# OPTICAL COMMUNICATIONS AND NETWORKS


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In the first issue of the Optical Communications and Networks Series in 2024, we have selected five fascinating articles reporting on recent advances in optical communications and networking. These advances and innovations are aimed for expanding the application area of optical communication technologies. More specifically we have selected five contributions that address (i) network time synchronization using optical signals, (ii) novel network technology for quantum networks, (iii) wireless communication using ultraviolet signals, (iv) the latest standard for optical camera communication and (v) underwater wireless optical communication in deep sea.

The first article, "Color-Based Time Synchronization for Future Networks: Advantages, System Architecture, and Potential Use Cases" by Ahmet Burak Ozyurt *et al.*, discusses the potential of optical wireless signals for time synchronization (TS) in various applications, including high-precision manufacturing and power distribution. More specifically, the authors propose the use of color-based encoded timestamps for TS. In the proposed technique, the master node transmits timestamps to the existing slave nodes encoded in optical signals. To do this, they introduce the implementation of the color-based TS technique and highlight its merits. It is concluded that color based optical signals can be efficiently used for TS in future networks.

The second article, "Quantum Wrapper Networking" by Ben Yoo *et al.*, proposes Quantum Wrapper as a novel networking technology that enables simultaneous control, management, and operation of quantum networks that coexist with classical networks. The quantum wrapper networks enable the transparent and interoperable transportation of quantum wrapper datagrams consisting of quantum payloads and, notably, classical headers to facilitate the datagrams witching without measuring or disturbing the qubits of the quantum payload. Furthermore, quantum wrapper networks can utilize the common network control and management for performance monitoring on the classical header and infer the quantum channel quality.

In the third article "Ultraviolet-Based Indoor Wireless Communications: Potentials, Scenarios, and Trends" by Tianfeng Wu *et al.*, the authors address the potential of Ultraviolet (UV)-based wireless communications to tackle some of the issues of radiofrequency (RF)-based wireless communications such as spectrum scarcity and security. The authors discuss other distinctive benefits of UV-based wireless communications, such as its wide unlicensed bandwidth, its advantageous scattering and reflection properties, as well as its use for sterilization and disinfection. The authors provide a comprehensive comparison of wireless technologies including but not limited to UV and RF, and a detailed design of a UV indoor communication system. They investigate performance indicators including the relationship between data rate and communication range for different optical powers, field of view and line-of-sight scenarios. The authors conclude by exploring future potential applications of UV-based technologies for indoor communication and discussing the challenges of this technology deserving further research and investigation.

The fourth article, "Enabling Technologies and New Challenges in IEEE 802.15.7 Optical Camera Communications Standard" by Huy Nguyen *et al.*, reviews recent optical camera communication (OCC) technologies that deploy light emitting diodes (LEDs) and image sensors. They explain the amendment of the IEEE 802.15.7-2018 standard, termed the IEEE 802.15.7a (TG7a) Higher Rate, Longer Range OCC Task Group, which has a significant influence on the advancement of OCC technology. Technical issues in TG7a and a comparison with the existing standard are also presented. The current status, new challenges, and future directions of research and development are also discussed.

In the fifth article, "Long-Term and Real-time High-speed Underwater Wireless Optical Communications in Deep Sea" by Jialiang Zhang *et al.*, the authors demonstrate 30-day long term undersea optical communication with 30 m transmission distance at a depth of 1650 m, using green light and blue light. The direction adjustable green light link achieves transmission rate of 125 Mb/s and the non-line-of-sight blue light transmission achieves a bit rate of 6.5 Mb/s, both with bit error rate less than $1 \times 10^{-5}$.

As the Editors of Optical Communications and Networks Series, we continue to strive to select interesting, timely, and informative articles for the *IEEE Communications Magazine* readership. We would like to thank all the authors for submitting their important new research results to this Series, the reviewers for their voluntary work and willingness to give back and serve the scientific community by providing high-quality reviews, feedback and comments to the authors that allow maintaining the high standards of this Magazine, and to the publication staff and the Editor-in-Chief of *IEEE Communications Magazine* for their support.

## BIOGRAPHIES

MATHIEU CHAGNON (chagnon@ieee.org) received his Ph.D. degree in Electrical and Computer Engineering, Photonic Systems Group, from McGill University, Montreal, Canada, in 2016. He is currently a Principal Optical Systems Architect at Infinera, California, USA. Prior to that, he was a Member of Technical Staff and research scientist in the Core Research group at Nokia Bell Labs in Stuttgart, Germany, where he worked on disruptive solutions for optical communication systems. His research interests and industrial focus include digital signal processing and machine learning for communication systems. He authored and co-authored more than 140 peer-reviewed publications including a number of invited and tutorial papers, a book chapter on high-speed optical interconnects, and patents in the field of fiber-optic communication systems. He has given several invited and tutorial talks at major conference venues in China, Europe, and the USA, and is on the Editorial Board of the *IEEE Communications Magazine* as both Associate Technical Editor and Series Editor of the Optical Communications and Networks series.

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