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Flat-top pulse enabling 640 Gb/s OTDM demultiplexing

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In ultra-high speed optical time division multiplexed systems (OTDM) with bit rates of 640 Gb/s at single wavelength and single polarisation, timing jitter is perhaps the most detrimental factor, limiting switching quality [1]. Here, we report on using a novel flat-top pulse shaping technique, which increases the tolerance of a switch to timing jitter, enabling 640 to 10 Gb/s demultiplexing.

Figure 1 shows the experimental set-up. An OTDM transmitter with a pulse compressor based on highly non-linear fibre (HNLF) followed by standard single-mode fibre (SMF) emits 730 fs wide data pulses multiplexed from 10 Gb/s to bit rates of 320 or 640 Gb/s (2^7-1 PRBS). The data timing jitter is measured to be 230 fs.

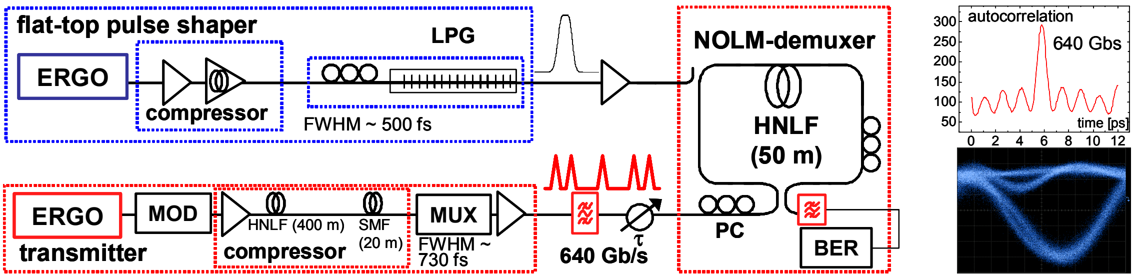

Figure 1. Experimental set-up. Right (top): 640 Gb/s data signal. Right (bottom): Demultiplexed 640 to 10 Gb/s eye.

The muxed data signal is sent to a non-linear optical loop mirror (NOLM) based demultiplexer with only 50 m HNLF. The NOLM is gated by a control pulse, which has been made a flat-top pulse through a specially tailored long-period fibre grating (LPG) [2]. The width of the flat-top pulse depends mostly on the input pulse width, which is a 500 fs soliton-compressed Gaussian-like shaped pulse. The control pulse timing jitter is measured to be 210 fs.

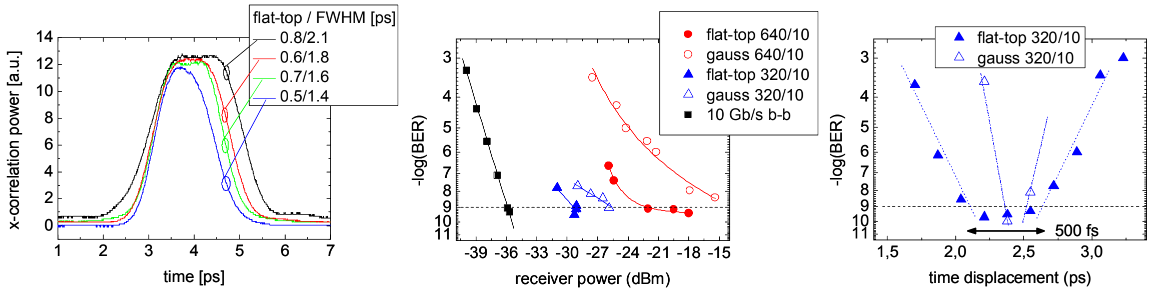

Figure 2. Experimental results. Left: Generated flat-top pulses. Middle: Bit error rate curves for 320 and 640 Gb/s demultiplexing. Right: Timing tolerance for 320/10 Gb/s demultiplexing.

Figure 2 (left), shows the generated flat-top pulses with flat-top widths and FWHM values ranging from 0.8/2.1 to 0.5/1.4 ps, corresponding to input pulse FWHM values of 900 to 500 fs. The latter is used for demultiplexing in this experiment. Figure 2 (middle) shows BER curves for demultiplexing the 730 fs data pulses when multiplexed up to 320 or 640 Gb/s, and using the original Gaussian control pulse or the flat-top pulse. With the flat-top pulse, the performance is clearly improved with respect to the Gaussian case (320 G: 4 dB sensitivity improvement at BER 10^{-9}. 640 G: 8 dB improvement at BER 3.9×10^{-9}). The penalties are caused by slightly too wide data pulses (600 fs is ideal), some pulse pedestals and the timing jitter. At 640 Gb/s, it is *only* possible to get error-free performance with the flat-top pulse. Figure 2 (right) shows the timing tolerance when switching the 730 fs data pulses using 320 Gb/s. With the original Gaussian-like control pulse, an only 150 fs tolerance is obtained. This is improved by more than a factor three to 500 fs with the flat-top pulse, revealing the width of the flat part of the pulse.

In conclusion, we present the first ever use of flat-top pulses for 640 Gb/s switching, and we demonstrate a significant improvement of the tolerance to timing jitter, enabling error free 640 to 10 Gb/s demultiplexing.

References

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