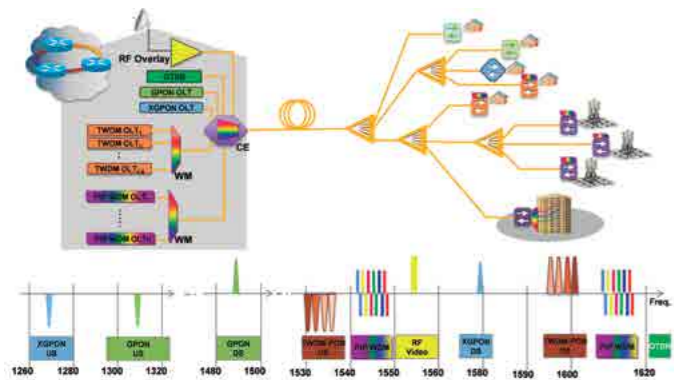


Real Time Ultra Dense WDM-PON

Real-time ultra-dense wavelength division multiplexing passive optical network (Real-PON) aims to demonstrate real time ultra-high capacity PONs for future optical access networks. Within the framework of this project we will focus mainly on the development of 10 Gb/s cost-effective UDWDM-PON systems using coherent detection as well as direct detection.



Main Project Team

| | OCP-Av |
|------------------|--------|
| Antonio Teixeira | OCP-Av |
| Ali Shahpari | OCP-Av |
| Ricardo Ferreira | OCP-Av |
| Paulo André | OCP-Lx |
| Adolfo Cartaxo | OCP-Lx |
| Tiago Alves | OCP-Lx |

Indicators

| | |
|-------------------|-------|
| Funding | 40k € |
| Journal Papers | 10 |
| Conference Papers | 10 |
| Book Chapters | 1 |
| Workshop | 1 |
| Concluded PhD | 3 |
| Concluded MSc: | 4 |

Two Main Publications

A. Shahpari, R.M.F. Ferreira, F. P. Guiomar, S. B. Amado, S. Ziaie, C. Rodrigues, J.D. Reis, A. N. Pinto, A. Teixeira, Real-time bidirectional coherent Nyquist UDWDM-PON coexisting with multiple deployed systems in field-trial (Post-Deadline), "IEEE/OSA Journal of Lightwave Technology", Vol. 34, No. 7, pp. 1643 - 1650, April, 2016.

R.M.F. Ferreira, J.D. Reis, S. M. R. Rossi, S. B. Amado, A. Shahpari, F. P. Guiomar, J. R. F. O. Oliveira, A. N. Pinto, A. Teixeira, Coherent Nyquist UDWDM-PON with digital signal processing in real-time (Invited), "IEEE/OSA Journal of Lightwave Technology", Vol. 34, No. 2, pp. 826 - 833, January, 2016

PROJECT WEBPAGE URL

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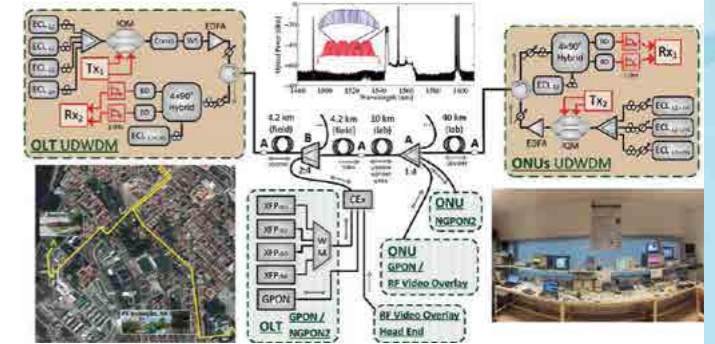


Fig. 1 Laboratory infrastructure for Field-trial setup for UDWDM-PON coexisting with GPON, NG-PON2 and RF video overlay technologies

GENERAL MOTIVATION AND OBJECTIVES

PONs are known an excellent fit for high-capacity mobile back/front haul traffic, but the number of users, capacity, reach and flexibility at minimal cost, complexity and occupied bandwidth are the most important challenges faced by service providers and vendors. Specially, when each connected user needs high dedicated bitrate and is assigned a unique wavelength, so the number of wavelengths has to be high in order to connect a suitable user base per feeder fiber. This leads to the development of ultra dense wdm (udwdm) systems with wavelength spacing as low as 3-5 GHz. In addition, udwdm with high-order modulation formats using coherent or direct detections together with paired channel technology can enable both high capacity and an easy upgrade for flexible bandwidth future optical access network (F-OAN). Its main scientific and industrial objectives are as follows:

- 1 - To identify and classify all PON architectures and perform of the state of the art analysing the main current investigating on access network.
- 2 - To overcome the limitations of the existing systems by proposing advanced architectures and modulations appropriate for real-time work conditions, compatible with PON standards.
- 3 - To experimentally implement a fully real-time bidirectional upstream and downstream prototype in fibre and free space optic with more reliable and cost-effective equipment.

CHALLENGE

In Real-PON project, significant effort must be given to minimizing electrical and optical component requirements for UDWDM in the optical network unit (ONU) and optical line terminal (OLT) as well as network architectures, so as to achieve cost effectiveness. This includes fundamental functionalities such as coherent detection techniques, subcarrier multiplexing WDM (SCM-WDM) with direct detection and burst mode operation. Also, to meet the ONU cost requirements, the need for very accurate tunable laser and complex Digital Signal Processing (DSP) techniques have to be addressed. Furthermore, In order to apply these technologies to real PON systems there must be a strong R&D effort to develop efficient architecture with simple DSP and reduced hardware requirements. This is currently

a hot topic in this year OFC and ECOC conferences, which needs to be faced in many different fronts, such as:

- 1-Analysis of the coherent and direct detection architectures aiming at increased capacity, flexibility and simplified operation (baud rate, detection scheme, modulation format, multiplexing/demultiplexing scheme, topology, ...).
- 2- Considering the existing and required DSP operations in PON find a path towards its simplification in both off-line and real-time processing (aiming low power consumption and gate count)
- 3-Real-time implementation of the proposed scenarios (at least 2 Tb/s aggregate rate bi-directional PON in a single trunk fiber and FSO operating in real time).

WORK DESCRIPTION AND ACHIEVEMENTS

In this project, we will try to develop new architectures with linear and nonlinear equalizers in DSP, in order to simultaneously enable higher bit-rates, low channel spacing (3-5GHz) and longer propagation distances without sacrificing the received signal quality. Therefore, this project will be organized around 4 main tasks:

- Task 1: State of the art survey and equipment acquisition.
- Task 2: Select a future PON system.
 - Task T2.a: Coherent UDWDM-PON.
 - Task T2.b: Direct Detection UDWDM-PON.
- Task 3: DSP Optimization:
- Task 4: Real-time Validation:

- Achievements:
- Book chapter:1
 - Publications in Journals:10
 - Publications in conference proceedings: (Post-deadline paper (PDP): 1) Regular papers: 9)
 - Demonstrations
 - Fully bidirectional PTMP optical wireless UDWDM-PON.
 - Demonstration of real-time UDWDM PON with FSO.
 - First real-time experimental demonstration of digital Nyquist coherent UDWDM-PON - using FPGA-based 8-bit DSP.
 - Field-trial of a real-time bidirectional UDWDM-PON coexisting with GPON, RF video overlay and NG-PON2 systems.