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Performance Analysis of BPON on Alcatel and Corning Commercial Fibers

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ABSTRACT: In this paper the performance of BPON is analyzed using two commercial fibers Alcatel-Lucent SMF-28(G.652) and Corning SMF-28(G.652).It is evaluated for varying lengths of bidirectional optical fiber(5 to 40km) and Pin (0.5 to -7dBm). In this the transmitted power is varied and the output is seen by using various compensation techniques such as Pre-,Post- and Symm-.

KEYWORDS: BPON, Power,Pre-,Post-,Symm-,

I. INTRODUCTION

BPON (Broadband PON) is the most popular current Passive Optical Network(PON) application in the beginning. ATM work as the protocol of BPON. ATM is widely used for telephone networks in telephone exchange and the methods of transporting all data types (voice, Internet, video, etc.) are well known. BPON digital signals operate at 155, 622 and 1244 Mb/s ATM data rates. The coverage range of BPON is less than 20 kms. Downstream digital signals from the CO through the splitter to the home are sent at 1490 nm data rate. This signal carries both voice and data to the home. Video on the first PON systems are used the same technology as CATV, an analog modulated signal, broadcast the signal separately using a 1550 nm laser which may require a fiber amplifier to provide enough signal strength to overcome the loss of the optical splitter. Video service of PON could be upgraded to digital form of signal using IPTV, negating the need for the separate wavelength for video [1]. Upstream digital signals for voice and data are sent back to the CO from the home using an inexpensive 1310 nm laser.
Dispersion is a major problem in PON. It hampers the performance of the system as it causes the intersymbol interference. In common language dispersion is distributing things or people over a wide area. In optics it is the phenomenon by which phase velocity depends on frequency. Example of this is dispersive action of a prism. We find in a prism the light gets dispersed into different colors. Several methods have been proposed to overcome the impairments caused by chromatic dispersion including fiber Bragg grating [8], optical phase conjugation [9,10], dispersion compensating devices [11,12]. The use of power and dispersion compensated fiber (DCF) is an important method to upgrade the already installed links. The high value of negative dispersion is used to compensate for positive dispersion over large lengths of ordinary fiber. Kaler et al. [16] investigated the pre-, post- and symmetrical dispersion compensation methods for 10 Gbps non-return to zero (NRZ) links using standard and dispersion compensated fibers. The EDFA is used as a power compensator. The reported results of three compensation methods are compared and it is found that the symmetrical compensation method is superior to pre- and post-compensation methods. The achieved maximum transmission distance for post-compensation is up to 288 km. Randhawa et al. [12] compared the different dispersion mapping techniques like pre-, post- and hybrid-compensation in the presence of fiber nonlinearities in 10 and 40 Gbps carrier-suppressed return to zero (CSRZ) systems and it is observed that hybrid-compensation provide better results for high speed optical system. Unfortunately, these models have very low capacity and cannot be used for high speed optical communication because it is limited to single channel with 10 Gbps speed. Tiwari et al. [17] achieved dispersion and power compensation in parallel by using pumped dispersion compensating fiber means Raman amplification has been done by using counter pumped DCF(PDCF). f the paper is structured as follows. Section 2 is described the optical simulation setup. In Section 3, comparison results have been reported for the different commercial fibers used and finally in Section 4, conclusions are made.

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II. SIMULATION SETUP

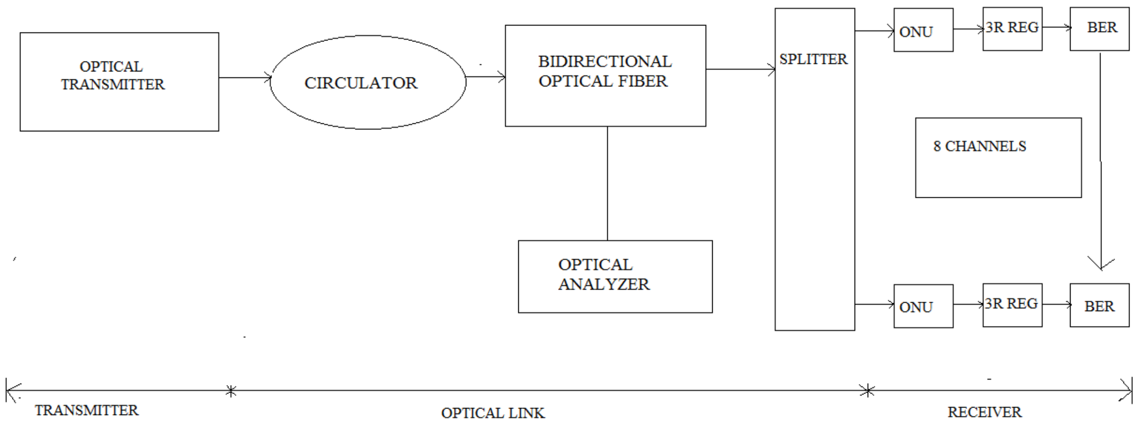

Fig 1.Simulation setup for power compensation.

To investigate the performance of the three different power and dispersion compensation techniques, the structure is shown in Fig. 1. Three fiber links are provided with the pre-, post- and hybrid-compensations are modeled as shown in Fig. 2. In pre-compensation scheme, the DCF is placed before the standard single mode fiber (SSMF) to compensate the positive dispersion in SSMF. In post-compensation, the DCF is placed after the SSMF to compensate the positive dispersion in SSMF. In symmetrical-compensation, both the schemes (pre-, post-compensation) are used i.e. DCF is placed before as well as after the SSMF to achieve the dispersion. Dispersion compensated fibers are specially designed fibers with negative dispersion. The high value of negative dispersion is used to compensate for positive dispersion over large lengths of ordinary fiber.Spans made of single mode fibers and dispersion compensated fibers are good for long distance transmission as their high local dispersion is known to reduce the phase matching.

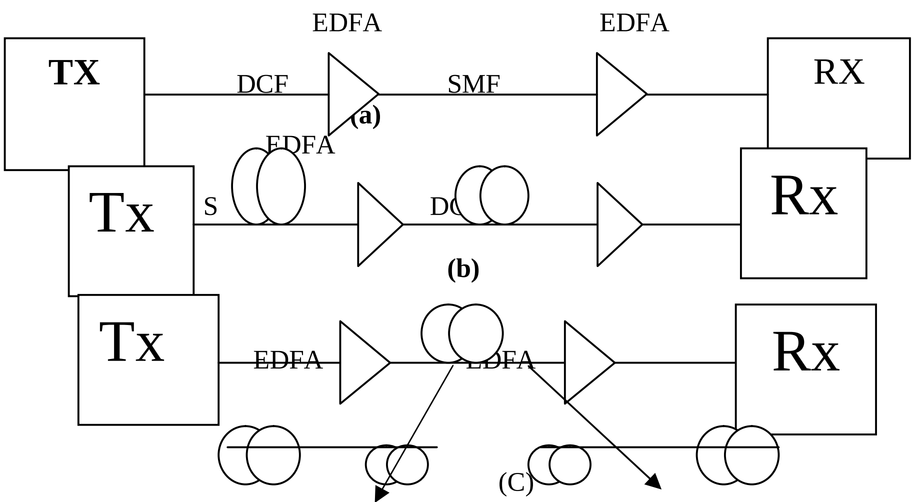

Fig 2 The compensation schemes (a)pre-,(b) post- (c) symm-.

. It works at 1550nm wavelength and at a power of -5dBm. It works at NRZ format and at 2.5Gb/s. It generates the desired transmission data format and converts it into electrical signal. Then the signal goes to the circulator. Circulators

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can be used to achieve bi-directional transmission over a single fiber. Because of their high isolation of the input and reflected optical powers and their low insertion loss they are widely used. 3 Bidirectional optical fiber as the name says this fiber transmits the signal as well as receives the signal ie it works in two directions. The fiber optic splitter is one of the most important passive devices in the optical fiber link. It is an optical fiber tandem device with many input and output terminals. It splits the signal to 1:8 or 1:32 users, in this we have used 8 channels. The output optical signal is detected at the receiver by ONU and is passed through BER and the output is observed on an electroscope. Q factor is measured from the electroscope.The two fibers taken here are Alcatel-Lucent SMF-28(G.652) and Corning SMF-28(G.65). The specifications of fiber used are:

Table 1 Specifications of Alcatel and Corning

Parameters	**Alcatel SMF-28**	**Corning SMF-28**
Wavelength used	1550nm	1550nm
Attenuation	0.24dB/km	0.18dB/km
Dispersion	16.75ps/nm/km	18ps/nm/km
Dispersion slope	0.92ps/nm^2/k	0.92ps/nm^2/k
Effective area	62.99µm^2	67µm^2

3. Results And Discussion

Performance of two fibers Corning and Alcatel-Lucent with Pin 0.5 to -7dB is analyzed in this section.

The different cases are calculated using a formula

$$L2=L1\times \frac{D1}{D2} \qquad (1)$$

Where L2 is length of DCF

L1 is length of SMF

D1 is dispersion of fiber1

D2 is dispersion of fiber2

Table 2. Different cases for variation of lengths for DCF and SMF determined from Eq. (1).

CASE	**DCF (km)**	**SMF (km)**
1	11	55
2	12	60
3	13	65
4	14	70
5	15	75
6	16	80
7	17	85
8	18	90
9	19	95

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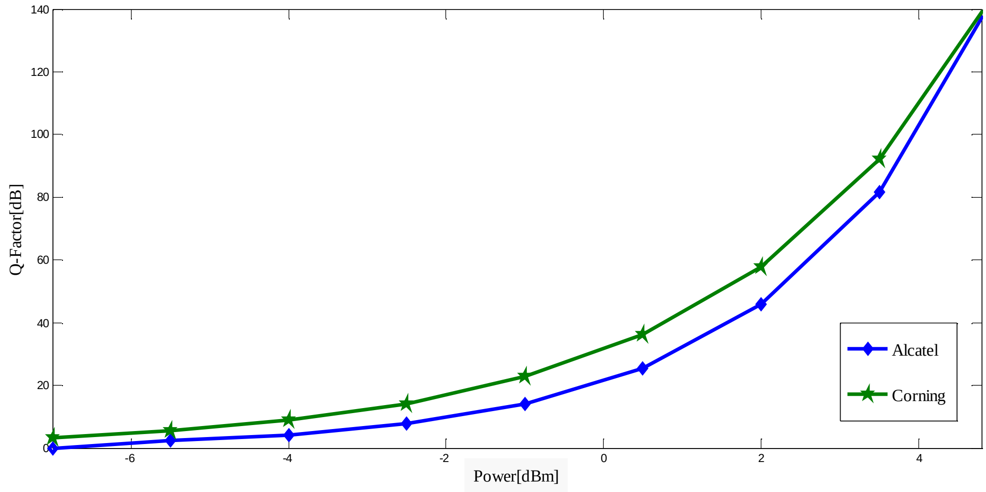
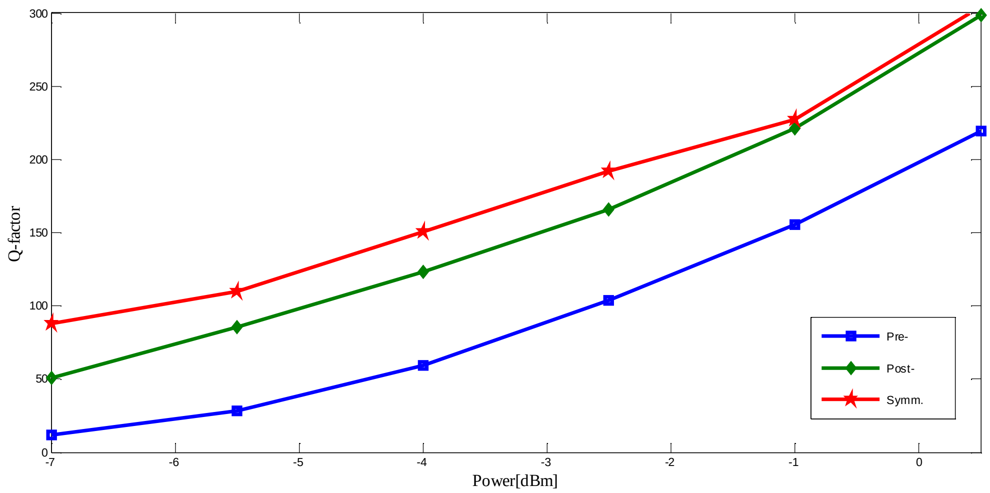


Fig 2 Alcatel verses q factor when no compensation technique is applied

It is found that when no compensation technique is applied as in the above graph the quality factor obtained is much less so it can be said that with compensation techniques the range of quality factor increased



(a)

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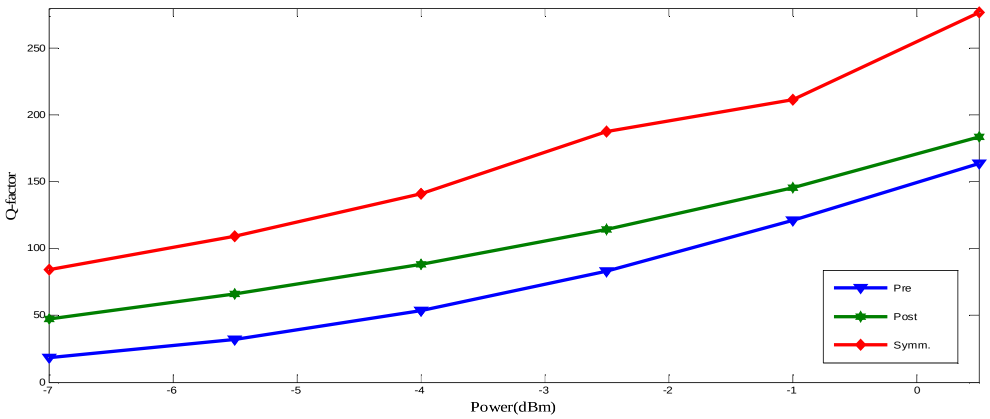


(b)

Fig 4 Quality factor and power for the three compensation techniques (a) Corning (b) Alcatel

The results have been taken on 1532.6 nm of wavelength for each configuration. The total length of the communication link is changed according to cases as shown in Table 2. In this setup each case with two spans is considered. The graph between quality of the signal and power is shown in Fig. 4. It is observed that quality of the signal increases with increase in the power .For post-compensation, the quality factor is better indicating best performance. Increases the power further will bring the quality factor lower .There is further scope for increase in power for these configurations. But for pre compensation, the situation is drastic. Also between corning and alcatel it is found that the quality factor for alcatel is much more even for same values of power**.** The reason due to which the power first rises and then falls is non linearities which occur in the transmitter.

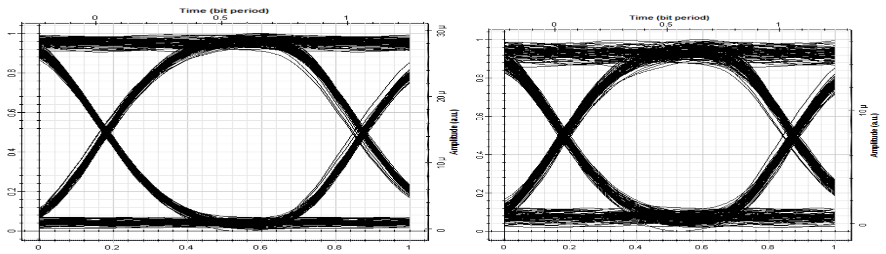
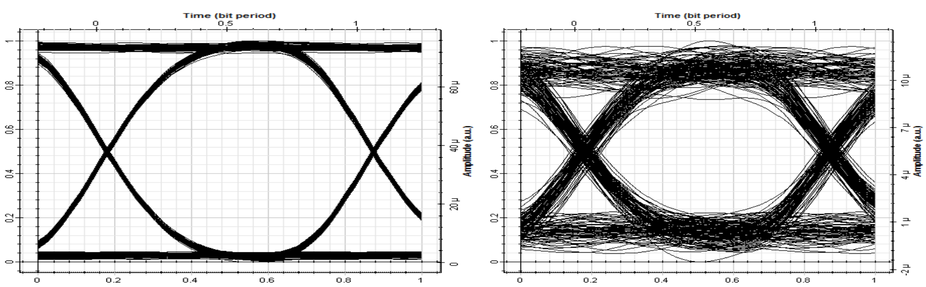


Figure 4.3 Received eye diagrams with NRZ modulation format for power in Pre compensation corning fiber (a) -2.5dBm and (b) -7dBm.



(a) (b)

Figure 4.4 Received eye diagrams with NRZ modulation format for power in post corning fiber (a) -4dBm and (b) -7dBm.

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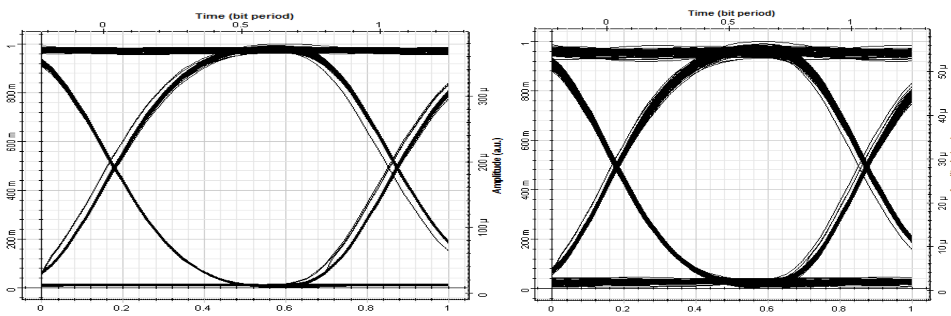

(a) (b)

Figure 4.5 Received eye diagrams at a bit rate of 2.5 Gb/s with NRZ modulation format for power in Alcatel symm-.fiber (a) -4dBm and (b) -7dBm

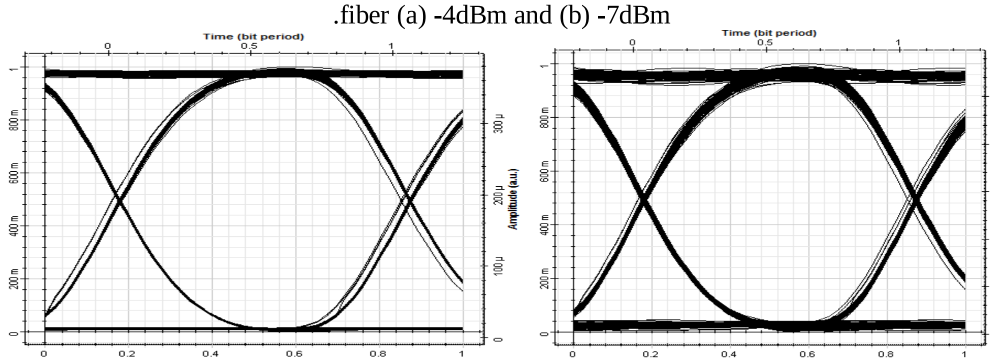

Figure 4.5 Received eye diagrams at a bit rate of 2.5Gb/s with NRZ modulation format for power in Alcatel post fiber (a) -4dBm and (b) -7dBm.

The closure for the post- and symmetrical compensation method is better than pre-compensation method, with pre-compensation method the deterioration is very large.

IV. CONCLUSION

The paper illustrate the performance comparison of pre-, post-, symmetrical dispersion and power compensation From the simulation results, it is found that both post-, and symmetrical compensation methods provide better results for change in input power and post-compensation method is the best alternative among others.

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