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Invited paper

Challenges to FDM-QAM coherent transmission with ultrahigh spectral efficiency

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Abstract

Quadrature amplitude modulation (QAM) is an excellent modulation format for realizing optical communication systems with a high spectral efficiency of much greater that 1 bit/s/Hz. I describe recent progress on 1 Gsymbol/s, FDM (Frequency Division Multiplexed)-QAM coherent transmission experiments by using heterodyne detection with a frequency-stabilized laser and an optical phase-locked loop technique.

Extended Abstract

Improving the spectral efficiency of WDM systems is very important to increase the total capacity of optical transmission systems. Recently multi-level phase-shift keying (PSK) or a combination of PSK and amplitude-shift keying (ASK) have become attractive candidates for such a purpose because multi bit information can be transmitted by 1 symbol data. Coherent quadrature amplitude modulation (QAM) is another interesting way of increasing the spectral efficiency in optical communication. 2N QAM signal processes N bits in a single channel, so it has N times spectral efficiency compared with OOK (On-off-keying). This technique enables us to realize a high-speed system with low speed devices. For example, if we can develop 64~1024 QAM, which was originally developed for microwaves, we may obtain an enormous advantage such as an ultrahigh spectral efficiency exceeding 10 bit/s/Hz. Even better results may be expected than with conventional QAM wireless transmission or metallic cable transmission as optical fibers have wider bandwidths and no fading noise.

In this talk, I summarize progress on 1 Gsymbol/s 64-128 coherent QAM transmission using heterodyne detection with a frequency-stabilized fiber laser and an optical PLL circuit. I refer to FDM (Frequency Division Multiplexed)-QAM transmission. These results indicate that we can handle optical beams in the same way as microwaves with respect to coherency.

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After receiving Ph. D. degree from the Tokyo Institute of Technology in 1980, he joined the Ibaraki Electrical Communication Laboratory of Nippon Telegraph and Telephone public corporation (NTT), where he has been engaged in research on soliton transmission, EDFAs, and Terabit/s OTDM transmission. He was a visiting scientist at MIT in 1984. He became the first NTT distinguished researcher in 1994 and a Fellow in 1999. In 2001, he became a professor at Tohoku University. Dr. Nakazawa received many awards including the IEE Electronics Letters Premium Award, IEEE Daniel E. Noble Award, OSA R. W. Wood Prize. He is a Fellow of the IEEE, OSA, IEICE, and NTT R&D.