1 Tb/s WDM/OTDM-OFDM-PON Power Budget Extension Techniques

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Abstract—In this paper we demonstrate two different techniques for 1 Tb/s QPSK-WDM/OTDM-OFDM-PON optical power budget extension. Our simulation results show that EDFA outperforms SOA and results in more access budget. We address the bandwidth requirements of 64 customers with 0.625/40 Gb/s/λ, guaranteed/peak bit rate downstream scenario. The bandwidth can be shared among customers using WDM/OTDM PON architecture.

Keywords—Passive Optical Network (PON); Erbium Doped Amplifier (EDFA); Semiconductor Optical Amplifier (SOA); Orthogonal Frequency Division Multiplexing (OFDM); Wavelength Division Multiplexing (WDM).

I. INTRODUCTION

The Next Generation Passive Optical Networks (NG-PON) needs to provide variety of broadband services such as, high speed internet, Web, cloud data centers, HD video conferencing, online gaming, mobile back haul and etc. [1]. The services necessitate for higher bandwidth. To address this bandwidth demand the effort is to increase the bit rate, the number of customers, and at the same time longer the reach of the optical access networks. Wavelength Division Multiplexing-PON (WDM-PON) appears to be an intriguing option of NG-PON [2], as it can serve point-to-point connectivity from Optical Line Terminal (OLT) to Optical Network Unit (ONU), guarantied bandwidth, higher security, and longer transmission distance. Moreover, from perspective of network operators reducing deployment cost as well as energy efficiency are significant factors. Therefore, they [3] plan to decrease the number of central office per service areas while increasing the distance to the customers. In order to address the aforementioned challenges, the PONs have gone through various configurations with continuously increasing the optical power budgets. The commercial interest is to continue the enhancement of optical power budget [3].

In this paper we present optical power budget extension techniques for 1 Tb/s WDM/OTDM-OFDM-PONs. We demonstrate our simulations results for 25λ×40 Gb/s/λ, in two different configurations. In the first configuration an EDFA is used before the Remote Node (RN) as a PON extender, however in the second setup where an SOA used, we employ different polarizations for neighboring channels to circumvent the nonlinear effects of SOA on our OFDM symbols. This technique is elaborated in the following sections.

II. 1 Tb/s WDM OFDM POWER BUDGET EXTENSION

Figure 1(a) depicts 1 Tb/s WDM/OTDM-OFDM-PON simulation setup. The OLT consists of 25 transmitters with starting wavelength at 1538.18 nm channel spacing of 100 GHz (ITU grid) in C-band and a multiplexer (Mux). Each OFDM transmitter consists of a basic OFDM transmitter [4], CW laser, Mach-Zehnder Modulator, and a band-pass optical filter to produce Single-Sideband (SSB)-OFDM. There is 40 km of fiber in the feeder line, and a Variable Optical Attenuator (VOA1) to emulate the loss from OLT to RN. In the RN, an EDFA is used to increase the optical power budget for all 25 channels simultaneously. The access line encompasses a VOA for each channel to control the loss of the link and a 10 km fiber. At ONU site, direct detection is used as it is a cost effective solution in comparison to coherent detection. The Figure 1(b) is the configuration for the SOA-based power extension, the transmitter is divided into X and Y polarization. This approach is used to reduce the impacts of nonlinear SOA on the OFDM symbols. Additionally, there is Power Beam Splitter (PBS) at receiver side to eliminate the noise on the unmodulated polarization.

![Figure 1. a) EDFA-based , b) SOA-based power budget extension.](image-url)
In conclusion, we demonstrated our two configurations our simulations for 1Tb/s WDM/OTDM-OFDM-PON downstream scenario. We showed that we can address the bandwidth demand of 1600 customers with 0.625/40 Gb/s/λ guaranteed/peak bit rate. The architecture is a cost effective solution as we used direct detection and only one optical amplifier in RN. This maybe envisioned as an interesting solution for future PONs.

REFERENCES


