as PMD causing polarization related crosstalk. This explanation also can be applied to the fact that PDM with TDM system suffered more signal loss and distortion, especially imbalance between two channels.

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All-optical flip-flop using an injection locked Fabry-Perot laser diode

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Recently, all-optical gain control of semiconductor lasers or semiconductor optical amplifiers have been studied for implementing all-optical flip-flop, such as methods based on the architectures of coupled ring laser, coupled Mach-Zehnder interferometers or coupled nonlinear polarization switches. However, these schemes are too complicated and bulky to realize optical memories with multi-state all-optical flip-flop. In this paper, we demonstrate the operation of a novel all-optical flip-flop. The flip-flop consists of a slave Fabry-Perot laser diode (FP-LD) and a specially designed master FP-LD. The main advantage of the proposed all-optical flip-flop is simple and cost effective structure since only two coupled FP-LDs are used. One of the two FP-LDs is an ordinary commercial FP-LD and the other is specially designed in order to have a built-in external cavity and operates in single longitudinal mode with high side mode suppression ratio. The on-off state of the proposed optical flip-flop is determined by whether the former FP-LD (called slave FP-LD) is injection locked or not in accordance with separate set and reset pulses. Separate set and reset pulses are external control signals and the sustaining beam from the master FP-LD is always injected into the slave FP-LD. A dual mode injection locking method is used to reduce the locking threshold for making "on" state using external "set" pulse. The key principle of our proposed scheme is the bistability of the injection locked FP-LD. To set up injection locking operation, the power of an injected beam should be greater than a locking threshold and the threshold power changes according to the wavelength difference between the injection beam and a selected mode in a slave FP-LD. The bistability relates to the locking threshold and it shows typical hysteresis curve. Once the input power of the injection beam exceeds the locking threshold, the slave FP-LD is injection locked to the injection beam and the locking state is maintained even if the input power is lowered than the initial threshold.

Two tunable lasers were used for set and reset pulses. Both pulse signals were generated by 1 Gbit/s pattern modulation using Mach-Zehnder modulators. Both pattern lengths were 16 bits composed of one "1" level and fifteen "0" levels. This means that the pulse duration is 1 ns and the pulse repeats every 16 ns. The optical power of set and reset pulses were -11.08 dBm and -9.23 dBm, respectively. Rising and falling time of the toggling output were measured and the both values were about 50 ps.

The operation speed is limited by the response time of an injection locked FP-LD and the fiber delay length of control signal. If the entire components are integrated and the control signal path length is minimized, the operation speed can be extended to a few Gbit/s since the rising time and falling time of the output signal are only 50 ps and there is already 10 Gbit/s injection locking operation is proved in other application. This simple and cost-effective architecture of all-optical flip-flop will be useful for future all-optical signal processing system such as optical buffering, optical memory and self-routing network.

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Simulation approach to the improvement of dispersion tolerance for electrical-binary-signal-based duobinary transmitters

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This paper proposes a way to greatly improve the dispersion tolerar an electrical-binary-signal-based duobinary transmitter by optimiz the relative time delay and the driving voltage. Duobinary transmitt based on electrical binary signals have been demonstrated overcome some problems of an electrical ternary-signal-bas transmitter with electrical low-pass filters (LPFs). The three-lev signals can experience significant distortions due to the imperfe response of LPFs and modulator drivers operating in the saturati region and have word-length pattern dependency.

One of the duobinary transmitters based on electrical binary signals i transmitter using a dual-arm Mach-Zehnder (MZ) modulator driven w two complementary signals relatively delayed by one bit [hereinaf referred to as one-bit delay (OBD) duobinary]. In spite of lo intersymbol interference (ISI) of the transmitter, the OBD duobina signals don't have as large dispersion tolerance as convention duobinary signals based on electrical LPFs due to frequency chirps the rising and falling edges of the signals. OBD duobinary signals is n possible for the transmission over larger than 75 km of SSMF due to t large frequency chirps of the signals.

To improve the dispersion tolerance of the OBD duobinary transmitt the overall modeling was performed by optimizing the relative tin delay between two complementary signals and driving voltage to th modulator. For the simulation, 10-Gbit/s NRZ data with the PRBS leng 231-1 were fed into the MZ modulator. The fiber launch power was s to be less than 3 dBm to avoid the effects of fiber nonlinearities. For receiver, we employed an optically preamplified receiver with an optic bandwidth of 0.3 nm. System performance was assessed by usir receiver sensitivities measured at a bit-error ratio of 10-9.

First, we consider the phase variation by the delayed time duration. Th polar diagram of the duobinary signals with 0.6-bit time delay has fo circles: two outer circles for transitions between marks and spaces, ar the other two inner circles for space-to-space transitions. The inn circles of the polar diagram imply ripples between spaces. It has bee recently shown that the ripples between spaces help improve th dispersion tolerance of duobinary signals. It is thought that bi alternating phase of the ripples compensates for adverse ISI generat by dispersion-induced pulse broadening. However, the duobina signal with 0.6-bit time delay still has a large amount of frequen chirps at the rising and falling edges. Subsequently reducing th driving voltage to 25% shrinks the locus of the polar diagram in vertic direction, indicating reduced frequency chirps at the rising and falli edges of the signals.

The optimization results show that we can transmit the duobina signal with 0.6-bit time delay over 175 km of SSMF without dispersi compensation. Further improvement of the dispersion-limit transmission distance is performed by reducing the driving voltage 25%. A good receiver sensitivity of -28.8 dBm after 200-k transmission is achieved by a duobinary transmitter with 0.6-bit ti delay and 25% driving voltage.

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A novel optical label switching method based on optical CDMA label encoding

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The optical label switching has been proposed to simplify the pac forwarding process. It prefixes a label to a packet, such that pac