

SPECIAL ISSUE

**SPECIAL ISSUE ON SCALING OPTICAL FIBER CAPACITIES**

*Edited by P. J. Winzer, K. Nakajima, and C. Antonelli*

**1619 The Role of Parallelism in the Evolution of Optical Fiber Communication Systems**

*By W. Klaus, P. J. Winzer, and K. Nakajima*

| INVITED PAPER | This article serves as an introductory paper, highlighting the state of the art in fiber-optic transmission systems, pointing to capacity scalability issues, and laying out various capacity scalability options.

**1655 Challenges in Estimating the Information Capacity of the Fiber-Optic Channel**

*By M. Shtaiif, C. Antonelli, A. Mecozzi, and X. Chen*

| INVITED PAPER | This article reviews fiber-optic capacity scaling from an information-theoretic perspective, including the difficulties imposed by the nonlinear nature of fiber-optic transmission.

**1679 Coherent Optical Transceivers Scaling and Integration Challenges**

*By T. Kobayashi, J. Cho, M. Lamponi, G. de Valicourt, and C. R. Doerr*

| INVITED PAPER | This article addresses hardware and digital signal processing aspects of modern coherent optical transponders, which have revolutionized the optical communications industry over the past decade and have let commercial optical communication systems closely approach their fundamental limits.

**1699 Scaling Optical Interconnects for Hyperscale Data Center Networks**

*By C. Xie and B. Zhang*

| INVITED PAPER | This article reviews data center interconnect (DCI) solutions, highlighting hyperscale data center network architectures and requirements, as well as the differences between DCI optical networks and traditional optical carrier networks.

**1714 Flexible Technologies to Increase Optical Network Capacity**

*By A. Lord, S. J. Savory, M. Tornatore, and A. Mitra*

| INVITED PAPER | This article focuses on optimizing wavelength routing around the network, maximizing the benefits arising from fine-control coherent digital signal processing with increasingly accurate real-time monitoring, and the deployment of multiband and multifiber connectivity to cope with exponentially increasing traffic demands to support broadband access and 5G wireless applications.

**1725 Ultrawideband Systems and Networks: Beyond C + L-Band**

*By T. Hoshida, V. Curri, L. Galdino, D. T. Neilson, W. Forysiak, J. K. Fischer, T. Kato, and P. Poggiolini*

| INVITED PAPER | This article explores optical fiber transmission systems and networks utilizing extended optical amplification bands beyond the C-band and L-band commercially used today and discusses merits and challenges of such ultrawideband optical transport systems and networks.

**1742 Devices and Fibers for Ultrawideband Optical Communications**

*By J. Renaudier, A. Napoli, M. Ionescu, C. Calò, G. Fiol, V. Mikhailov, W. Forysiak, N. Fontaine, F. Poletti, and P. Poggiolini*

| INVITED PAPER | This article extends the system-level aspects of ultrawideband networks to a device level and explores devices and subsystems that are needed to construct such networks, including the design and fabrication of lasers, optical amplifiers, optical switches, and optoelectronic modulators for ultrawideband applications.

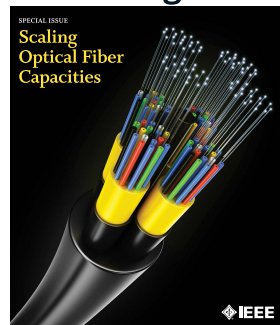
DEPARTMENTS

**1615 SCANNING THE ISSUE**

**Scaling Optical Fiber Capacities**

*By P. J. Winzer, K. Nakajima, and C. Antonelli*

**1889 FUTURE SPECIAL ISSUE/SPECIAL SECTIONS**



**On the Cover:**

Our cover image of a multifiber optic cable aptly captures the key element at the heart of this month's special issue coverage.

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By *T. Sasaki, F. Sato, B. G. Risch, and P. A. Weimann*

**| INVITED PAPER |** This article reviews the state of the art in optical fiber cabling and deployment technologies. Modern high-density optical fiber cables can carry thousands of optical fiber strands and hence represent a massively parallel transmission medium, suitable for the massive spatial parallelism that will be needed to scale fiber-optic network capacity.

## 1772 **Weakly Coupled Multicore Fiber Technology, Deployment, and Systems**

By *T. Matsui, P. L. Pondillo, and K. Nakajima*

**| INVITED PAPER |** This article explores the integration of high fiber-count optical cables using multicore optical fibers to realize even higher degrees of spatial parallelism in the future than what can be achieved today.

## 1786 **Randomly-Coupled Multi-Core Fiber Technology**

By *T. Hayashi, T. Sakamoto, Y. Yamada, R. Ryf, R.-J. Essiambre, N. Fontaine, M. Mazur, H. Chen, and T. Hasegawa*

**| INVITED PAPER |** This article considers an even higher density spatially parallel integration technique that allows for random coupling between the cores of multicore fibers.

## 1804 **Few-Mode Fiber Technology, Deployments, and Systems**

By *P. Sillard, K. Benyahya, D. Soma, G. Labroille, P. Jian, K. Igarashi, R. Ryf, N. K. Fontaine, G. Rademacher, and K. Shibahara*

**| INVITED PAPER |** This article reviews the third advanced category of space-division multiplexing fibers, which use the coupled waveguide modes of few-mode fibers in conjunction with multiple-input-multiple-output (MIMO) digital signal processing to achieve the highest spatial information density.

## 1821 **Photonic Lanterns, 3-D Waveguides, Multiplane Light Conversion, and Other Components That Enable Space-Division Multiplexing**

By *N. K. Fontaine, J. Carpenter, S. Gross, S. Leon-Saval, Y. Jung, D. J. Richardson, and R. Amezcua-Correa*

**| INVITED PAPER |** This article reviews the mode-shaping technologies needed to perform mode-division multiplexing on few-mode fibers and discusses implementations and tradeoffs of four different techniques: multiplane light conversion, fused fiber devices, 3-D waveguides in glass, and free-space imaging systems.

## 1835 **Optical Switching in Future Fiber-Optic Networks Utilizing Spectral and Spatial Degrees of Freedom**

By *D. M. Marom, Y. Miyamoto, D. T. Neilson, and I. Tomkos*

**| INVITED PAPER |** This article examines the capacity scaling requirements of optical networks from a switching perspective that leverage both spectral and spatial degrees of freedom.

## 1853 **Using Global Existing Fiber Networks for Environmental Sensing**

By *E. Ip, F. Ravet, H. Martins, M.-F. Huang, T. Okamoto, S. Han, C. Narisetty, J. Fang, Y.-K. Huang, M. Salemi, E. Rochat, F. Briffod, A. Goy, M. Del Rosario Fernández-Ruiz, and M. González Herráez*

**| INVITED PAPER |** This article reviews recent advances in distributed fiber-optic sensing and their applications, summarizing recent experimental and field trial results where fiber-optic sensing was used in such wide-ranging applications as geohazard monitoring, seismic monitoring, traffic monitoring, and infrastructure health monitoring.

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