40-Gb/s Polarization Multiplexed RZ-ASK-DPSK Signal Wavelength Conversion using a 32-cm Bismuth-Oxide Highly Nonlinear Fiber

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Multilevel modulation format allows data signals to be transmitted at a higher bit-rate than binary modulation without the need to increase the existing bandwidth of the electronic and optoelectronic components. Using various multiplexing, coherent or multi-level techniques, the bit-rate can be increased at a given symbol rate, thereby reducing the transmission impairment associated with a high symbol rate [1]. In particular, the combination of amplitude shift-keying and phase shift-keying modulation formats is of great interest. To perform wavelength conversion of data signals containing the phase information, four-wave mixing (FWM) can be exploited since it is a phase preserving process [2]. However, FWM is polarization sensitive and it cannot be directly applied for the nonlinear processing of a polarization multiplexed signal. In this work, we demonstrate wavelength conversion of a polarization multiplexed RZ-ASK-DPSK signal using FWM in a 32-cm Bi-NLF incorporated in a polarization diversity loop.

In the experiment, the 40-Gb/s RZ-ASK-DPSK input signal is combined with a 30-dBm CW pump using a 3-dB coupler. The signal and the pump are then launched to a 32-cm Bi-NLF incorporated in a polarization diversity fiber loop. The polarization diversity loop is built with a polarization beam splitter and two polarization controllers. The polarization of the pump is adjusted such that the pump power is equally split into two branches of orthogonal polarizations, A and B, by the PBS. Each of the polarization multiplexed input signal branches is also aligned with one polarization axis of the PBS. Thus, the two polarization branches in the RZ-ASK-DPSK signal counter-propagate in the polarization diversity loop. FWM wavelength conversion takes place at the 32-cm Bi-NLF in both directions, one for signal conversion at polarization A and the other for signal conversion at polarization B.

Eye measurements are performed for both the input and the output signals. The polarization multiplexed RZ-ASK-DPSK input signal is launched to a PBS to extract the two different polarization branches. The branches are individually split into two additional branches for ASK and DPSK detection. The ASK signal is directly detected at the coupler output while the DPSK signal is decoded by a 100-ps delay interferometer. Figures 1(a) and (b) show the ASK portion and the decoded DPSK portion at polarization A, while Fig. 1(c) and (d) depict the ASK portion and the decoded DPSK portion at polarization B.

After the FWM wavelength conversion, the output signal at 1546.8 nm is filtered out using an optical bandpass filter. The signal is then polarization demultiplexed using a PBS before its detection. Figure 1(e) and (f) show the ASK portion and the decoded DPSK portion at polarization A, while Fig. 1(g) and (h) shows the ASK portion and the decoded DPSK portion at polarization B. It is found that the output eyes exhibit a higher level of amplitude noise arising from non-optimized polarization settings in the setup and from the FWM conversion process. The converted outputs at the two polarizations show very similar characteristics. The output OSNR is over 20 dB. We observe that the output eyes and the OSNR remain nearly the same over a wavelength conversion range of 12 nm.

![Fig. 1. Measured eye diagrams. (a)-(d) input signal (a) ASK portion at polarization A (b) decoded DPSK portion at polarization A (c) ASK portion at polarization B (d) decoded DPSK portion at polarization B. (e)-(h) wavelength converted signal (c) ASK portion at polarization A (f) decoded DPSK portion at polarization A (g) ASK portion at polarization B (h) decoded DPSK portion at polarization B.](image)

References