Guest Editorial
Photonic Packet Switching Technologies, Techniques, and Systems

WELCOME to the first special issue of the JOURNAL OF LIGHTWAVE TECHNOLOGY devoted to photonic packet switching systems, techniques, and technologies. This special issue attempts to bring together a representative cross section of activities related to routing and forwarding packets in an all-optical network environment. Since 1987, there have been multiple conferences and journal special issues that cover photonic packet switching as a subarea, including the Topical Meetings on Photonics in Switching, the Conference on Optical Fiber Communications (OFC), an IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS (JSAC) 1988 Special Issue on Photonics in Switching, and a 1996 Special Issue on Optical Networks (JSAC).

The topic of photonic packet switching has recently received increased attention due to the rapid growth in internet traffic and the need for next-generation internet technologies. The proliferation of data and packet-switched networks in our everyday activities and commerce has raised the importance of advancing research beyond circuit switched optical networks to support packet switching. In assembling this issue, it was our intent to document the maturation of photonic packet switching as a field and to present its applications to next-generation internet and packet-switched technologies. It is our hope that this issue addresses the open question of the benefits of optical packet switching in contrast to pure electronic packet switching and the partnership between photonic and electronic technologies in this critical communications area.

Photonic packet switching is a broad area that involves transport of optical packets without optoelectronic conversion of the payload at intermediate routing nodes. Key technology issues involve packet generation, header coding, packet-mode recovery and processing, optical buffering, synchronization, regeneration, and fast optical switching. Architectural issues deal with tradeoffs using multiple domains to switch (wavelength, space, and time) and resulting performance issues including, but not limited to, network throughput, latency, packet loss, and scalability.

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This issue is divided into four sections. The first section covers key photonic packet switching techniques including synchronization, regeneration, and buffering. The second section reports on architectures and network demonstrators including photonic routing of internet protocol (IP) over wavelength division multiplexing (WDM), ultrafast photonic packet switching systems, and photonic ATM switching systems. The third section covers key technologies involving packet recovery and fast switching technologies. The fourth section covers the important area of performance issues.

We wish to thank the many authors for submitting contributed and invited papers and we are most grateful to the reviewers who responded quickly and helped maintain the high quality of the papers. The IEEE Editorial staff responsible for this issue, A. Nakamura, and F. Jetko deserve special thanks for handling the submission and review process and for keeping the publication schedule on track. Special thanks are due to the JLT Editorial Board and to Dr. Rod Alferness, Editor-in-Chief of the JOURNAL OF LIGHTWAVE TECHNOLOGY without whom this issue would not be possible.

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Daniel J. Blumenthal (S'91–M'93–SM'97) received the B.S. and M.S. degrees in electrical engineering from the University of Rochester, Rochester, New York, in 1981 and Columbia University, New York, NY, in 1988, respectively. He received the Ph.D. degree from the University of Colorado at Boulder in 1993.

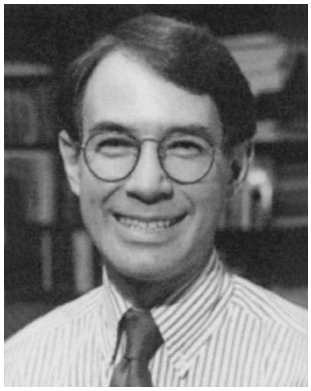
From 1981 to 1985, he worked at StorageTek, Louisville, CO. From 1993 to 1997, he was an Assistant Professor in the School of Electrical and Computer Engineering at the Georgia Institute of Technology, Atlanta. Currently, he is Associate Professor in the Department of Electrical and Computer Engineering at the University of California at Santa Barbara, where he heads the Optical Communications and Photonic Networks (OCPN) Research Group and is Associate Director of the Center for Multidisciplinary Optical Switching Technology (MOST). His current research areas are in optical communications, wavelength division multiplexing, photonic packet switching, all-optical networks, wavelength conversion, optical subcarrier multiplexing, and multispectral optical information processing. He has authored or coauthored over 40 papers in these and related areas.

Dr. Blumenthal was the recipient of an NSF Young Investigator Award and a Office of Naval Research Young Investigator Program Award. He is currently an Associate Editor for IEEE PHOTONICS TECHNOLOGY LETTERS and an Associate Editor for IEEE TRANSACTIONS ON COMMUNICATIONS. He is Program Chair for the OSA 1999 Topical Meeting on Photonics in Switching and has served on numerous program committees including OFC'97, OFC'98, OFC'99, and CLEO' 99. He is a member of the Laser and Electro-Optics Society (LEOS) and the Optical Society of America (OSA).

Tetsuhiko Ikegami (S'67–M'68–SM'84–F'87) was born in Tokyo, Japan, on May 11, 1940. He received the B.E., M.E., and Dr.E. degrees from the Tokyo Institute of Technology, Tokyo, Japan, in 1963, 1965, and 1968, respectively.

From 1968 to 1971, he worked on optoelectronics as a Lecturer at the Tokyo Institute of Technology, Tokyo, Japan. In 1971, he joined Nippon Telegraph and Telephone Company (NTT) and was appointed Executive Manager of Optoelectronics Laboratories in 1989, Deputy Executive Manager of R&D Headquarters in 1992, and Senior Executive Manager of NTT Science and Core Technology Laboratory Group and NTT Basic Research Laboratories in 1994. He was appointed Senior Vice President, Board Member of NTT in 1993, where he was in charge of managing R&D activities. In June 1996, he was appointed President and CEO of NTT Advanced Technology Company (NTT-AT, a subsidiary of NTT Company). In July 1998, he left NTT and became Vice President (VP), University of Aizu, Fukushima Prefecture, Japan, by request and it is the first case in Japan where a CEO became a VP in a public university. He is also an NTT Executive Advisor. In his R&D capacities, he has performed pioneering work on optical-fiber communication, in particular on laser diodes. He found the resonance-like phenomenon which was an essential property in directly modulated laser diodes, conducted reliability studies of the devices which led to the success in undersea optical fiber system application, and contributed to the development of single-mode operation under direct modulation of laser diodes; this enables large capacity and long distance fiber transmission at gigabits per second range in NTT. He succeeded in the first CW operation of DFB laser at 1500 nm wavelength range in September 1981 and the first demonstration of 100 km transmission through the standard single-mode fiber at 400 Gb/s by using the DFB laser which became the standard large capacity system in service. He is now interested in how to create global cross-stream network for industry, university, and national laboratory.

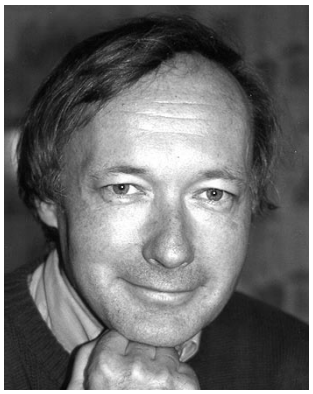
Dr. Ikegami has been very active in professional societies, international standardization activities (IEC), the Optical Society of America (OSA), the Institute of Electronics, Information Communications Engineers (IEICE) of Japan, and JSAP of Japan. In 1994, he served as President of IEEE/Laser and Electroptics Society (LEOS). He has served as committee member of major international conferences including Optical Fiber Conference (OFC), European Conference on Optical Communication, Workshops in European Community, etc., and was General Chair of IEEE Semiconductor Laser Conference in 1992 and the CLEO'95 in Pacific Rim, and the International Symposium on Compound Semiconductors in 1998. He has given Plenary and Invited Talks at major international professional conferences. He has been appointed member of committees in Japanese government (Science and Technology Agency, MITI, Ministry of Education) in particular for implementation of Japanese Science and Technology policy. He is a Fellow of the Optical Society of America (OSA) and recipient of IEICE YonezawA Award in 1967, the JSAP Excellent Paper Award in 1980, IEICE Distinguished Work Award in 1983, OITDA Sakurai Memorial Award in 1996, and IEEE LEOS Distinguished Service Award in 1998.



Paul R. Prucnal (S'75–M'78–SM'90–F'92) received the A.B. degree from Bowdoin College, Brunswick, ME, in 1974 and the M.S., M.Phil., and Ph.D. degrees from Columbia University, New York, NY, in 1976, 1978, and 1979, respectively.

In 1988, he joined Princeton University, Princeton, NJ, as Professor of Electrical Engineering. His research interests include experimental and theoretical work on optical multiple-access techniques for broad-band networks, photonic fast packet switching with optically processed control, and optical multiprocessor interconnects. He has published over 100 papers and holds five patents in these fields. From 1990 to 1992, he served as Acting Director of the Center for Photonics and Optoelectronic Materials at Princeton.

Dr. Prucnal is currently an Associate Editor of the IEEE TRANSACTIONS ON COMMUNICATIONS in the area of optical networks. He serves on the Editorial Board for *Optical Fiber Technology* and the Advisory Board for *Photonic Network Communications* (New York: Kluwer Academic). He has been an Optical Society of America (OSA) Fellow since 1997 and was a recipient of the 1990 Rudolf Kingslake Medal from the International Society of Optical Engineering.



Lars Thylén (M'91) received the M.Sc. degree in electrical engineering and the Ph.D. degree in applied physics, both from the Royal Institute of Technology, Stockholm, Sweden, in 1972 and 1982, respectively.

From 1973 to 1982, he was with SRA Communications, working in the areas of image processing, diffraction optics, and optical signal processing. From 1976 to 1982, he held a research position at the Institute of Optical Research, Stockholm, where he was engaged in research in integrated and guided-wave optics, notably waveguide theory, RF spectrum analysis, and optical signal processing. In 1982, he joined Ericsson, heading a group doing research in the areas of integrated photonics in lithium niobate and semiconductors and their applications to optical communications and switching. In 1985 to 1986, he was a Visiting Scientist with the Department of Electrical Engineering and Computer Sciences at the University of California, Berkeley. He has also been a Visiting Scientist with the Optical Sciences Center at the University of Arizona, Tucson. In 1987, he was appointed Adjoint Professor at the Department of Microwave Engineering, Royal Institute of Technology, Stockholm. He has been active in the inception, planning, and running of several EU projects. Since 1992, he has been a Professor at the Laboratory of Photonics and Microwave Engineering. Current research interests include low-dimensional optics and electronics, devices for photonic switching and optical networks. He has authored or coauthored more than 100 journal papers and conference contributions as well as a book chapter, served on program committees for major optics conferences and has served as Program Chair and General Chair for the 1995 and 1997 OSA Topical Meetings on Photonics in Switching, respectively.

Dr. Thylen is a member of the Optical Society of America (OSA).