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.

**GENERAL MOTIVATION AND OBJECTIVES**

PONs are known an excellent fit for high-capacity mobile backhaul 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 networks.
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 prototypes in fibre and free space optics 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 on their 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 further. 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 and find a path towards its simplification in both off-line and real-time processing (minimising 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:

1. State of the art survey and equipment acquisition.
2. Select a future PON system.
3. Coherent UDWDM-PON.
4. Direct Detection UDWDM-PON.

**Main Project Team**

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**Funding**

- Journal Papers: 10
- Conference papers: 10
- Book Chapters: 1
- Workshop: 1
- Concluded PhD: 3
- Concluded Misc: 4

**Main Publications**


- OCP-Av, OCP-Lx, OCP-PDP: 1) Regular papers: 9) Post-deadline papers: 1) Regular papers: 9)