All-optical 40 Gbit/s compact integrated interferometric wavelength converter

Jørgensen, Carsten; Danielsen, Søren Lykke; Hansen, Peter Bukhave; Stubkjær, Kristian; Schilling, M.; Daub, K.; Lach, E.; Laube, G.; Idler, W.; Wünstel, K.

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TuN7 with coherent light sources. The solid lines are theoretically calculated curves. The wavelength while the wavelength of pump channel was varied. The FWM of incoherent sources is about 5 dB more efficient than that of coherent sources due to the degeneracy factor.

Fig. 2. Experimental setup. Pol: polarizer, PC: polarization controller, TF: tunable filter, OA: optical amplifier.

Fig. 3. FWM efficiencies of incoherent light sources in comparison with coherent light sources. The solid lines are theoretically calculated curves. represents the measured data for incoherent sources and represents the measured data for coherent sources. In this measurement, the signal channel was set at the dispersion-zero wavelength at 1.55 μm. The pump and signal powers were 0 dBm and 5 dBm, respectively. The inset shows an optical spectrum measured at the output of dispersion-shifted fiber with two incoherent input signals.

Some of the most practical all-optical wavelength-conversion devices reported in the literature exploit the cross-gain (XGM) or cross-phase (XPM) modulation concept using semiconductor optical amplifiers (SOAs) alone or SOAs integrated into interferometric structures. Recently, 40 Gbit/s wavelength conversion using the very simple XGM principle in a speed-optimized SOA was demonstrated verifying the potentially high-speed operation associated with the relatively simple interband carrier recombination process. Here, an interferometric Michelson wavelength converter is presented that combines a speed-optimized SOA technology with the benefits of the integrated interferometer showing 40-Gbit/s wavelength conversion for the first time to our knowledge. The optimized wavelength converter demonstrates noninverted converted signals as well as converts to both shorter and longer wavelengths. Excellent results are achieved with ~10 dB extinction ratio and more than 25 dB signal-to-ASE (amplified spontaneous emission) ratio (1 nm) for the converted signals at 40 Gbit/s.

The monolithic integrated Michelson interferometer (MI) chip is realized using all-active multiple quantum well (MQW) based layer...
TuO1  Fig. 2. (A) Eye diagram and (B) waveform for 40-Gbit/s converted signal at 1562 nm. Signal-to-ASE ratio (in 1 nm) is 27 dB; signal input power (in the fiber): 8 dBm; cw power: 9 dBm.

and (B) waveform for 40-Gbit/s converted signal at 1562 nm. Signal-to-ASE ratio (in 1 nm) is 27 dB; signal input power (in the fiber): 8 dBm; cw power: 9 dBm.

Wavelength-division multiplexing (WDM) networks are expected to utilize all-optical cross connects (OXCN) for signal routing. Because a signal path is likely to contain a number of OXCNs, their cascadability is essential. Furthermore, because wavelength converters in the OXCNs improve traffic performance and ease network management, their cascadability, in particular, is important. Using interferometric wavelength converters (IWCs) we have previously demonstrated experimentally a cascade of 10 converters at 10 Gbit/s with <2-dB penalty. In this paper we analyze the cascadability limitations of OXCNs deploying IWCs.

The wavelength converters used in the experiments and in this analysis are interferometric wavelength converters, where semiconductor optical amplifiers (SOAs) are used as optically controlled phase shifters in a Michelson configuration. Converters based on this principle have the capability of pulse reshaping due to their sinusoidal transfer function and small chirp.

Importantly, when cascading nonlinear devices such as IWCs, the resulting transfer function is not the product of the individual IWC transfer functions. Here we show by detailed modeling that IWCs are cascadable in large numbers (>30) at 10 Gbit/s and their reshaping capability enhances the possible transmission distance when interconnected by nondispersion-shifted (NDS) fiber. The modeling shows excellent agreement with experiments.

In networks where the OXCNs are interconnected by dispersion-compensated fiber (zero accumulated dispersion between OXCNs), pulse distortion along the signal path arises during conversion. The effect of this pulse distortion is seen in Fig. 1, where the penalty for a...