PhD in Electrical, Electronics and Communications Engineering

Research Title: Abstracting the physical layer of optical networks by the synergistical use of analytical models and artificial intelligence

SESSION: SUMMER 2019

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

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Context of the research activity	In optical networks, the enabler for the optimal exploitation of data transport is the control layer. Software-defined network controllers rely on a network abstraction where Quality-of-Transmission (QoT) degradation on Optical Line Systems (OLS) is given by the capability of OLS controllers to operate at the optimal working point. The higher the accuracy in pursuing such a task, the lower the margin for traffic deployment and the larger the deployed traffic rate. Moreover, recovery of network failures could be automatized and sped up. So, it is mandatory to rely on a QoT estimator (QoT-E) that can reliably predict the lightpath performance before its actual deployment, i.e., the generalized SNR (GSNR), that includes both the effects of ASE noise and nonlinear

	interference (NLI) accumulation. The network abstraction as a graph weighted by the GSNR establishes a challenging and fertile scenario for an interesting and productive research activity. The optical communications group of PoliTo is a leader in developing mathematical models for fiber propagation. Prof. Curri is representing PoiTo in the consortium Telecom Infaproject, TIP in the following (see references below) and is the Scientific Chair of the GNPy project (oopt.telecominfraproject.com) that aims at developing an open source library for the abstraction of data transport in open optical networks. Within this framework, it has been understood through extensive experimental tests that the nonlinear fiber propagation needs mathematical models, while, the main issue is given by the uncertainty on the working points of network elements, mainly of amplifier. This operation needs the use of artificial intelligence techniques, as preliminary experimentally shown within the Cisco-funded project ALPINIST (Rif DET: CTR. N. 538/2018 - CISCO SYSTEMS - PROF. CURRI) within a collaboration including also Links Foundation. **References for the TIP**: The TIP is a non-profit consortium led by Facebook that aims at developing open source hw and sw for open 5G networks. PoliTo is a member of the TIP with Prof. Curri as scientific reference (D.R. 12, 14 jan 19). Moreover, DET has signed an MSA with TIP (D.R. 1008/18, 5 Nov 18 and “convenzione dipartimentale” 819/2019) that has enabled the in-force TIP-founded SOW under the PI of Prof. Curri (Rif. DET: CTR. N. 1016/2018 - TELECOM INFRA PROJECT - PROF. CURRI) **Synergies** : this project is synergetic with the activities of the Marie-Curie ETN WON for which prof. Curri is the PI of the PoliTo unit

Objectives	• Mathematical models for fiber propagation aimed at the implementation within a quick quality of transmission estimator
	  • Worst-case math models for planning
	  • Spectral load dependent math models for lightpath deployment
	  • Issues related to single channel propagation at ultra-high symbol rate
	• Use of artificial intelligence techniques to implement zero margin line system controllers
	  • Experimental statistical assessment of OSNR

	fluctuations over a line system • Machine learning techniques to predict fluctuations an automatization

Skills and competencies for the development of the activity	**Education**: physics or electrical engineer **Experience**: deep theoretical knowledge of electromagnetic phenomena, machine learning applications, academic research, experiences in private companies. **Skills**: applied mathematics, electromagnetic phenomena, Python coding, knowledge on using machine learning techniques **Publications**: candidates with accepted and/or submitted publications in the field are preferred.