

Advances in Broadband Access Networks



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With the explosive growth of the Internet and ever-increasing user demands for various broadband applications, such as Internet telephony, Internet Protocol television (IPTV), and interactive gaming, today's subscriber access networks are becoming a potential bottleneck for providing broadband access services. In recent years, subscriber access networks have been extensively upgraded with the deployment of innovative xDSL and CaTV technologies. However, these technologies still have their own limitations and are insufficient to meet the ever-increasing bandwidth demands of users. To address this issue, fiber to the home/curb/business (FTTH, FTTC, and FTTB) technologies have been long envisioned as a preferred solution, and passive optical networks (PONs) have been widely considered as a promising technology for implementing various FTTx solutions. Meanwhile, recent advances in wireless communication technology have led to significant innovations that enable wireless access (e.g., WiMAX) to provide more bandwidth with convenient and inexpensive deployment and mobility. Regardless of the technology used, a promising broadband access network must not only be able to provide reliable and high-quality broadband services, but also be implemented cost effectively. This presents many challenges in the design of network architectures and protocols, which have motivated a significant amount of research activities in the area. The purpose of this special issue is to expose the readership of *IEEE Network* to the latest research advances in broadband access networks, focused on network architectures and protocols.

The special issue at hand includes a collection of six outstanding articles, which cover a diversity of architectural and protocol issues in broadband access networks. The first three articles are on optical access, while the other three are on wireless access.

In the first article, "Long Reach Optical Access Technologies," Shea and Mitchell open our special issue with an interesting article that summarizes the economic arguments behind long reach access and examines a number of leading long reach optical access technologies.

In the second article, "Toward Quality-of-Service Protection in Ethernet Passive Optical Networks: Challenges and Solutions," Assi *et al.* present a survey of various solutions proposed to date to support quality of service (QoS) in Ethernet

PON (EPON), and propose an admission control framework that is capable of supporting and protecting the QoS of real-time traffic while guaranteeing a minimum bandwidth for best effort traffic.

In the third article, "Resource Management for Broadband Access over Time-Division Multiplexed Passive Optical Networks," Luo *et al.* present an overview of the resource management issues along with the state-of-art schemes over time division multiplexed PONs (TDM-PONs), compare the pros and cons of various solutions proposed in the literature, and introduce a unified state space model under which all TDM-PON resource management schemes can be evaluated and analyzed for their system level characteristics.

In the fourth article, "A Generic Framework for Modeling MAC Protocols in Wireless Broadband Access Networks," Ling *et al.* present a simple yet accurate generic analytical model for a family of CSMA/CA-based MAC protocols widely used in various wireless broadband access networks. The proposed model is based on a hierarchical three-level renewal process concept, which leads directly to some important MAC protocol performance metrics, such as throughput and average frame service time.

In the fifth article, "Channel-Aware Scheduling for QoS and Fairness Provisioning in IEEE 802.16/WiMAX Broadband Wireless Access Systems," Iera *et al.* propose a channel-aware scheduling algorithm suitably conceived for a point-to-multipoint WiMAX architecture, which aims at enabling downlink traffic delivery with a differentiated service treatment, even in non-ideal channel conditions. A technique for compensation of channel errors is proposed to preserve QoS and fairness of a WF2Q+ based scheduling algorithm.

In the sixth or last article, "Toward Efficient Service-level QoS Provisioning in Large-Scale 802.11-Based Networks," Taleb *et al.* propose a scheme for efficient provisioning of QoS-enabled services for mobile users, which constantly monitors the overall network performance to effectively perform admission control and traffic conditioning at the 802.11-based access points and mobile terminals. They also propose a dynamic service level agreement (SLA) negotiation protocol that allows mobile terminals to perform hand-offs between different WLANs while maintaining the agreed level of service.

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We would like to thank all the authors who submitted their articles to this special issue. Highlighting the significance and amount of research activities in this area, we received nearly eight times the number of articles that could be published, a number that was beyond any of our expectations. We are grateful to all the reviewers for their time and input in carefully reviewing all the articles and providing valuable review comments. Many thanks go to *IEEE Network* for giving us the opportunity to serve our community by putting together this special issue. We would like to thank the Editor-in-Chief, Ioanis Nikolaidis, for giving support and guidance during the whole process of this special issue, and the liaison editor, Paolo Giacomazzi, for providing valuable comments in making the final decisions. We would also like to thank the previous Editor-in-Chief, Chatschik Bisdikian, for his support and encouragement during the early stages of this special issue. In addition, we are thankful to Sue Lange, the Digital Production Manager, and all other publication staff for their support and help during the publication process.

It is our hope that the articles included in this special issue present a good snapshot of the latest research advances in broadband access networks and become an important reference for researchers and practitioners in the area. Finally, we hope that the readers of *IEEE Network* will find this special issue timely, informative, and enjoyable.

Biographies

JUN ZHENG [M] (jzheng@ieee.org) is a research scientist with the School of Information Technology and Engineering of the University of Ottawa, Canada. He received his Ph. D. degree in electrical and electronic engineering from the University of Hong Kong, China, in 2000. He is an editor of *IEEE Communications Surveys & Tutorials*, an associate editor of *Wiley Wireless Communications and Mobile Computing*, and an associate editor of *OSA Journal of Optical Networking*. He has served as Lead Guest Editor for several special issues of different archival magazines and journals, including *IEEE Network* and *Wiley International Journal of Communication Systems*. He is currently serving as Lead Guest Editor for a special issue of *IEEE Journal on Selected Areas in Communications* on broadband access networks. He has served as General Chair, Symposium Co-Chair, and Technical Program Committee Co-Chair for several international conferences

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ABBAS JAMALIPOUR [S'86, M'91, SM '00, F'07] (a.jamalipour@ieee.org) holds a Ph.D. from Nagoya University, Japan. He is the author of the first book on wireless IP and two other books, has co-authored five books and over 180 journal and conference papers, and holds two patents, all in the field of wireless networks. He is an IEEE Distinguished Lecturer and a Fellow of Engineers Australia. He was Chair of the Satellite and Space Communications Technical Committee (2004–2006), and is currently Vice Chair of the Communications Switching and Routing TC and Chair of the Asia-Pacific Board, Chapters Coordinating Committee. He is the Editor-in-Chief, IEEE Wireless Communications, and a Technical Editor of IEEE Communications Magazine, Wiley's International Journal of Communication Systems, and several other journals. He is a voting member of the IEEE GTC and has been a Vice Chair of IEEE WCNC '03-'06, Chair of IEEE GLOBE-COM '05 (Wireless Communications), and a symposium Co-Chair of IEEE ICC '05-'08 and IEEE GLOBECOM '06-'07, among many other conferences. He is the recipient of several international awards, most recently the Best Tutorial Paper Award and Distinguished Contribution to Satellite Communications Award, both from the IEEE Communications Society in 2006.

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economy is facing a huge roadblock: control and regulation (down to possibly even taxation) in the monetary systems within Metaverses. The concern is that the economy within the Metaverse could “leak” into the real tangible world and without some strong form of identity management it could become, among other things, the perfect place for money laundering. At the same time, strong notions of identity are at odds with one of the original attractions to joining Metaverses: users could abandon their real identity and assume alternate ones (even many identities). It might turn out that one reason for Metaverses to open their architectures up to external protocols will be to allow identities to be established and managed.

Finally, as with most networked applications, the value increases the more users contribute content; thus, the underlying chicken-and-egg problem whereby services provided in the Metaverse would be successful if there is adequate attraction so that users contribute, but users do not contribute unless they are attracted to it in the first place. This is also one reason why Metaverses are already integrating and interoperating with other application experiences (VoIP telephony, Web browsing, etc.). The transition is not without its parallels, similar to what we expect of Web browsers where many other network applications are accessible directly or indirectly; hence the question becomes whether the 3D element of Metaverses will make them the “browsers” (albeit of collective nature when so desired) of the future.

A common denominator for enhanced user experience in Metaverses is that the higher the access bandwidth, the more engaging the resulting experience should be. Even when rendering is local on the client, the handling of multiple streams into (and, possibly, out of) a single user's device requires an appropriate level of access bandwidth. Hence, the topic of access technologies will continue to be with us, and possibly even more urgent, in the following years. This is the topic of the Special Issue in your hands: “Advances in Broadband Access Networks.” I would like to thank the authors, the Guest Editors, Jun Zheng, Yang Xiao, and Abbas Jamalipour, and the issue's Liaison Editor, Paolo Giacomazzi, for producing an interesting and balanced collection of contributions on wired (optical) and wireless broadband access networks.

As always, your feedback regarding the direction and substance of the magazine is invaluable and always appreciated. Please contact me, by e-mail, at yannis@cs.ualberta.ca, to let me know what you think about the editorial comments, what type of content might be more interesting to you, and in what ways the magazine's distinct character could be improved or further publicized.

References

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