Ph.D. in Information Technology
Thesis Defenses

July 3th, 2023
at 16:00
Room "Aula Seminari Alessandra Alario" and online by Zoom

Alessandro Perino– XXXV Cycle

Reconfigurable photonics for spectrum monitoring and equalisation in optical network

Supervisor: Prof. **Marco Sampietro**

Abstract:

This PhD thesis presents the collaboration between academia and a startup company with the goal of developing a product in the field of integrated photonics for the telecommunications market.
The startup aims to create a full module called "PhotonPath white box" incorporating multiple devices such as Erbium-Doped-Fiber-Amplifier (EDFA), integrated optical channel monitor (OCM). The idea is to integrated the white box in the amplification node of both core and metro optical networks. The white box, besides amplifying the signal with the EDFA, will have the capability to provide information regarding the status of the optical network with the OCM.
This thesis focuses specifically on the development of two crucial components, the dynamic equaliser (DE) placed at the output of the EDFA, and the OCM. Regarding the DE, different technologies have been employed for gain equalization. A common solution is to use Wavelength Selective Switches(WSS). In spite of their good performance and reconfigurability, WSSs are bulky and expensive. A more compact and cost-effective solution can be found with integrated photonics. One of these solutions is the implementation of a fixed gain flattening filter (GFF). However, GFFs have limitations in adapting to fabrication tolerances and variations in the gain of the EDFA. To address these limitations, programmable filters can be employed. Programmable filters possess the capability to adjust their transfer functions, allowing them to compensate for fabrication errors and accommodate different gain profiles associated with various gain values. The objective of this thesis is to combine the advantages of an integrated solution with the reconfigurability offered by bulkier alternatives. Regarding the OCM, they are in high demand in the optical networks market for monitoring network performance. The use of precise optical spectrum analysis with high resolution provided by economical and reliable spectrometers leads to a significant reduction in size, weight, and power consumption compared to traditional discrete-optics instruments, which are often bulky. This project aims to integrate a full OCM system into a QSFP module that is not yet available on the market yet, to the best of my knowledge. The research was conducted both in an academic environment and within the company, providing a unique opportunity to combine the strengths of both settings. The author was responsible for the development and design of the integrated photonic chips, the design of the control electronics and firmware, as well as the algorithms for the calibration and control of the photonic devices. The fast-paced nature of the startup environment often required to adapt the work style to the changing priorities dictated by the market and customer needs.
In addition to collaborating with the startup, another project was also being carried out at Polifab. This project focuses on the design of high-sensitivity sensors that can be integrated onto waveguides. Sensors of this type, also called 'transparent' sensors, add no losses to waveguides

other than propagation losses. Transparent sensors allow complex photonic circuits to be reconfigured and controlled. The designed sensor is able to detect light variations down to −60dBm.

PhD Committee
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