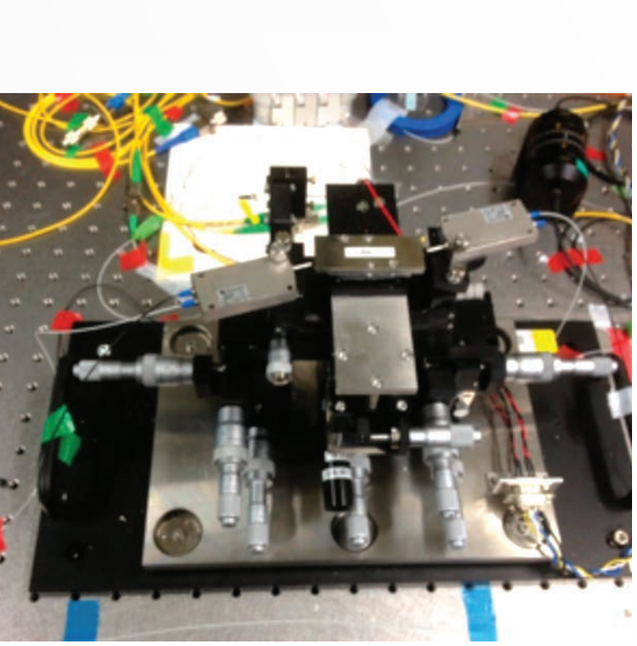
CONTACT

Components and techniques for high capacity optical communications

The continuous demand for more bandwidth has fuelled the need to improve the capacity of optical networks. In this way all-optical processing is a cost-effective solution for future optical networks, which should be transparent and energy efficient. The project addresses these issues by developing new components and techniques to increase the capacity and reduce the power consumption.



PROJECT WEBPAGE URL

http://www.it.pt/project_detail_p.asp?ID=1492

Main Project Team

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Funding Agencies

Fundação para a Ciência e Tecnologia	79.572,00€
Start Date	01-01-2011
Ending Date	01-12-2012

Indicators

Journal Papers	12
Conference Papers	27
Concluded PhD Theses	3
Concluded MSc Theses	3

Two Main Publications

Drummond, M. V.; Teixeira, A.T.; Monteiro, P.; Nogueira, R.N.; **"Flexible OTDM to WDM converter enabled by a programmable optical processor",** Optics Express, Vol. 20, No. 2, pp. 1783 - 1789, January, 2012.

Albuquerque, A.; Drummond, M. V.; Nogueira, R.N. ; **"Transfer Matrix and Fourier Transform Methods for Simulation of Second-Order Nonlinear Interactions in a PPLN Waveguide "**; IEEE/OSA Journal of Lightwave Technology, Vol. 29, No. 24, pp. 3764 - 3771, December, 2011.

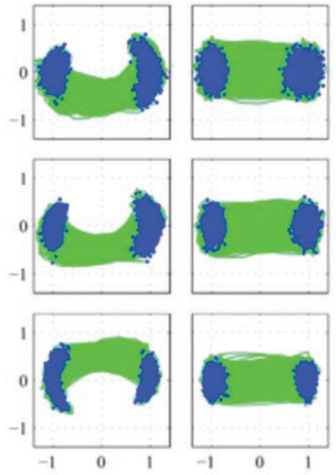

Fig. 1 Phase regeneration of a noisy signal. Left: degraded signal; right: regenerated.

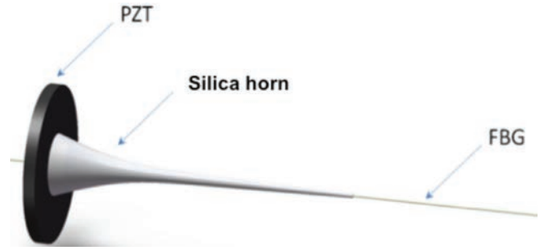

Fig. 2 Silica horn and piezoelectric transducer for acousto-optic modulation in optical fibers.

GENERAL MOTIVATION AND OBJECTIVE OF THE PROJECT

The development of new optical devices and techniques has boosted new possibilities in many different topics. In these, the field of communications has been one of the most prolific, with the exponential growth of optical communications, fuelled by the explosion of the internet and the increased demand for "broadband for all". However, today's optical networks are fairly static and operate within well-defined specifications. The addition of new nodes or the upgrade of existing links demands an enormous expenditure. A cost effective implementation of future optical networks should accommodate old static networks, as well as new highly-efficient networks. Future optical networks should be intelligent, self-managed, monitored and dynamically-reconfigurable and should be able to accept new nodes in a plug-and-play manner. All-optical processing devices are a cost-effective solution for the implementation of future optical networks. Such devices allow surpassing some of the limitations inherent to electric devices by keeping the signal in the optical domain, avoiding electrical-optical-electrical conversions. In order to enable the reconfigurability of the network, all-optical devices should be transparent to modulation format, bit rate, protocol, as well as other requirements.

In this way, the main objective of the project is to develop new techniques and components to increase the capacity of current systems using all-optical processing and advanced modulation formats.

CHALLENGE,

Development of a set of components and techniques based on all-optical processing that allows a transparent and reconfigurable optical network.

MAIN WORK DESCRIPTION

- Development, production and characterization of a set of novel low cost components for optical systems, including lasers, filters, clock recovering, phase regeneration, wavelength conversion.
- Development of new concepts, ideas, strategies and architectures for the transmission above 100 Gbit/s.
- Development of new concepts based on the periodic poled lithium niobate (PPLN) technology.

Study on advanced modulation formats to optimize current optical networks.

TECHNICAL ACHIEVEMENT OF THE IT TEAM

The IT team developed a set of novel components and techniques to boost the capacity of current optical networks. The results can be categorized in devices, sub-systems and systems.

Devices:

- Novel simulation models for PPLN devices allowing the custom design of these components for all-optical processing.
- Novel techniques for ultrafast tuneable delay lines and dispersion compensators
- Development of a simulation model for acoustic modulation on optical fibers to change the properties of fiber Bragg gratings (FBGs).
- Tunable gain equalization of an optical amplifier.
- Development of advanced techniques for optical amplification.

Sub-systems:

- Phase regeneration of a noisy signal.
- All-optical clock recovery at 160 Gbit/s
- Numerical models for all-optical 16 Quadrature Amplitude Modulation (QAM) and 64QAM generation.
- Novel techniques for instantaneous frequency measurement

Systems:

- All-optical OTDM-WDM multiplexing/demultiplexing at 160 Gbit/s
- All-optical routing with header decoding.
- Optimized advanced modulation formats to expand the capacity limits of optical communication systems

The work was done in collaboration with NICT in Japan and UTFPR in Brazil.