Multi-Channel Dual-mode Pulse Generation for DWDM and Fiber-Wireless System Application

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Abstract – In this paper we propose a novel technique for the generation of wideband dual-mode pulses from a single subharmonically synchronous mode-locked laser diode (LD). The obtained pulse source exhibits high extinction ratio (>15 dB) and low timing jitter (<0.5 ps) over all the channels from 1550 to 1564 nm. The proposed scheme is cost-effective and a promising candidate as a pulse source for generation of carrier suppressed return-to-zero (CSRZ) modulation format in dense wavelength division multiplexed (DWDM) systems and optical generation of millimeter-wave frequency signals in multiple channel fiber wireless systems.

I Introduction
With the development of high data rate WDM systems, the need for achieving higher spectral efficiency and longer system reach has become the focus of the recent research. The development of advanced modulation formats has been pursued as one of the effective solution to achieve those requirements. CSRZ is one of such modulation format with advantages such as improved spectral efficiency and reduced intersymbol interference due to the alternating optical phase of successive bits [1]. CSRZ data stream can be generated via synchronous gating of optical pulses with alternating phase using an electrical data stream. Pulse source with alternating phase can be generated using a Mach-Zehnder modulator biased at the null point with a frequency half the bit rate or using mode-locked dual-mode laser diode. These schemes for CSRZ pulse source generation would suffer high cost for multi-channel WDM applications. In this paper, we propose a new low-cost technique to generate optical pulse trains from a single LD which can be demultiplexed into a number of pulse trains at different wavelengths with dual-mode optical spectrum and later used for the generation of multi-channel 40 Gb/s WDM signals with CSRZ modulation format. This technique is also promising of being used as optical signal generation at microwave or millimeter-wave frequencies in fiber wireless systems, where modulated microwave and millimeter-wave radio signals are transported to and from remote antennas (base station) and central office via optical fiber. In those applications, the dispersion induced RF power fading is a major limitation for the double sideband format signals generated using an external modulation approach. Using dual-mode optical pulse sources proposed in this paper, RF power fading can be avoided [2] and a cost-effective multi-channel WDM source suitable for fibre wireless systems can be developed. Using the method, we have generated 25 channel dual mode pulse sources with a repetition rate of 32.5 GHz per channel from a subharmonically synchronous mode-locked two section laser. The performance of the obtained pulse source was also evaluated in terms of extinction ratio, amplitude modulation, and timing jitter.

II Conclusions
We proposed a novel technique for the generation of multi-channel dual-mode pulse source from a single subharmonically synchronous mode-locked laser diode (LD) [3]. The generated pulse source with 32.5 GHz repetition rate exhibits high extinction ratio (>15 dB) and low timing jitter (<0.5 ps) over all the channels from 1550 to 1564 nm. The wavelengths and intensity of each channel of pulses are highly stabilized [4]. A slight increase in relative intensity noise (RIN) at low frequency part is observed due to the inherent aspect of spectrum slicing and could be suppressed by using SOA [5]. The proposed scheme is cost-effective and promising candidates of pulse source generation for 40 Gb/s carrier suppressed return-to-zero (CSRZ) modulation format in DWDM systems and optical signal generation at millimeter-wave frequencies for multiple channel fiber wireless systems.

References: