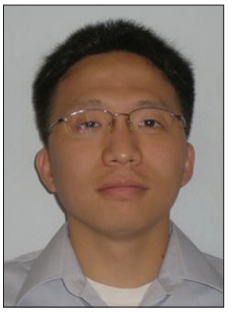
ADVANCES IN OPTICAL COMMUNICATIONS TECHNOLOGIES

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Optical communications and networking technologies continue to play an important role in realizing cost-effective interconnection of a wide variety of resources over highly distributed network environments for massive data exchange and processing. In 2016, with momentum gained from physical network elements virtualization, software-defined networking (SDN), and network functions virtualization (NFV), optical communication networks are becoming more flexible, programmable, and application-aware to enable service providers to deliver shortened time to market, and elastic and cost-effective services and solutions. Following this trend, we expect to witness continued global expansion of optical and data center networks, and faster convergence of optical and IT infrastructures in 2017.

In this first Optical Communications Series (OCS) issue of 2017, we have selected three contributions that address laser diode-based visible light communications (LD-VLC) systems, network hardware virtualization in core networks, and reconfigurable add-drop multiplexer (ROADM) contention in optical networks.

In the first contribution entitled "Laser Diode-Based Visible Light Communication: Toward Gigabit Class Communication," F. Zafar, M. Bakaul, and R. Parthiban present an overview of LD-VLC systems. VLC systems based on light-emitting diodes (LEDs) have been proposed to address the current limitations in capacity and RF spectrum availability in wireless communications. Although LEDs have been considered for their superior switching capabilities compared to other light sources, their modulation bandwidth, typically in the range of 20 MHz, is insufficient to support data rates over 1 Gb/s. In this contribution, laser diodes (LDs) that can support much higher direct modulation rates and provide higher electrical-to-optical conversion efficiencies are proposed as better-performing front-end transmitters to realize high data rate VLC systems. However, despite their superior performance, the usage of LDs can be restricted by their cost and potential health hazards. The authors provide a detailed overview of the advantages of LDs over LEDs and discuss various configurations of LD-VLC systems. They summarize the data rates achieved by the LD-VLC systems and the illumination capabilities for commercial implementations. The market opportunities and potential applications of LD-VLC systems are also discussed along with such challenges as the presence of speckles, power limitations, thermal management, and cost.

In the second contribution, "Network Hardware Virtualization for Application Provisioning in Core Networks" A. Gumaste, T. Das, K. Khandwala, and I. Monga present their summary of the trends and developments in service providers' transition to virtualized core networks. Service providers and their suppliers have been seeking approaches to realize faster and more efficient service provisioning to meet the needs and requirements of their customers in a timely and cost-effective manner. There have been consensus and progress toward achieving faster service provisioning by replacing physical network elements with programmable hardware that has non-proprietary interfaces. Such a programmable network would have lent itself to satisfy user requirements precisely and permit much faster provisioning of next generation services to meet users' evolving business needs. In this contribution, the authors outline the impact of virtualization in core networks for growing service provider businesses. The article provides an outline of a decision map for the applications with network virtualization technologies. It also presents an approach to integrate the services of over-the-top (OTT) content providers with those of traditional service providers using network virtualization in hardware. The authors describe the concept of virtualized network equipment partitioning and propose the policies for each service need/requirement.

In the third contribution, "A Closer Look at ROADM Contention," J. M. Simmons presents an overview of the contention issue when using reconfigurable optical add/drop multiplexers (ROADMs) in optical transport networks. ROADMs provide wavelength switching capability in the optical transmission layer of transport networks. As the needs for rapid service provisioning grow, service providers use ROADMs that enable greater flexibility to configure/reconfigure their networks. While the global industry has been pursuing the development of ROADMs for colorless, directionless, gridless, and contentionless operation, it has been proven to be challenging to ensure contentionless operation since ROADM contention appears in various forms. Thus, this contribution is aimed at examining the ROADM contention issue. It focuses on wavelength contention, which is defined as the unavailability of a wavelength on a network fiber for use by a ROADM port. As described in the article, wavelength contention can occur due to a limited number of add/drop ports, limited edge configurability, and/or limited pre-deployment equipment. Along with the conditions under which wavelength contention can occur, network architectures to avoid contention and to ensure contentionless operation are also proposed.

This OCS issue marks the beginning of our service term as the new Series Editor Team. We thank the former Series Editor, Dr. Admela Jukan, for her service. With the continuing support from our authors and reviewers, and valuable feedback from our readers, the Optical Communications Series is expected to continue contributing to future advancements in the field of optical communications, networks, and applications.

BIOGRAPHIES

XIANG LIU [F'17] (xiang.liu@huawei.com) received his Ph.D. degree in applied physics from Cornell University in 2000. He is currently the senior director of Optical Access Networks Research at the U.S. R&D Center of Huawei Technologies, focusing on next-generation optical access technologies. He spent the early part of his career at Bell Laboratories in New Jersey, working on high-speed optical fiber transport technologies. He is a Fellow of the OSA and a Deputy Editor of *Optics Express*.

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