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Cost-efficient Colorless WDM PON Based on RSOA for High Capacity

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***Abstract*-This paper investigated the design and implementation of a Wavelength division multiplexing(WDM) passive optical network(PON) system based on Reflective semiconductor optical amplifier (RSOA) using periodicity of arrayed wave guide grating(AWG).This paper also proposes an Erbium doped fiber amplifier (EDFA) which is optimized in the C and L band range. The system is defined for a range of 88km with 10Gbps data rate and supporting a maximum of 128 users. The need of laser source at subscriber end is eliminated by replacing it with RSOA due to which system becomes cost efficient.**

***Index terms*- Fiber-to-the-Home(FTTH), Passive optical network(PON), Reflective semiconductor optical amplifier(RSOA), Wavelength division multiplexing(WDM).**

I. INTRODUCTION

To meet the demand of large bandwidth for sending more data at high speed an optical fiber is needed[1].A single optical fiber serves multiple customers at low cost using passive optical network(PON) technology[2]. Bandwidth is distributed in entire architecture using Fiber-to-the-home(FTTH) technology as signals are sent over optical fiber from Optical line terminal(OLT) to home[1].Several schemes have been proposed for FTTH architectures such as AON,PON etc. PON as a FTTH solution is attractive scheme due to use of passive components[3]. A passive optical network reduces the operation and maintenance cost[4]as they do not require any external power. Also they eliminate the use of repeaters and optical amplifiers at source. Thus, reducing the initial cost of the system[5].

In a PON system, there is an Optical line terminal(OLT),a remote node(RN), and optical network units(ONUs)[6]. In WDM technology multiple signals of different wavelengths are multiplexed on single optical fiber.As WDM-PON assigns individual signals a different wavelength[7].So, bandwidth is used effectively [4,8].

Also, WDM technology offer high security[9] than TDM.A WDM PON system was developed[7]which provide high bandwidth capacity. The range of this system is increased by using optical amplifier. EDFA is used for this purpose because an EDFA has a comparatively wide wavelength range of amplification making it useful as transmission amplifier in wavelength division multiplexing systems[10].But the major disadvantage of WDM PON is that it uses a laser source at ONU which is replaced using RSOA(reflective semiconductor optical amplifier) at subscriber end and makes the ONU's colorless and cost is reduced.In this paper, a WDM PON configuration with 88 km fiber link is proposed and single 10Gb/s wavelength channel is assumed to be shared between 8 users.

This paper is organized as follows: section 2 describes the simulation setup. Results and discussions are explained in section 3 and at the end section 4 summarizes the work.

II. SIMULATION SETUP

Figure 1 shows the simulation architecture of proposed system. In this architecture NRZ(non return to zero) modulation is used. This architecture is composed of single mode fiber (SMF) of 35km, dispersion compensated fiber(DCF) of 13km,array waveguide grating (AWG), 1×8 splitter and reflective semiconductor optical amplifier(RSOA).The DCF is used in mid span as it compensates the dispersion. The optimised amplifier used EDFA has length of2.2m with forward and backward pump power of 10mW.The array waveguide grating(AWG) isimportant component as it multiplex a large number of wavelengths into a single optical fiber, thereby increasing the transmission capacity of optical network.In the system setup 128 users can access data signal up to 88 kms.

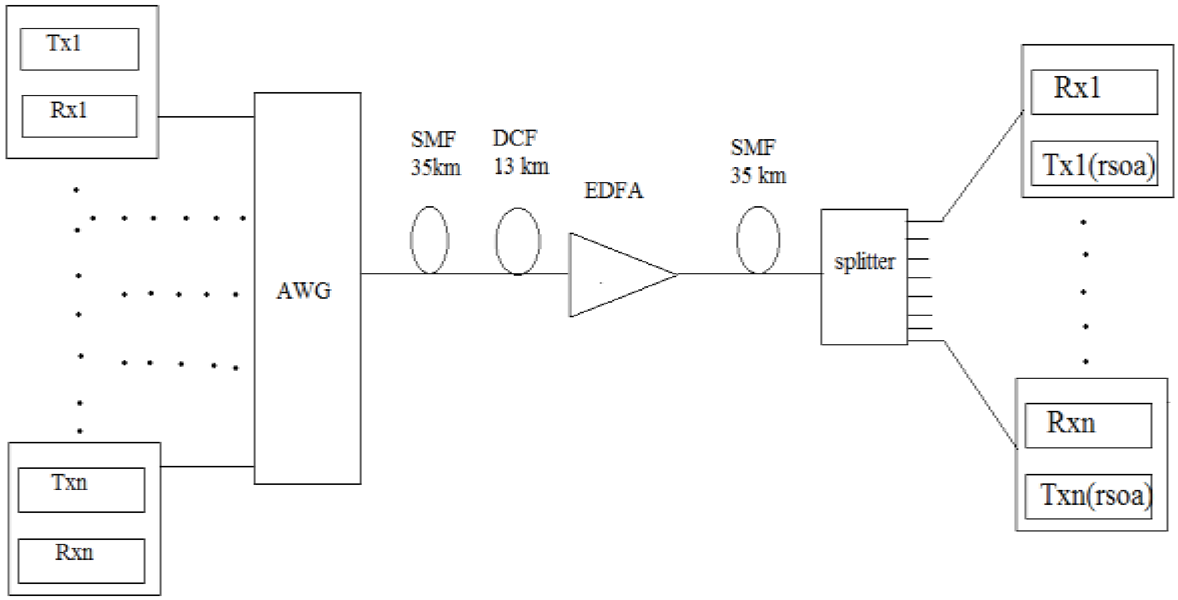

Figure 1: RSOA based WDM PON Architecture

At Optical line terminal (OLT), 16 channels of 10Gb/s data rate with 100GHz channel spacing are multiplexed with external laser sources into AWG. Then, into DCF followed by SMF of 35 km[6]. Which are demultiplexed with an AWG at remote node (RN) and each channel is split with 1×8 splitter and then, propagates through a SMF of 5kms with some delay to the user end during downstream transmission. In upstream transmission, an upstream signal is amplified and simultaneously modulated by RSOA at ONU.

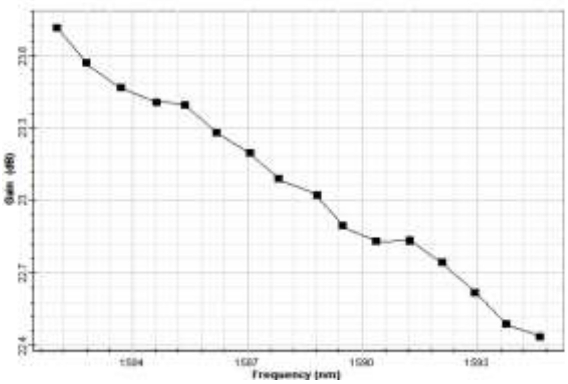

Figure 2(a): Downstream Gain curve

III. RESULTS AND DISCUSSION

To investigate performance of our proposed architecture we measure measure Gain, Noise figure and Bit error rate (BER) values for both upstream and downstream signals.BER values are calculated at back-to-back and after 88 km transmission using Erbium doped fibre amplifier(EDFA).

Figure 2(a) and 2(b) represents gain curve for downstream and upstream transmission. Noise figure curve for downstream and upstream transmission are represented in figure 3(a) and 3(b).

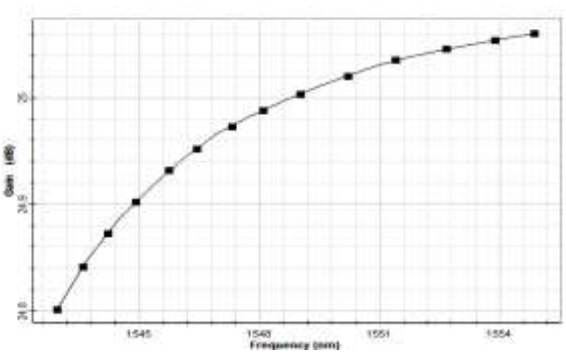

Figure 2(b): Upstream gain curve

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Gain values are found to be between 22.4 dB to 23.8 dB for downstream transmission and 24.8 to 25.1 dB for upstream transmission.

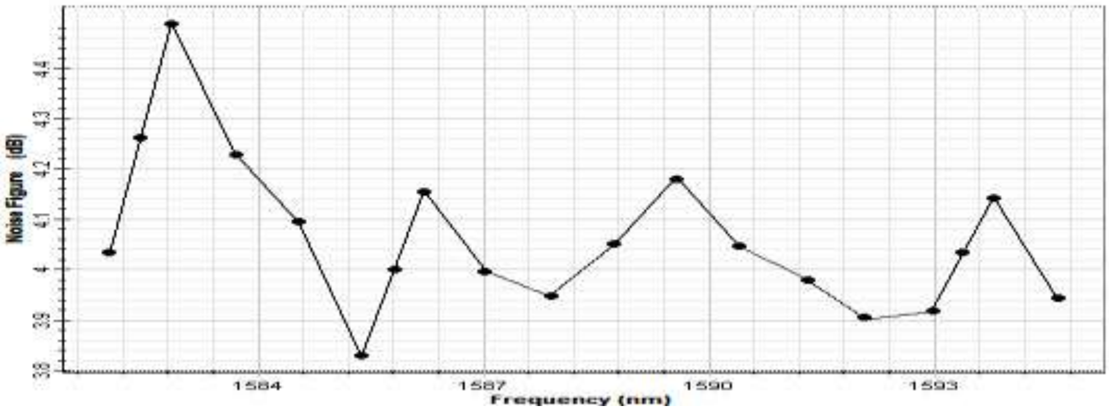

Figure 3(a):Downstream noise figure curve

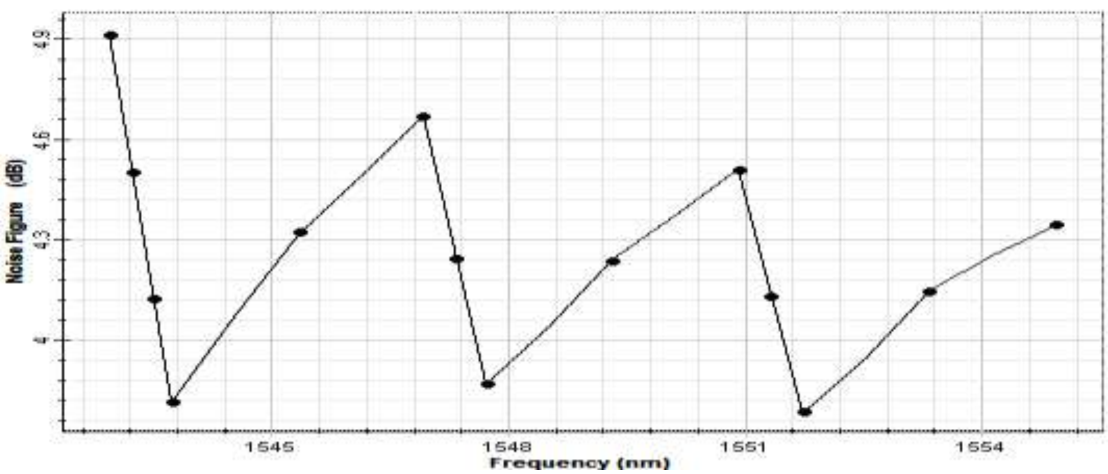

Figure3(b):Upstream noise figure curve

Figure 4(a) represents BER versus power curve for downstream transmission and Figure 4(b) represents BER versus power curve for upstream transmission. We have calculated the BER values using receiver sensitivity. Results are better with back-to-back fiber and BER values of proposed architecture are found to be less than 10^{-9}.

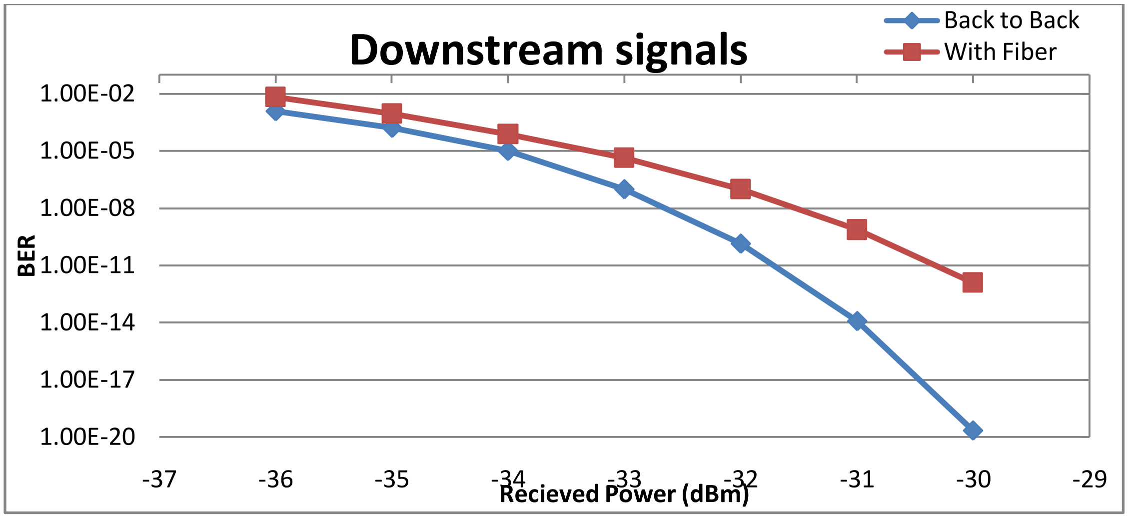

Figure 4(a): BER versus received Power curve for downstream transmission

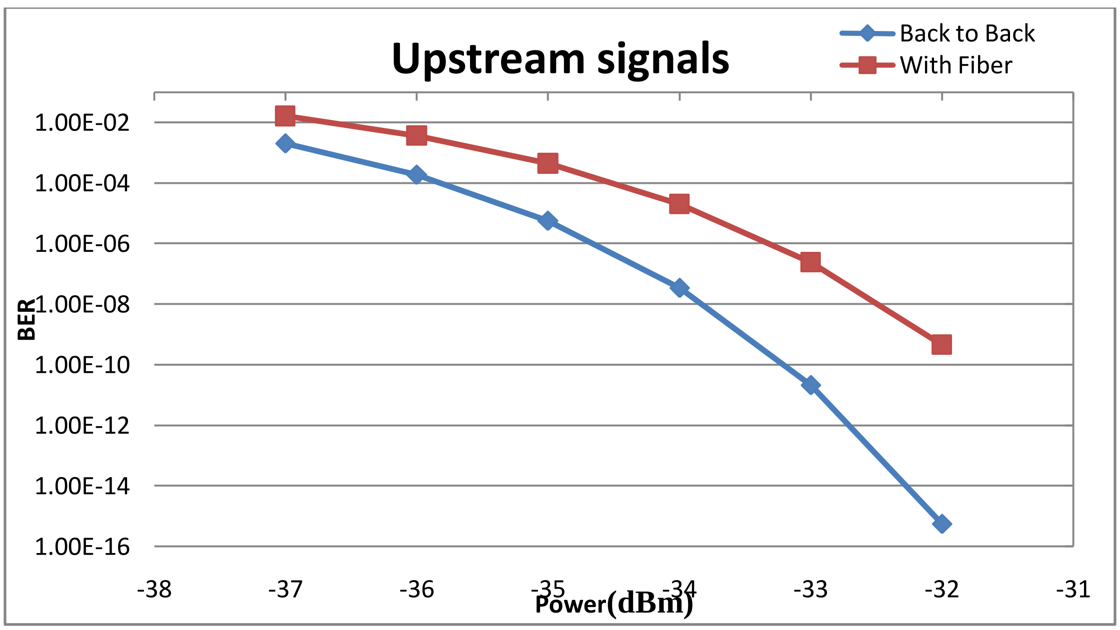

Figure 4(b): BER versus received Power curve for upstream transmission

IV. CONCLUSION

We have successfully proposed a RSOA based WDM PON by using colorless ONU's. Our proposed amplifier has successfully increased the range of our WDM PON by providing a gain of ~23.7dB and a noise figure of less than 4.4dB. Also our colorless WDM PON hassuccessfully provide a BER of less than 10^{-9} for receiver sensitivity of -31dB for downstream transmission and BER of less than $10^{-9}$for receiver sensitivity of -32dB for upstream transmission.This architecture not only increases the number of subscribers and provide security due to WDM but also reduces the cost by using RSOA making ONU's colorless.There is much scope for further work to increase the number of users to achieve longer distance and to improve component performance, particularly source output power and improved BER values.

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