As an ultimate broadband access solution for future Internet, the passive optical network (PON) brings many advantages such as cost effectiveness, energy savings, service transparency, and signal security over other last-/first-mile technologies. Over the past several years, we have witnessed significant development and deployment of time-division multiple access (TDMA) PONs such as IEEE 802.3ah Ethernet PONs (EPONs) and ITU-T G.984 Gigabit PONs (GPONs) to provide high-quality triple-play services for residential users. However, future Internet applications, apart from triple-play service (e.g., peer-to-peer [P2P] social networking, online video sharing, grid computing, and mobile Internet), along with their unique traffic characteristics and huge bandwidth requirements, pose big challenges for current PON design and migration, which in turn are driving legacy TDMA PONs toward ultra-high-speed flexible next-generation PONs such as wavelength-division multiplexed (WDM) PONs and optical orthogonal frequency-division multiplexed (OFDM) PONs, and/or a hybrid WDM/OFDM/TDM PON.

This special issue features recent and emerging advances in PONs. Of the large number of submitted papers, five were selected for this issue. The selected articles cover topics including next-generation PON architecture, energy-efficient PONs, layer 2 medium access control (L2 MAC), quality of service (QoS) provisioning in future PONs, and PON monitoring techniques. The first article, “Opportunities for Next Generation Optical Access,” co-authored by Dirk Breuer, Frank Geilhardt, Ralf Hülsemann, Mario Kind, Christoph Lange, Thomas Monath, and Erik Weis, discusses the impact of the new business models on network architecture based on the comparison of different optical access network variants. It also provides perspective on access node consolidation for network operators.

One of the PON’s advantages is the potential to provide high energy efficiency toward future green communications. The second article, “Cost and Energy Consumption Analysis of Advanced WDM-PONs” contributed by Klaus Grobe, Markus Roppelt, Achim Autenrieth, Jörg-Peter Elbers, and Michael Eiselt, focuses on the analysis of cost and energy-consumptions of future advanced WDM-PON options. The authors conclude that it is essential to carefully clarify the requirements for next-generation access with regard to per-PON client count and maximum reach. In particular, if client count does not exceed ~320, and a passive filter-based optical distribution network (ODN) is accepted, the most efficient solution, with regard to both cost and power consumption, is a simple WDM-PON. The article “Toward Energy-Efficient 1G-EPON and 10G-EPON with Sleep-Aware MAC Control and Scheduling,” co-authored by Jingjing Zhang and Nirwan Ansari, presents L2 techniques, proposing sleep-aware MAC control and scheduling approaches for EPON. Two sleep-mode control and sleep-aware scheduling schemes are analyzed: sleep for over one DBA cycle and sleep within one DBA cycle.

In addition to reducing energy consumption, multirate and multi-QoS provision is a critical feature next-generation PONs shall possess naturally to cater for existing and emerging Internet applications. The article titled “Multi-rate and Multi-Quality-of-Service Passive Optical Network Based on Hybrid WDM/OCDM System” by Hamzeh Beyranvand and Jawad A. Salehi proposes a new scheme to guarantee multi-QoS in WDM/OCDM system. The basic idea is to use multilength variable-weight optical orthogonal codes (MLVWOOC) as the signature sequence of an OCDM system. The code weight and code length of MLVWOOC are designed based on the characteristics of the requested classes of services.

The last article, “Passive Optical Network Monitoring: (Continued on page S14)
Challenges and Requirements,” co-authored by Moham-
mad M. Rad, Kerim Fouli, Habib A. Fathallah, Leslie A.
Rusch, and Martin Maier, touches on a different problem.
In addition to the discussion of challenges and require-
ments for PON monitoring, it presents a comprehensive
review of techniques for in-service monitoring PONs to
detect and localize faults. The authors recommend the
hybrid techniques as promising solutions for delivering the
maintenance and protection functionalities required by
current and next-generation PONs.

We would like to take this opportunity to thank our
reviewers for their effort in reviewing the manuscripts. We
also thank the Editor-in-Chief, Dr. Steve Gorshe, for his
supportive guidance during the entire process.

BIOGRAPHIES

MAHMOUD DANESHMAND (daneshmand@att.com) is a Distinguished Member
of Technical Staff, AT&T Labs Research; executive director of the University
Collaborations Program and assistant chief scientist of AT&T Labs; adjunct
professor of electrical engineering at Sharif University of Technolo-
gy. He has more than 35 years of teaching, research and publications, and
management experience in academia and industry, including Bell Laborato-
ries, AT&T Labs, the University of California at Berkeley, the University of
Texas at Austin, Tehran University, Sharif University of Technology, National
University of Iran, New York University, and Stevens Institute of Technolo-
gy. He has published more than 70 journal/conference papers and book
chapters, co-authored two books, given several keynote talks, and served as
general chair and TPC chair of many IEEE conferences. His current areas
of teaching and research include artificial intelligence, knowledge discovery
and data mining, complex network analysis, sensor network and RFID sys-
tem reliability and performance, and mining of sensor and RFID data. He
has Ph.D. and M.A. degrees in statistics from the University of California,
Berkeley, and M.S. and B.S. degrees in mathematics from the University of
Tehran.

CHONGGANG WANG (cgwang@ieee.org) is a senior staff engineer in InterDigi-
tal Communications. Before joining InterDigital Communications, he con-
ducted research with NEC Laboratories America, AT&T Labs Research, the
University of Arkansas, and Hong Kong University of Science and Technolo-
gy. His research interests include future Internet, machine-to-machine
(M2M) communications, and wireless networks. He has published more
than 80 journal/conference articles and book chapters. He is on the editori-
al boards of IEEE Communications Magazine, IEEE Network, ACM/Springer
Wireless Networks, and Wiley Wireless Communications and Mobile Com-
puting. He has served as a TPC member for numerous IEEE conferences
including ICNP, INFOCOM, GLOBECOM, ICC, and WCNC. He received his
Ph.D. in computer science from Beijing University of Posts and Telecommu-
nications in 2002.

WEI WEI [SM] (weibit@gmail.com) is a senior engineer at Ciena Corpora-
tion. Before joining Ciena, he conducted research with NEC Laboratories
America and the State University of New York at Buffalo. His research inter-
est include cognitive optical networks, network virtualization, and future
Internet. He has published more than 60 journal/conference articles and
book chapters. He also has rich engineering experiences in developing and
designing broadband optical networks and IP networks. He is the holder of
three patents with five others pending. He has served as a TPC member for
several IEEE conferences including GLOBECOM and ICC. He received his
Ph.D. degree in electrical engineering from Shanghai Jiao Tong University.