OPTICAL COMMUNICATIONS AND NETWORKS


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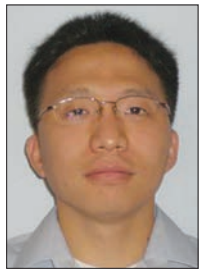
Zuqing Zhu

In this second issue of the Optical Communications and Networks Series in 2021, we have selected three articles that present recent advances in optical communications and networking. These advances and innovations are aimed at making the optical infrastructure of future Internet more secure, energy-efficient, and intelligent.

More specifically, in this issue, three articles have been accepted with contributions addressing: (i) security enhancement by using all-optical signal processing techniques for passive optical networks; (ii) reduced cost and latency energy-efficient large-scale data centers; and (iii) optical access network architecture and silicon integration.

The first article, "Security Issues and Possible Solutions of Future-Oriented Optical Access Networks for 5G and Beyond" by X. Gong *et al.*, discusses the potential security threats and presents several existing solutions against these security threats in optical access networks. The authors envisage the use of all-optical signal processing techniques to achieve the optical-layer security of optical access networks for 5G and beyond. The research work provides a new means for security enhancement of massive services in the 5G era. The numerical simulations for optical domain intrusion detection lay a solid foundation for their vision. This paradigm for optical-layer security motivates further work in both future-oriented optical access network architectures and advanced optical signal process techniques.

The second article, "Hyperscale Datacenter Networks with Transparent HyperX Architectures" by Md Nooruzzaman and X. Fernando, presents a comprehensive review of real-world large-scale datacenter network topologies. The modern large-scale datacenter should grow with limited network hops, hence the authors propose a novel hyper-scale datacenter network architecture called Transparent HyperX (TH) that maintains the pod-to-pod path cost under two hops and can connect over one million servers. The TH concept is inspired by the conventional HyperX topology, with an optimal number of additional all-optical diagonal links. The proposed TH topology not only reduces the path cost and latency, but also saves the number of active components, hence saving electricity.

Finally, the third article, "Silicon Photonics in Optical Access Networks for 5G Communications" by X. Guan *et al.*, attacks both densification and front-haul bandwidth for 5G. The authors envisage the use of a deployed fiber-to-the-home infrastructure to overlay 5G analog radio-over-fiber signals, providing low latency transport to a smart edge. The coexistence of digital and analog signals is enabled with silicon photonic subsystems that populate both the smart edge and the remote radio units. The experimental demonstrations (designing custom chips and running the fabricated chips through systems testing) lay a solid foundation for their vision. This paradigm for heterogeneous services on deployed infrastructures motivates further work in both optical access network architecture and silicon integration, as we move from 5G to 6G.

As Series Editors, we hope that the *IEEE Communication Magazine* readers will find these articles interesting and informative. We will continue to do our best to select additional outstanding papers for future issues. We would like to thank all the authors for submitting their important results to this series, the reviewers for their high-quality reviews that provide valuable feedback and comments to the authors, and the publication staff members as well as the Editor-in-Chief of the *IEEE Communications Magazine* for their guidance and support.

BIOGRAPHIES

MOHAMED-SLIM ALOUINI [F'09] (slim.alouini@kaust.edu.sa) received his Ph.D. degree in electrical engineering from the California Institute of Technology (Caltech), Pasadena, CA, USA in 1998. He served as a faculty member at the University of Minnesota, Minneapolis, and then at Texas A&M University at Qatar, Education City, Doha, before joining King Abdullah University of Science and Technology (KAUST), Thuwal, Makkah Province, Saudi Arabia, as a professor of electrical engineering in 2009. His current research interests include the modeling, design, and performance analysis of wireless communication systems.

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