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(Article begins on next page)

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Abstract: We demonstrate the possibility of laser sharing, using a multiple-output EDFA, to be adopted by central offices serving multiple PONs, showing compatibility with NG-PON2 standard.

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1. Introduction

Considering mid-size to large cities and the typical number of users to be connected to a PON, in a possibly near future with a large percentage of population to be connected to a fiber-to-the-home system, a possible optimization to be performed in central offices (CO) in terms of cost, power consumption and footprint could be sharing laser sources between several PONs, not necessarily on the same fiber infrastructure. This idea foresees the need of having a (top rack) unit made with a CW laser and a proper optical amplification system, to serve several OLTs. An architectural example is shown in Fig. 1, where we consider the availability of a multiple-output EDFA, as in the experiments described in the following we are using a unit with M=24 output ports at +17 dBm each.

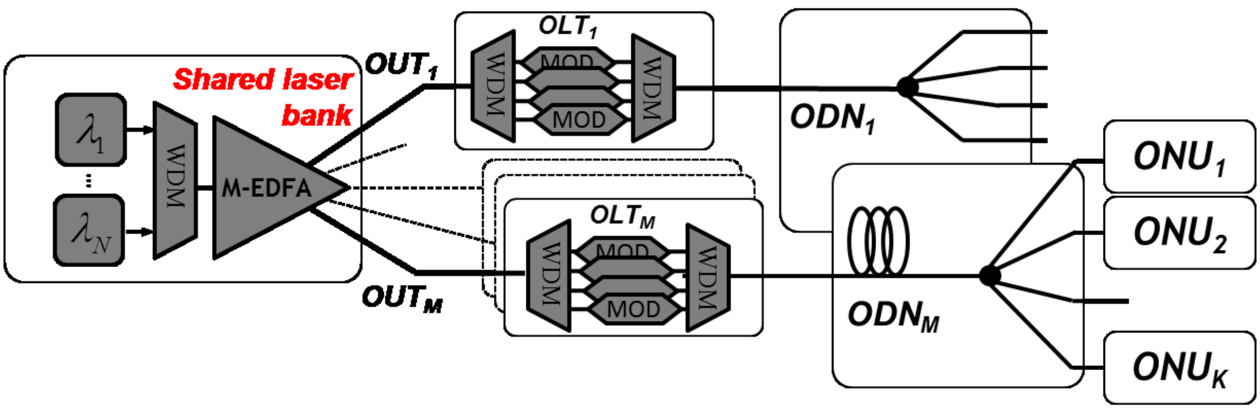

Fig. 1 The laser-sharing concept.

As we also propose to mix this concept with the reflective-PON approach, considering 4 wavelenghts in the upstream and 4 in the downstream as foreseen by NG-PON2 and the 24 output ports, this approach can be economically viable provided that the cost of the M-EDFA is lower than the cost of 184 lasers. In terms of power consumption, considering the unit we used has a nominal consumption of 35 W, the solution is viable in case a single laser has a consumption lower than 190 mW.

The proposal is quite general and can be applied to many different advanced PON architectures, and we demonstrate in the following a specific implementation of the laser bank idea focusing on a solution that uses self-coherent detection for upstream traffic and that, consequently, requires high quality external-cavity lasers for which laser sharing may be particularly cost-effective.

2. Experimental setup and results

The experimental setup we adopted in our laboratory is shown in Fig. 2. In particular, we address a PON using N=4 λs per direction, carrying 10 Gbps per λ (thus 40 Gbps total per direction). For the downstream, we propose a traditional OOK modulation in the L band, while for the upstream we propose a more advance self-coherent reflective approach [1]. As we do not have the M-EDFA unit working in the L-band, we emulated its employment for the downstream using a single laser and setting the proper output power, while for generating the bank of CW for the reflective approach in C band we used a “Prisma II” EDFA unit by CISCO. The ODN is composed by 37 km of real installed metropolitan buried SMF fiber, a variable optical attenuator (VOA) to act on the ODN loss and a 1x4 optical splitter. The experiments have been carried out with the off-line processing approach, as the traffic is generated by Pattern Generators programmed with a PRBS 2^{15}-1 at 10 Gbps for the downstream and an 8B/10B (to counteract Rayleigh backscattering) OOK sequence for the upstream. The ONU is composed by a Reflective Electro

Absorption Modulator (REAM), used to reflect and modulate the US λ under test, selected by means of a standard 100 GHz grid optical filter. US signal is detected at the OLT by means of a self-coherent receiver, that uses the same CW sent to the ONU for being modulated as local oscillators, thanks to optical splitters.

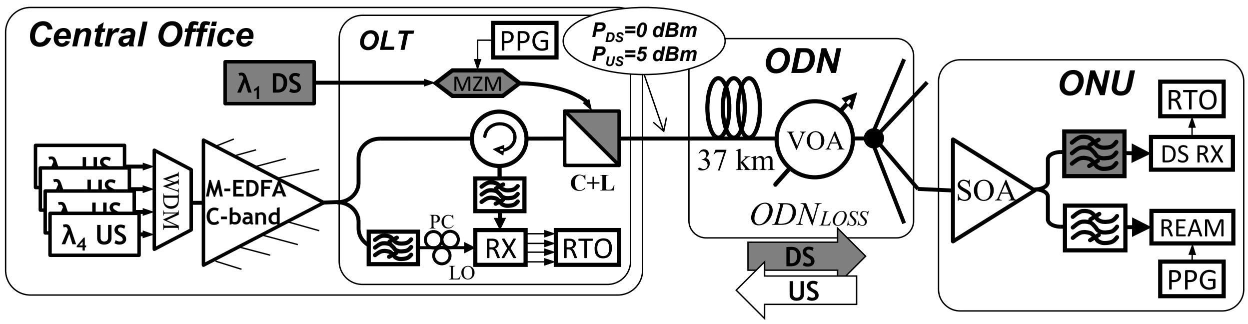

Fig. 2 Laboratory measurement setup using a real fiber infrastructure.

The system performance was first measured with the US WDM signals only, as reported in Fig. 3, in terms of BER of the channel under test as a function of the ODN loss. The SOA bias current has been optimized for each ODN loss value in order to avoid US signal saturation. Fig. 3 shows that the proposed setup supports the WDM feature up to 31 dB of ODN loss before reaching a pre-FEC BER=10-3, satisfying ITU-T ODN class N2 ([2]). We then switched on the DS l, reporting both US and DS performances in Fig. 4. The DS signal is recovered up to 35 dB of ODN loss, and the DS presence does not affect the US performance, as expected.

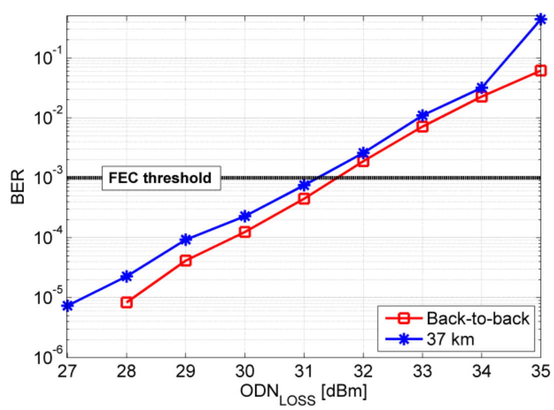

Fig. 3: Performance of the US channel under test in terms of BER vs ODN loss.

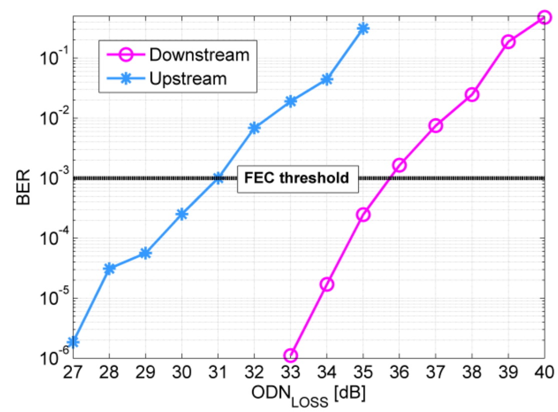

Fig. 4: Performance of the upstream and downstream transmission in terms of BER vs ODN loss.

3. Conclusions

We propose a possible approach for laser sharing between OLTs at the CO, and speculated on its economic viability when coupled to a reflective-PON architecture. In these conditions, we also experimentally demonstrate with commercial components the compatibility with the ODN specifications set by ITU-T for NG-PON2.

4. Acknowledgments

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5. References

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