Guest Editorial >>>

Special Topic on New Generation FTTR Communication and Networking Technology

Guest Editors

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The convergence of optical and wireless technologies is driving the evolution of intelligent indoor networks, with Fiber-to-the-Room (FTTR) emerging as a key architecture for delivering gigabit connectivity in both home and enterprise environments. By deploying optical fiber directly to rooms and integrating it with advanced wireless solutions such as millimeter-wave and Wi-Fi 7, FTTR enables next-generation applications, including immersive Virtual Reality (VR)/Augmented Reality (AR) and industrial Internet of Things (IoT). Nevertheless, its large-scale deployment presents challenges in network management, energy efficiency, interference mitigation, and intelligent root cause analysis.

Following a rigorous review process, seven high-quality papers have been selected for this special issue. These works advance FTTR technology through contributions spanning physical layer monitoring, receiver design, energy-saving mechanisms, and artificial intelligence (AI) -driven optimization.

The first paper, "PON Monitoring Scheme Based on TGD-OFDR with High Spatial Resolution and Dynamic Range," introduces a time-gated digital optical frequency-domain reflectometry (TGD-OFDR) system that decouples spatial resolution from pulse width. This breakthrough achieves both 0.3 m resolution and 30 dB dynamic range, substantially enhancing passive optical network (PON) monitoring capabilities.

The second paper, "Insights on Next Generation WLAN: High Experiences (HEX)," identifies poor quality of experience (QoE) as the primary challenge in current wireless local area network (WLAN) systems. The authors propose making high experiences (HEX) the core objective for next-generation networks through systematic architectural improvements.

The third paper, "FTTR-MmWave Architecture for Next Generation Indoor High-Speed Communications," proposes a hybrid FTTR-millimeter-wave architecture, leveraging mmWave's natural isolation to reduce interference while supporting multi-gigabit rates for ultra-high-speed indoor communications.

The fourth paper, "A Transformer-Based End-to-End Receiver Design for Wi-Fi 7 Physical Layer," proposes a Transformer-based receiver for Wi-Fi 7 that directly decodes Orthogonal Frequency Division Multiplexing (OFDM) signals without channel estimation, achieving significant performance gains over conventional designs.

The fifth paper, "Root Cause Analysis of Poor FTTR Quality Based on Transformer Mechanisms," addresses network maintenance challenges in FTTR deployments. The authors develop a multi-task Transformer model that achieves an accuracy of 96.75% in identifying degraded access points and classifying root causes, outperforming traditional methods significantly.

The sixth paper, "QoS-Aware Energy Saving Based on Multi-Threshold Dynamic Buffer for FTTR Networks," tackles energy efficiency in dense FTTR deployments. The proposed Multi-threshold Buffer Energy Saving (MBES) scheme introduces dynamic buffer thresholds to enable intelligent sleep cycle management while maintaining strict QoS requirements, achieving energy savings of up to 17.75%.

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The seventh paper, "C-WAN for FTTR: Enabling Low-Overhead Joint Transmission with Deep Learning," presents a centralized wireless access network solution that addresses synchronization and channel state information overhead in multi-access point (AP) coordination. The proposed deep learning model reduces sounding overhead while maintaining transmission performance.

In conclusion, this special issue provides comprehensive coverage of recent advances in FTTR and integrated fiber-wireless systems. We believe that these contributions will serve as valuable references for researchers, engineers, and industry professionals working toward next-generation communication networks. We extend our sincere gratitude to the authors, reviewers, and editorial team members for their dedicated efforts in making this special issue possible.

Biographies

GE Xiaohu is currently a full professor with the School of Electronic Information and Communications at Huazhong University of Science and Technology (HUST), China. He is also affiliated with the China International Joint Research Center of Green Communications and Networking at HUST. He serves as an Adjunct Professor with the Faculty of Engineering and Information Technology at University of Technology Sydney (UTS), Australia. He received his PhD degree in communication and information engineering from HUST in 2003. He has worked at HUST since Nov. 2005. Prior to that, he was a researcher at Ajou University, Republic of Korea, and Politecnico Di Torino, Italy from January 2004 to October 2005. His research interests include mobile communications, traffic modeling in wireless networks, green communications, and interference modeling in wireless communications. He has published more than 200 papers in refereed journals and conference proceedings and has been granted about 25 patents in China. He received the Best Paper Awards at IEEE GlobeCom 2010. He served as the General Chair for the 2015 IEEE International Conference on Green Computing and Communications (IEEE GreenCom 2015). He also serves as an associate editor for *IEEE Wireless Communications* and *IEEE Transactions on Vehicular Technology*. He is a Senior Member of the IEEE.

ZHONG Yi received his BS and PhD degrees in electronic engineering from the University of Science and Technology of China (USTC) in 2010 and 2015, respectively. From 2015 to 2016, he was a Postdoctoral Research Fellow at the Singapore University of Technology and Design (SUTD), where he worked with the Wireless Networks and Decision Systems (WNDS) Group. He is currently an associate professor with the School of Electronic Information and Communications at Huazhong University of Science and Technology (HUST), China. He served as an associate editor for *IEEE Wireless Communications Letters* and other academic journals. His research interests lie in advanced wireless network theory, with a focus on spatio-temporal modeling, stochastic geometry, spatial network calculus, and energy-efficient communications in next-generation networks. He is a Senior Member of the IEEE.