NETWORK ELEMENTS BASED ON A MODULAR APPROACH FOR MULTI-TB/S SUSTAINABLE MANs

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The H2020 research project PASSION proposes an innovative photonic modular approach for the implementation of metropolitan area network elements, developing a photonic integrated transmitter with multi-Tb/s capacity and a switching node architecture featuring different levels of aggregation.
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Abstract

The concentration of the data traffic in relatively small geographical areas, is challenging the evolution of the metropolitan area networks (MANs). The future MAN architectures will need to support a huge total throughput in transmission and routing; consequently, the metro optical equipment will have to guarantee flexibility and scalability, together with sustainability; new photonic technologies are explored for this target. The EU-H2020 project PASSION proposes an innovative photonic modular approach for the MAN network elements, developing a photonic integrated circuit (PIC) modular transmitter with multi-Tb/s capacity and a switching node architecture featuring different levels of aggregation. In particular, the exploitation of long-wavelength high-bandwidth vertical cavity surface emitting lasers (VCSEL) directly modulated (DM) with discrete multitone (DMT) modulation allows a per channel per state of polarization (SOP) capacity above 50 Gb/s [1]. A 40-VCSEL based module (MOD) is designed by integrating in SIPh 4 sub-MODs, each one containing 10 VCSELs with 400-GHz spacing. In the MOD, the 40 50-Gb/s modulated VCSEL emission wavelengths cover the C band with 100-GHz granularity, so an aggregated capacity per MOD of up to 2 Tb/s is achieved. This 40-VCSELs MOD constitutes the PASSION fundamental building block. By combining 4 of such a MOD, a full 160-channels TX super-MOD is obtained, characterized by 25-GHz granularity and enabling up to 8 Tb/s total capacity (Fig.1a). Polarization-division multiplexing (PDM) can be also exploited combined with coherent detection to achieve up to 16 Tb/s capacity. Similarly, the switching/aggregation node architecture is equipped with different photonic fundamental modules, depending on the featured hierarchical level and on the handling of the added and dropped traffic in both space and spectrum dimensions. The low-hierarchy node architecture is very simple whereas the higher-level node (Fig. 1b) includes photonic switching modules (PSM) and aggregate/ disaggregate switches to allow the routing of the dropped traffic either to the multicast switch (MCS) or to the add

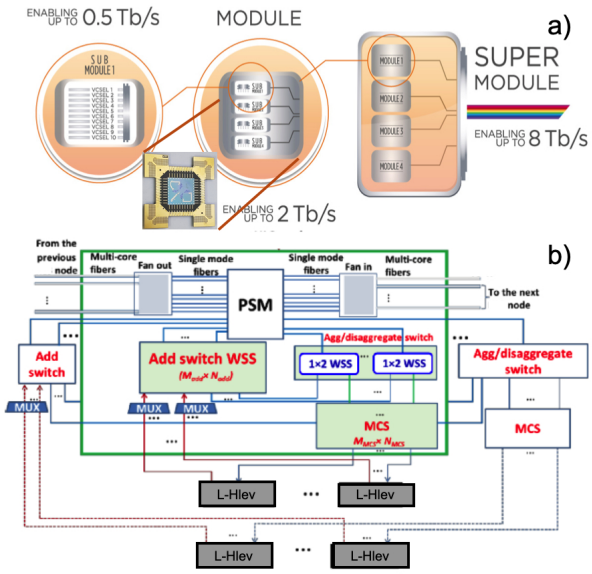

Fig. 1: a) TX modules b) Higher hierarchical level node architecture.

wavelength selective switch WSS [2]. These node architectures deliver on-chip switch node functionalities, with a modular approach obtained by repeating the same blocks. Both monolithic InP and hybrid WSS of SiPh switches are used, in combination of integrated InP SOAs, while the PSM is based on polymer switches. Preliminary performance evaluations [2, 3] demonstrated the ability of the developed photonic technological solutions to support huge throughputs and traffic scaling featuring a "pay as you grow" approach.

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