the topic of the next paper by Ohtera et al. The authors describe an autocloning technology that minimizes the propagation loss to 0.1 dB/mm. To reduce the propagation loss while increasing the capacity and distance of an optical network, laser amplifiers are essential. In the next paper, Wang and Dutta present a model for an Er-Yb double-clad amplifier. Theoretical as well as numerical analysis of amplifier gains for various pump and signal powers are presented. One of the critical components for achieving high-bit-rate communications systems is polarization mode dispersion (PMD) compensation. In the next paper, Khosravani quantifies the effect of PMD on system performance. The author presents ways to compensate for the PMD and minimize signal distortion. Distortion may degrade the performance of optical switching devices. In the next paper, by Pérennou et al., cross talk performance of an acousto-optic switch caused by distortion induced by multiple modulation signals is analyzed. They show a degradation of signal-to-noise ratio caused by these intermodulation effects.

The next three papers address components at the receiving end of the transmission system. Resonances characterized by maximum transmission/absorption have been used successfully for creating passive optical components. The paper by Işçi et al. uses a microsphere resonator to produce dips in the transmission characteristics, which can subsequently be used to construct an add/drop multiplexer. Add/drop multiplexers and demultiplexers at the receiving end need a stable clock source to operate. The next paper by Zhu et al. presents a method of clock recovery using a phase-locked loop in a Mach-Zehnder modulator. They show that it is possible to recover a 10-GHz clock from a 40- and 80-Gb/s data signal with only 50-fs jitter. Demultiplexer design using phased arrays is the topic of the last paper in the component category by Yehia and Khalil. Cascading small multimode interference phasar devices with high uniformity, they optimize a large structure with very low nonuniformity (less than 0.2 dB).
The second area on systems and optimization includes four papers that span from metropolitan WDM to optimization of various cost functions. DeCusatis reports results from DWDM test beds for metropolitan area data communication networks. He evaluates the performance in terms of scalability and performance for different data communication protocol. Katangur, Pan, and Fraser apply simulated annealing to minimize the number of passes to avoid cross talk for a WDM network. They compare the performance of routing and scheduling using their method with several other methods including the genetic algorithm. Kartalopoulos proposes a WDM transmission method supporting many clients with different traffic types, which may be more than the number of wavelengths. He also discusses strategies to optimize cost and enhance quality of the network. Network cost optimization is the topic of the next paper by Billah, Wang, and Awwal. They propose algorithms for grooming the traffic to minimize the number of add/drop multiplexers. Their approach provides more general results than have been obtained previously.

In the last section, we see two different applications of WDM components in the arena of digital optical computing, namely digital memory logic and parallel computing architecture. McAulay provides an architecture for constructing basic memory elements such as a flip-flop using a semiconductor optical amplifier. The simulation shows more than 5-Gb/s operation as well as bistable behavior essential to achieve memory logic. In the last paper of this special section, the applications of optical communication components to digital computing or smart pixel arrays, characterized by having optical I/O with digital intelligence in each pixel, are considered. Mal et al. develop and compare two different general purpose architectures of smart pixel computing. Their architecture based on CMOS technology, reduced instruction set computer architecture, and photoreceiver circuits has the potential to be used for page-oriented data processing applications.

The balance of the papers in this special section weigh heavily toward the components side. As the components mature, more systems-level testing will be on the horizon. Interesting applications are expected to spring up as researches from different areas look for devices elsewhere to fit into their applications.

We would like to thank all those who made this special section on WDM components, systems, and applications possible—especially the authors for all the submitted papers and the reviewers for their time and effort. We would also like to thank Karolyn Labes and other SPIE staff for working with us to make this special section a reality.

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