Improving capacity utilization of the optical transport network has been an important research challenge for many years. Extensive research efforts have been devoted to developing approaches of grooming subwavelength traffic demand onto large wavelength capacity pipes. These efforts, however, only focus on efficiently utilizing the capacity pipes, without addressing the issue of fixed ITU-T grid and frequency spacing in the DWDM layer. Under the fixed frequency spacing, optical spectrum is often over-provisioned for a low-rate optical channel, and this inefficiency becomes even prominent when more advanced modulation formats are employed. Advanced optical transmission and networking techniques are needed to provide flexibilities for optical channel spectrum allocation and to develop the related network control system so as to cater to the bandwidth elasticity of Internet traffic and improve fiber optical spectral usage.

Significant attention has been given to develop spectrum-efficient and elastic optical transport networks in both academia and industry in the past few years, and currently there are many research efforts underway targeting at the development of appropriate solutions for future dynamic elastic and scalable photonic infrastructures and network architectures, efficient new algorithms that determine how optical frequency resources can be matched to traffic demands in an optimized way, and a more flexible control and management plane. The technical issues that remain open for such elastic optical transport networks include efficient architecture, spectrum-efficient transmission technique, reconfigurable optical add/drop multiplexer (ROADM), routing and spectrum assignment (RSA), spectrum de-fragmentation, traffic grooming, new protocols and control plane, and more.

Our objective of this special issue is to identify various challenges posed by the spectrum-efficient and elastic optical transport networks and explore research avenues for addressing them. We have received a total of 27 papers, and after multi-round careful reviews by both reviewers and guest-editors, we have accepted six papers for this special issue.

The accepted articles span various topics ranging from routing and spectrum assignment (RSA), traffic grooming, elastic optical network testbeds, and CO-OFDM optical transmission systems.


In “Time-Varying Spectrum Allocation Policies and Blocking Analysis in Flexible Optical Networks,” K. Christodouloupolous, I. Tomkos, and E. Varvarigos propose and analyze three spectrum expansion/contraction (SEC) policies for modifying the spectrum allocated to each service connection. They also derive exact formulas for calculating the blocking probability for a connection and for the whole network.

In “Elastic Spectrum Allocation for Time-Varying Traffic in FlexGrid Optical Networks,” M. Klinkowski, M. Ruiz, L. Velasco, D. Careglio, V. Lopez, and J. Comellas formulate a Multi-Hour Routing and Spectrum Allocation (MHRSA) optimization problem and solve it by means of both Integer Linear Programming (ILP) and efficient heuristic algorithms.

In “Adaptive Spectrum Control and Management in Elastic Optical Networks,” K. Wen, X. Cui, Y. Yin, D. J. Geisler, R. Proietti, R. P. Scott, N. K Fontaine, and S. J. B. Yoo present an adaptive spectrum control and management scheme, which includes: dynamic on-demand spectral defragmentation, adaptive combinational quality of transmission (QoT) restoration (ACQR) and supervisory channel-assisted active restoration.

In “Design and Experimental Validation of a GMPLS/PCE Control Plane for Elastic CO-OFDM Optical Networks,” R. Casellas, R. Muñoz, J. M. Fabrega, M. S. Moreolo, R. Martinez, L. Liu, T. Tsuritani, and I. Morita design and deploy a GMPLS control plane for flexible optical networks with coherent optical orthogonal frequency division multiplexing (CO-OFDM) transmission; the functional control architecture combines a centralized entity that performs path routing and modulation assignment, with a distributed spectrum allocation.

spectral efficiency and system reliability for high-speed optical transport networks.

We would like to thank all of the authors for contributing their important works to this special issue, and many reviewers for their help in the evaluation process. We would like to thank Laurel Greenridge, Bruce Worthman, and Sue Lange for their exceptional efforts in putting this issue together. We would also like to express our sincere gratitude to Moshe Zukerman and Martha Steenstrup for their excellent leadership and invaluable advice in launching this special issue. Finally, we hope this special issue is interesting to our readers and can spark more research interest in the area of spectrum-efficient elastic optical networks.

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