Introduction to the Issue on Optical Communications

TODAY'S communication society relies to an unprecedented extent on broadband communication solutions, with applications such as high-speed Internet access, mobile voice, data, and video services, multimedia broadcast systems, and high-capacity data networking for remote storage and grid computing. In order to most cost-effectively meet the widely differing bandwidth demands of various communication applications, several wireless and wireline communication technologies are being used today, each with their very own characteristics and advantages. Of all these technologies, optical communication systems feature unrivaled point-to-point transport capacities of many terabits per second over communication distances of up to 10 000 km using a single, 125-μm thin optical fiber. Consequently, optical communication systems find applications in nationwide fiber-optic backbone networks, transcontinental submarine links and (terrestrial as well as space-borne) free-space point-to-point connections. Optical communication systems are also massively entering the access market, with fiber-to-the-home deployments currently underway in several countries worldwide. In addition, high-bandwidth short-reach optical links are increasingly being used as rack-to-rack interconnects within routers and supercomputers. Further out on the horizon, yet already actively discussed in the research community today, are optical communication applications such as all-optical packet processing and label switching, or quantum key distribution systems, which offer means to exchange valuable data in a highly secure manner.

The goal of this issue of the IEEE JOURNAL OF S ELECTED TOPICS IN QUANTUM ELECTRONICS is to capture the current status of many areas of optical communications research through a combination of review-like invited papers and original research contributions. The issue starts with reviews on high-capacity terrestrial and submarine optical transport systems, and describes in a systems context the use of advanced optical and electronic technologies. Specific aspects of these technologies, such as advanced optical modulation formats, electronic signal processing, forward error correction, phase conjugation, and wavelength conversion, are then discussed in more detail through invited and contributed papers. A subsequent review paper by a service provider sheds light on optical networking from a carrier's perspective, and leads to a selection of papers dealing with higher-layer optical networking, such as scheduling issues in Ethernet and access networks. These more transport and network-oriented contributions are followed by forward-looking applications of optics in packet switching and all-optical processing. A set of device-oriented papers highlights some aspects of optical-communications-related device and subsystems research conducted today. In the context of new devices, optical waveform characterization plays an important role, summarized in a review paper. The issue concludes with applications of optical communications for wireless communications and a selection of papers on the interesting field of data security and quantum key distribution.

We hope that the papers presented in this Special Issue allow the reader to grasp the state of the art in optical communications research, to appreciate the benefits and shortcomings of various optical communications technologies, and to get a feeling for the type of problems and solutions encountered in optical communications. We thank all the authors for submitting their research results to this special issue, and we are grateful for the immense work put in by many experts in the field through the peer review process. Finally, we want to thank Janet Reed from the IEEE LEOS editorial office for all the organizational work going on behind the scenes, without which this issue would not have been possible.

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