Ph.D. in Information Technology:

Thesis Defenses March 19th, 2021 online by Teams – at 14.30

ASKARI LEILA – XXXIII CYCLE

Thesis: Dynamic Management of Virtual Network Functions in Optical Metro Network Architectures for 5GCommunications

Supervisor: Tornatore Massimo

Abstract

New services emerging in metro networks force network operators to seek new approaches for the provisioning of the resources required by these services in the network. The traditional approach that leverages the single-purpose hardware devices will not provide an agile way to provision services and impose high Capital Expenditure (CapEx) and Operational Expenditure(OpEx) on network operators. In other words, the hardware devices used as middle-boxes only provide a single functionality, therefore, to provide multiple functionalities in the network, several middleboxes are needed, resulting in high CapEx and OpEx, especially in terms of energy cost. Furthermore, these devices are typically expensive and have limited life cycle. Network Function Virtualization, as a new paradigm shift, has emerged to enable network operators reduce the CapEx and OpEx by replacing hardware devices by software instances that can run on generic purpose servers and switches. These software instance that can run on any generic server are referred to as Virtual Network Functions (VNFs). However, the decision about where to place these VNFs in the network and how to connect them in the specific order to provision a Service Chain (SC) is not trivial. In this thesis, we mainly focus on the problem of VNF placement in optical metro networks and develop novel algorithms to perform VNF placement for dynamic service chaining.

RAPISARDA MARIANGELA – XXXIII CYCLE

Thesis: Metro network capacity increase via innovative photonic technologies and communication systems

Supervisors: Boffi Pierpaolo

Abstract

In the following years, future Metropolitan Area Networks (MANs) will be required to support a large range of resource-hungry applications, but on the same time they will have to be efficient in terms of cost and energy consumption. This thesis takes into account a modular solution based on Sliceable Bandwidth/Bitrate Variable Transceivers (S-BVTs) developed in PASSION project. The focus of the thesis is to analyze the potentialities, in terms of transmitted capacity, of S-BVTs based on Vertical-Cavity Surface-Emitting Lasers (VCSELs) directly modulated with Discrete Multitone (DMT) and on coherent detection in MANs organized in hierarchical levels (HLs). The interplay between laser chirp parameters and tight optical filtering due to Wavelength Selective Switches is studied for both Dual Sideband (DSB) and Single Sideband (SSB) DMT modulations. The dependence of the interchannel crosstalk arising from 25-GHz spaced channels on the modulating signal bandwidth is proved. The effect of HL4 and HL3 nodes on the transmission performance is evaluated in terms of required Optical Signal-to-Noise Ratio (OSNR) to achieve given target capacities. Real network topologies are considered, and a target capacity of 50 Gb/s per channel per polarization can be reached by optimizing the launch power and the optical amplification. Furthermore, the presence in the network nodes of Semiconductor Optical Amplifiers (SOAs) working as Wavelength Blockers (WBLs) is

evaluated in terms of capacity reduction due signal distortion caused by Self-Gain Modulation (SGM) of the amplifier. The analysis is performed with two different optical sources, a Distributed FeedBack (DFB) laser and a VCSEL, which are externally and directly modulated respectively. They are modulated both with a DSB and a SSB DMT signal. At last, the performance of a system composed of a DSB DMT-modulated optical signal crossing a complete HL4 node, i.e., constituted of a channel Demultiplexing (DEMUX) filter, an SOA, and a Multiplexing (MUX) filter, followed by an optical SSB filtering and the addition of two SSB DMT-modulated adjacent channels in a 25-GHz grid is experimentally measured. The three channels propagate for 100 km.