Guest Editorial
Special Issue on Polarization-Mode Dispersion

POLARIZATION-MODE dispersion (PMD) and chromatic dispersion variability are two of the main impairments requiring mitigation in order to enable optical transmission at or above 40 Gb/s. This JOURNAL OF LIGHTWAVE TECHNOLOGY (JLT) special issue on PMD addresses one of these effects. After the telecom bubble, it might not seem obvious why high-speed long-haul optical communication links operating at 40 Gb/s or higher are needed. However, if one looks at the actual growth of combined Internet, data, and voice traffic, one finds that although the growth mix has shifted from voice to data with a slowdown in Internet traffic growth (from 150% in 2000 to 107% in 2003), the net traffic growth remains at the same level as it was three years ago (at about 65%)! Capacity is being exhausted at the same rate as it was during the pre-bubble time. Thus, it is only a matter of time until the existing infrastructure will run out of capacity and new capacity will have to be added to accommodate the ever-growing need for bandwidth. Future bandwidth demand will be fueled by thousands of television channels, videoconference telephony, movies on demand, distance learning, telemedicine, and a digital record of every sight and sound that we cherish everyday. This insatiable thirst for bandwidth can only be quenched by the capacity that is inherent in the optical fiber.

In addition to the growth described previously, fiber-to-the-home and fiber-to-the-premise (FTTH/FTTP) are no longer technologies that we only talk about. In Japan and Korea, FTTx is a growing reality, driving demand for high-bandwidth optical connections to the homes and premises today. In the United States, Verizon just announced their deployment plans for FTTH, with large-scale deployment starting in 2005. All of these trends indicate that high-bandwidth data pipes will be essential in the not-too-distant future.

Of the technical challenges that still exist for long-haul (>500 km) and ultra-long-haul (>1600 km) high-speed transmission, PMD is one of the most difficult. The statistical nature of the problem, combined with the difficulty in emulating the phenomena realistically in the laboratory, makes understanding the impact of PMD an interesting but challenging problem that appeals to both industry and academia. Significant work has been done over the past five years in the areas of understanding PMD and mitigating its effect in optical systems. The increasing percentage of papers on this subject at conferences dedicated to optical communication is a good indication of the energy devoted to PMD. Because of the near-term prospect of increasing fiber deployment and the increasing demand for bandwidth, this special issue of JLT dedicated to PMD is timely and appropriate.

Key PMD issues can be classified into three broad categories: 1) fundamental understanding of the phenomenon and its impact, 2) measurement, and 3) strategies for mitigation. In this issue, we cover all of these areas extensively, with invited, as well as regular, submissions.

In the area of fundamental understanding, the statistical nature of PMD and its mixture with other impairments, e.g., polarization-dependent loss and nonlinearity, are discussed. Also addressed are some practical aspects of simulation of these impairments that take into account the statistical nature of the phenomenon. In addition, schemes to overcome the difficulties of emulating realistic PMD in the laboratory are discussed.

Measurement of PMD is important both for gaining an increased understanding of the phenomenon and for compensation. The statistical and distributed nature of PMD brings new challenges to evaluating fiber characteristics and performance monitoring. Some novel and robust techniques to address both topics are covered in this issue.

Multiple strategies for mitigation of PMD-related impairments, along with monitoring, are described from theoretical and experimental points of view. Optical as well as electronic means of compensating PMD are presented and compared.

In summary, we hope that the collection of papers in this special JLT issue will provide a good overview of the exciting technical challenges and the recent progress on solving the problems posed by PMD.

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