Wavelength conversion devices

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transmitted at output 1 when applying 25 Volts. The experimental curve is displayed on Fig. 4 (control signal and output optical level). The switching time is limited by the electrical response of the amplifier and by the piezostack response. In the case shown on Fig. 4, one observes a delay of 40 μs between the electric control signal and the beginning of switching, and a switching time (10%-90%) of 30 μs. The main source of insertion losses and polarization dependence of this device is the circulator. Insertion losses are of course dependent on the output port, but with a three-port circulator they do not exceed 3 dB in the worst case (output 2).

In conclusion, we have demonstrated that piezoactuated gratings can be combined to build active demultiplexers or wavelengths routers. With minor modifications, this device can operate as a programmable add and drop multiplexer.


Wavelength conversion devices

Wagner converters will be essential devices to exploit the full potential of the wavelength dimension in wavelength-division multiplexed (WDM) networks. Their most important use will be: to avoid wavelength blocking in optical cross-connects, to allow wavelength paths to be allocated on a link by link basis thereby facilitating simplier network reconfiguration, protection switching, and wavelength referencing, and to perform routing functions together with optical filters (e.g., space switching in optical switches). Based on experiments, we discuss different candidates for efficient wavelength converters with attention to expected system requirements.

The ideal wavelength converter should be transparent to the bit rate and signal format and provide an unchirped output signal with both a high extinction ratio and a large signal-to-noise ratio. It should allow conversion to both shorter and longer wavelengths with equal performance and operate at practical input power levels. A simple implementation is also very important.

Today, no conversion device fulfills all the requirements. Nevertheless, many promising techniques have been proposed and demonstrated. The straightforward implementation is an electro-optic converter consisting of a front-end followed by a transmitter, that retransmits the incoming signal on a new wavelength. However, disadvantages such as complexity and large power consumption have directed the interest towards all-optical wavelength converters, that permit conversion without translating the signal to the electrical domain. Examples of all-optical wavelength conversion devices that will be discussed in this talk are (see Fig. 1): cross-gain modulation (XGM) and cross-phase modulation (XPM) in semiconductor optical amplifiers (SOAs), four-wave mixing (FWM) in SOAs or optical fibers, and optical modulation of different types of
Cross-gain and cross-frequency modulation (XFM) of different lasers have been exploited for wavelength conversion of 5-10 Gbit/s data. To make these converters feasible, they have to be realized with polarization-insensitive gain sections while maintaining single mode operation. For the high performance laser converters relying on XFM, the laser and the frequency discriminator should be integrated.

All converter devices addressed here require relatively high input powers to allow conversion of high data rates. Therefore, it would be desirable to integrate the different converter structures with optical pre-amplifiers.

Finally, general characteristics of the different converter devices are summarized in Table 1. The presentation will include a more in-depth discussion of the data. It should, however, be emphasized, that a comparison of the different conversion devices is not straightforward, considering the many possible applications of optical wavelength converters and the continuous progress in the field.

WG1 Table 1. Short-term and long-term requirements and performance of different conversion devices.

<table>
<thead>
<tr>
<th>Converter Type</th>
<th>Short-term Requirements</th>
<th>Long-term Requirements</th>
<th>Performance of Different Conversion Devices</th>
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<tbody>
<tr>
<td>XGM</td>
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<tr>
<td>XPM</td>
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<td>FWM</td>
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Efficient and stable high-speed wavelength conversion is a key function required in optical routing and switching systems. To overcome extinction ratio (ER) degradation and BER deterioration...