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A Novel Optical Labeling Scheme Using a FSK Modulated DFB Laser Integrated with an EA Modulator

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The feasibility of an optical FSK labeling scheme is demonstrated. An optical signal consisting of a 10Gb/s payload and a 312Mb/s label was generated, and its performance was evaluated in an 88km transmission link.

1. Introduction

All optical label switching implements the packet routing and forwarding functions of multiprotocol label switching (MPLS) directly in the optical layer. It is a promising technology for next-generation wavelength division multiplexing (WDM) networks. Several optical labeling methods have been proposed and demonstrated as possible solutions [1], in which the label is attached by time multiplexing or subcarrier multiplexing with the data payload. The optical label can also be achieved by angle modulation that is orthogonal to the intensity-modulated payload [2]. In direct detection systems, the label information can be modulated using either the differential-phase-shift-keying (DPSK) or frequency-shift-keying (FSK) format. The feasibility of the optical DPSK label was experimentally validated [3]. However, this scheme imposes stringent requirements on the laser linewidth. The scheme of combined FSK/ASK modulation was demonstrated to be more applicable in practical networks [4]. In this paper, we report the construction of a novel optical FSK transmitter and investigation of the optical FSK labeled signal's performance. The generated signal consists of a 10Gb/s intensity modulated payload and a 312Mb/s FSK format label, whose performance was evaluated in an 88km standard single-mode-fiber (SMF) transmission link.

2. Operation Principle of the Optical FSK Transmitter

The optical FSK transmitter plays an important role in optical labeling. The label information is impressed upon the frequency of the optical carrier through FSK modulation, while keeping its amplitude unaffected. Thus the optically labeled packet can be achieved when the payload information is modulated on the amplitude of the carrier.

An optical FSK signal can be generated simply by directly modulating the electrical current of a DFB or DBR laser diode [5]. However, the drive current variation also results in a simultaneous intensity modulation of the emitted light. As for the optical labeling, such residual intensity modulation has a detrimental effect on the optical packet carrying payload information to be added. To overcome this problem, we propose a novel optical FSK label generation scheme based on a commercially available integrated DFB laser.
signal, thus achieving the FSK demodulation. The demodulated label was received by an electrical receiver with 1.8 GHz bandwidth. Fig. 5 shows the eye-diagrams of the payload and label.

**Fig. 6 (a)** Payload and label receiver sensitivity

We have proposed a novel optical FSK label generation scheme based on a commercially available integrated DFB laser/EA modulator. An optically labeled signal consisting of a 10Gb/s payload and a 1.125Gb/s label was generated. Both payload and label data could be recovered error free after transmission over 88km SMF, validating the feasibility of the optical FSK labeling scheme.

**References**


**Fig. 6 (b)** Eye-diagram of received payload (electrical)

The intensity modulation depth of the payload signal is 2.2dB and 1.1dB respectively.

**Fig. 6 (c)** Eye-diagram of received label (electrical)

The payload modulation depth of the label signal is 1.8 GHz bandwidth. Fig. 6(c) shows the transmission performance of the signal with 6dB extinction ratio. The transmission penalties for label and payload are 2.0dB and 1.0dB respectively.

**Fig. 6 (d)** Payload and label receiver sensitivity versus extinction ratio of the payload

**Fig. 6 (e)** BER performance of the optically labeled signal

**Fig. 7**

**Fig. 8**