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The effect of the seeding power on RSOA-based colorless ONU performance in FTTH-PON

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Abstract— In this paper, the limitations of the RSOA-based colorless ONU in FTTH-PON are investigated and observed. First of all, the architecture of the colorless receiver used is described. Then, the relationship between the input power and the output power of RSOA is explained, while the RSOA is an important element in colorless schemes as a light source. After that, this paper will explain the effects of the relationship between input power and output power of RSOA on the upstream performance. It is clear from the simulation results that the seeding power must be high to saturate the RSOA and to make upstream performance better.

Index Terms— colorless ONU, Fiber to the home, passive optical network, semiconductor optical amplifier.

1 INTRODUCTION

During the last three decades, colorless optical network units (ONU) have been developed and studied. Optical network unit (ONU) does not depend on a particular wavelength in the network. This property gives the network flexibility in operation and maintenance. Besides flexibility, colorless is a cost solution, hence every ONU has the same equipments and mass production is possible. The mass production decreases the cost of the unit which makes it cost effective. There are many studies on colorless schemes to make it more efficient [1] .

In the most common architecture in colorless technique, the OLT sends the downstream wavelength, in the same time sends the upstream wavelength supply to the ONU, which called seeding light. The ONU receives these wavelengths and divides them by WDM to demodulate the downstream data and modulate the upstream data. In the ONU side, there are two stages which the seeding light goes through: (i) amplification and (ii) modulation. Reflective semiconductor optical amplifiers (RSOA) can be the amplifier, which can be considered as the light source of the ONU, and the modulator is electro-absorption modulator (EAM) [2-3].
In this paper, we study the effect of the seeding light power on the upstream performance. The rest of the paper will be organized as follows: The second section in this paper will investigate and report some characteristics of RSOA, while the RSOA is an important element in colorless schemes as a light source. After that, this paper explains the effects of these characteristics of RSOA on the upstream performance

2 COLORLESS FTTH-PON

Usually, RSOA is also used as a modulator. RSOA can transmit up to 2.5 Gbps, This data rate is suitable for 1Gbps channels. However, 10G EPON requires a higher bit rate, which RSOA cannot transmit [1]. Therefore, an external modulator is added to the upstream transmitter, to fulfill the requirements of IEEE802.3av standard. Figure 1. shows the Tree topology of EPON.

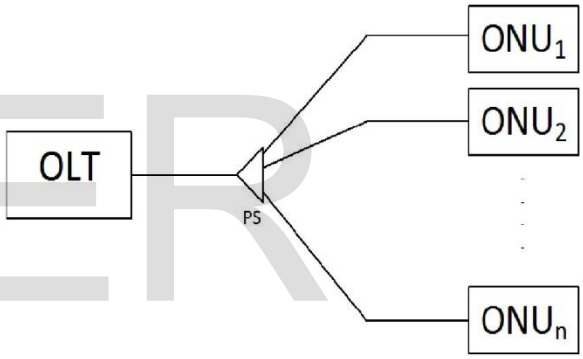

Figure 1. EPON Tree topology

When this technique is used in power-splitter-based-FTTH-PON, the upstream will be very dependent on the downstream situation, because the seeding light will be divided in term of power, which makes the received seeding light to the RSOA too low. In this case, RSOA will not be saturated. This will cause two main issues; the first is the increasing of the noise power generated by the RSOA, which makes the OSNR very low.

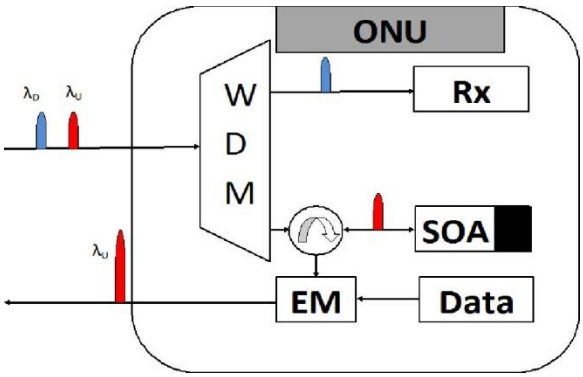

Figure 2 Colorless ONU

The second issue is the dependency of the output power of the RSOA on the downstream status. The goal of this work is to these issues and study FTTH-PON performance (BER) when

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colorless ONU is implemented.

3 Simulation Results and Discussion

The effect of the input power on the performance of the RSOA is explained in this section. Figure 3 shows the relationship between input power and output power of RSOA when the bias current is 130mA, 100mA and 80mA. The RSOA becomes saturated when the input power is more than -15dBm. Less than -15dBm input power, the relationship between the input power and the output power behaves almost as a linear relationship.

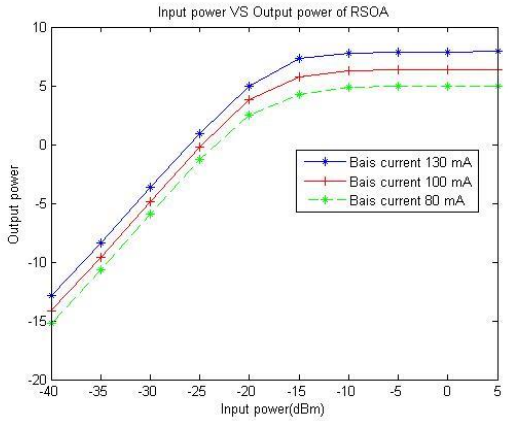

Figure 3 relationship between input power and output power of RSOA

In RSOA-based colorless ONU, upstream performance is dependent on the seeding power comes from OLT.

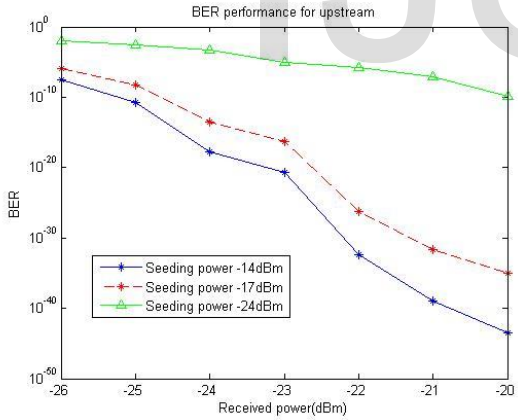

Figure 4. The effect of the seeding power on upstream performance.

Figure 4. shows the effect of the seeding power on the BER performance for the upstream data. It is clear that the performance is better when the seeding power in higher. That is a result of the saturation of the RSOA. When the RSOA become saturated, the amplified spontaneous emitting power (ASE) will decrease [4]. This improves the optical signal to noise ratio (OSNR). In case of low seeding power, the ASE increases and the signal power is not in a sufficient level, which makes the OSNR very low and reduce the performance of the upstream.

To guarantee good performance, the seeding light power should be high enough to saturate the RSOA. In case of increasing splitting ratio to increase customers, the seeding power sent from OLT must be pre-amplified.

4 Conclusion

As a conclusion, the limitations of the RSOA-based colorless ONU in FTTH-PON are caused by the effect of the low seeding light power. When the seeding power is low, the RSOA will not be saturated. In this case, ASE power will increase and makes the OSNR worse. To guarantee good performance, the seeding light power should be high enough to saturate the RSOA.

References

[1]. Chang-Hee, Lee, "Colorless optical sources for WDM-PON." *In Lasers & Electro Optics & The Pacific Rim Conference on Lasers and Electro-Optics, 2009*. CLEO/PACIFIC RIM '09, pp: 1-2, 2009.

[2]. Sengda Tu, Ho-Chun Lin, Ching-Sheu Wang, Hsin-Han Liao, Hai-Lin Wang, Gong-Cheng Lin, Ting-Chung Chang, Jy-Wang Liaw, Shian-Ming Chen . "The pilot trial of colorless WDM PON system in Taiwan". *In OptoeElectronics and Communications Conference (OECC)*, 16th, pp: 13-14, 2011.

[3]. Iwatsuki, K. and Kani, J. I,. "Applications and Technical Issues of Wavelength-Division Multiplexing Passive Optical Networks With Colorless Optical Network Units [Invited]." Journal of Optical Communications and Networking, IEEE/OSA 1(4): C17-C24, 2009

[4]. Ziad A. El-Sahn, Walid Mathlouthi, Habib Fathallah, Sophie LaRochelle, "Dense SS-WDM Over Legacy PONs: Smooth Upgrade of Existing FTTH Networks" *Journal of lightwave technology, vol*. 28, No. 10, MAY 15, 2010