Modeling and simulation of dispersion-limited fiber communication systems employing directly modulated laser diodes

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Abstract

This paper quantifies the role played by fiber dispersion in limiting the transmission distance in directly modulated gigabit optical fiber communication systems (OFCSs). The study is based on modeling and simulation of an OFCS deploying a directly modulated 1.55-mu m distributed feedback InGaAsP laser diode, a single-mode fiber and a PIN photodetector. The repeater distance of the system is decided to correspond to a bit error rate of 10(-9). The receiver sensitivity corresponding to the back-to-back configuration is calculated. Fiber attenuation was found to limit the maximum transmission distance to 162-202 km under bit rates ranging between 1 and 10 Gbps. This distance was found to be less affected by counting the chromatic dispersion of the fiber up to bit rate of 2 Gbps. A dramatic decrease in the transmission distance is predicted when the bit rate increases further and the system becomes dispersion limited. Influence of dispersion on the transmission distance is quantified in terms of the power penalty of the OFCS system associated with taking account of fiber dispersion. This power penalty is predicted to be within 7 dB for bit rates below 5 Gbps but jumps to values as high as 22 dB at higher bit rates.

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