PhD in Electrical, Electronics and Communications Engineering

Research Title: Multilayer virtualization of integrated photonic components for open optical networks

SESSION: SUMMER 2019

Funded by	Dipartimento di Elettronica e Telecomunicazioni (DET) Proff. Paolo Bardella, Andrea Carena, Vittorio Curri

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Context of the research activity	Optical Networks are fast evolving: from today standard where they are closed single-vendor systems to next generation paradigm becoming open systems. This is also testified by the blossoming of international consortia between operators and vendors, as for instance OpenROADM, OpenConfig and the Telecom Infra Project. Within such a scenario, driven by a tremendous traffic expansion caused by the growth of Data Center Interconnects (DCI), cloud computing and the imminent implementation of 5G networks, the vertical abstraction of network elements across layers in data structuring (common YANG models) and operational modeling (common APIs) is a fundamental requirement. We envision to extend this abstraction down, below the ISO-OSI layer-0, expanding it to single components. This approach is particularly suitable for the development of devices in the extremely timely field of the integrated photonics: it allows to virtualize components and describe them using a standardized interface based on the process specification of the chosen foundry (PDK), following a design flow similar to the one used for silicon based electronics components. The research activity funded through the proposed scholarship will exploit synergies between the in-force DET-Synopsys MSA and

	funding SOW on simulation of optical communications systems under the responsibility of Prof. Curri. Moreover, the scholarship will benefit of the donation to DET under the responsibility of Prof. Curri of the complete Synopsys photonic suite (see attached document) that will be the base for a virtual laboratory for multilayer testing of the components as well as the tool to design optical components to be realized by specialized foundries and then tested in the PoliTo PhotonLab facilities, in particular using a fiber alignment system recently acquired in the framework of the regional project “FIP - Tecnologie Fotoniche per l'Industria 4.0 in Piemonte”, guided by Prof. Perrone.

Objectives	The first objective of the proposed PhD program will be the activation of vertical synergies among different teams operating in the field of photonics within the DET. The playground for such a contamination will be the software suite donated by Synopsys to PoliTo. The PhD student supported by this scholarship will be the main player to activate the collaboration. For the specific of component development the main objectives of the PhD program will be the complete study of all-optical routing devices on Silicon photonics, including (a) the simulation of the electromagnetic properties of the basic blocks (waveguides and couplers) through Finite Differences Time Domain simulation and (b) the functional study of the complete device using scattering matrices based simulations, also including fabrication tolerances. Mask layouts will be prepared, to be sent to the foundry for the realization of the optical components, which will be characterized in PoliTO. For what concern the higher levels, main objectives will be on virtual and possibly experimental testing of the performance of the newly developed component, both in a transmission and networking scenario. In the networking scenario will be addressed the issue of getting operational parameters from the field. Techniques based on artificial intelligence will be considered to fill the possible gap of uncertainty left by available data. Through these activities, the Candidate will develop a strong expertise on the field of Silicon photonics, covering the design and the experimental measurement of both single components and whole optical systems.

Skills and competencies for the development of the activity	The candidate to this PhD position must have the following skills: • Fundamental of digital communications; • Fundamental of electromagnetism and guided optics; • Fundamental of semiconductor materials; • Experience on simulation tools.