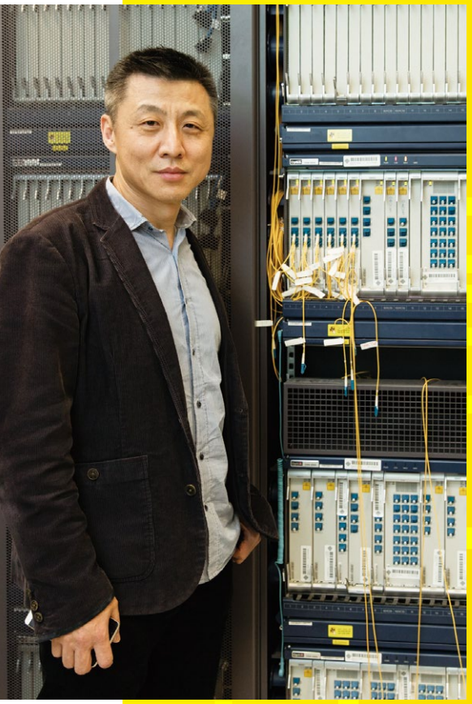
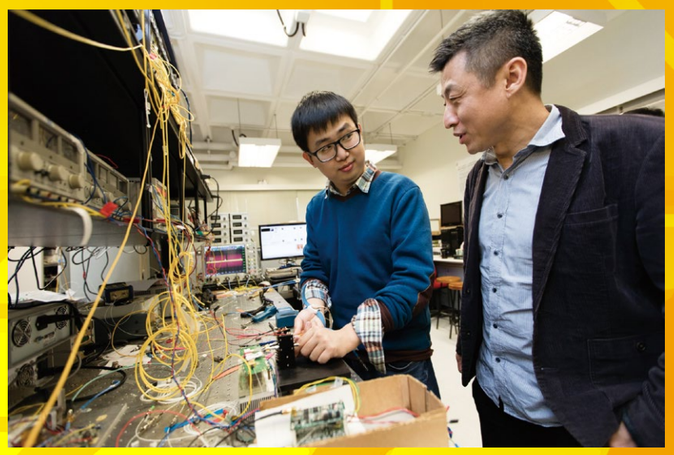
Optical Transmission Techniques for High Capacity Optical Networks

Professor Lu Chao
Professor
BEng, MSc, PhD, MIEEE



Optical fiber is an indispensable part of our digital age. It enables high capacity wired and wireless broadband connectivities that allow us to have fast access to many broadband services. Recent studies have shown that global Internet Protocol (IP) traffic has increased by fourfold in the past five years and the annual global IP traffic will pass the Zettabyte (1 zettabyte = 1 trillion gigabytes) threshold by the end of 2017 [1]. This requires us to develop transmission techniques that can cope with this ever increasing traffic demand. The only possibility is communication technology based on optical fiber.

In the past few years, the Communications Research Group at The Hong Kong Polytechnic University have worked closely with Huawei Technologies Co. Ltd., the global leader in information and telecommunication solutions, to develop optical communication technologies that enable the realization of multi-terabit optical networks. In particular, we have developed transmission and detection techniques as well as related digital signal processing (DSP) algorithm that allow the realization of 400Gbit/s per wavelength transmission (total capacity of a few tens of Terabit per fiber) over a few thousand kilometers [1]. In addition, the transmission techniques and DSP algorithm we have developed enable the implementation of flexible modulation formats and wavelength division multiplexing (WDM) grid which are essential for next generation flexible optical networks. We have also developed techniques for monitoring key network parameters that will add intelligence to future optical networks. This shall enable significant increase in the utilization of the capacity of future optical networks [2].



Another research focus of the Group has been on intra- and inter- data center short-reach optical communication systems. The ever-popular broadband and cloud services such as Facebook, Youtube, Instagram, WhatsApp and Dropbox means significant amount of data traffic will be generated within and between data centers. Unlike long-haul optical communication systems which typically cover distance of a few thousand kilometers, the required transmission distance of short-reach optical communication systems is much shorter, typically a few km to a few 10s of km. However, the amount of transmission and receiving devices involved are much more. To meet the demand of short-reach optical transmission systems, we have been developing techniques that allow high-capacity and low-cost transmission over short distance. We have developed a number of transmission schemes that allow 100Gbit/s transmission using 25Gbit/s optical devices [3,4]. The work carried out has not only enabled us to produce high quality publications in leading journals in the area but also contributed to the solutions for industrial applications.

References
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[2] Dong, Zhenhua, Faisal Khan, Qi Sui, Kangping Zhong, Chao Lu, and Alan Lau. "Optical Performance Monitoring: A Review of Current and Future Technologies." *Journal of Lightwave Technology*, Vol. 34, No.2(2016): 525-543.
[3] Zhong, K., Chen, W., Sui, Q., Man, J., Pak Tao Lau, A., Lu, C., & Zeng, L. (2015, March). Experimental demonstration of 500Gbit/s short reach transmission employing PAM4 signal and direct detection with 25Gbps device. In Optical Fiber Communications Conference and Exhibition (OFC), 2015 (pp. 1-3). IEEE.
[4] Zhong, K., X. Zhou, T. Gui, L. Tao, Y. Gao, W. Chen, J. Man, L. Zeng, A. P. Lau, and C. Lu. "Experimental study of PAM-4, CAP-16, and DMT for 100 Gb/s Short Reach Optical Transmission Systems." *Optics Express*, Vol. 23, No. 2 (2015): 1176-1189.