High-speed optical signal processing systems based on the switching of broadband frequency-chirped pulses

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Abstract: Future optical communication networks are likely to require a range of advanced OTDM channel processing functions if the full potential of the fibre transmission bandwidth is to be exploited. Critical processing functions include amongst others time-division demultiplexing, signal regeneration, channel add/drop, signal format conversion and packet compression. Ideally, these processes will be performed directly in the optical domain since this removes any bandwidth constraints associated with the use of electrical signals.

In this presentation we describe various optical processing systems that exploit time-to-wavelength signal conversion. All of our systems are based on the nonlinear optical sampling of a linearly chirped pulse that is shaped and synchronised to temporally overlap with a given number of (relatively high-power) OTDM tributary channels in a fibre based switch. The individual tributary OTDM channels are mapped directly onto distinct WDM channels at the switch output by the nonlinear sampling process. Further processing of the OTDM channels can then be performed simply by passive filtering of the resulting WDM channels. If required, the filtered WDM signal can then be mapped back into the time domain onto an OTDM signal in a second nonlinear fibre switch. To highlight the power of the approach we shall present experimental demonstrations of simultaneous demultiplexing of each of the constituent tributary channels of an OTDM signal, tributary channel aggregation into compressed packets, and 10Gbit/s multi-channel add/drop from a 40 Gbit/s TDM signal (see Fig.1 below).

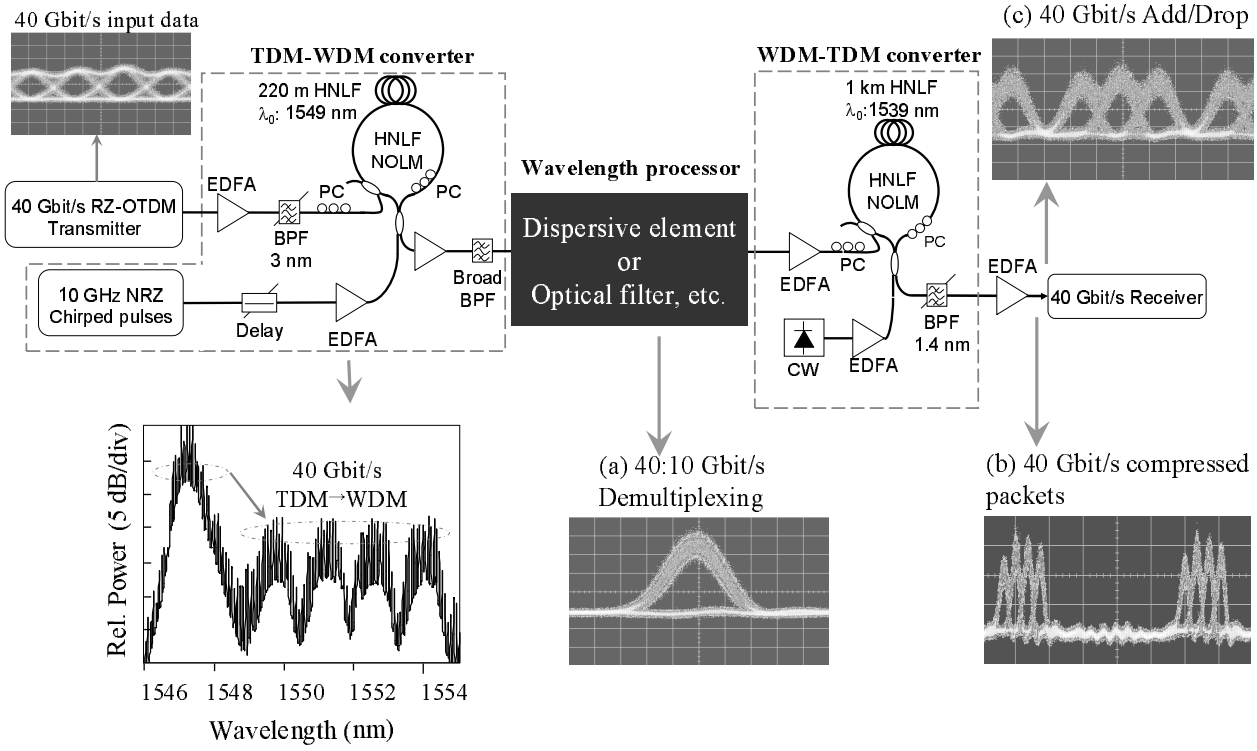

Fig. 1. Examples of signal processing at 40 Gbit/s using frequency-chirped pulse switching at a 10GHz rate. Insets show the switched signal spectra and eye diagrams of the processed signal after (a) demultiplexing, (b) packet compression and (c) channel add/drop.