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Performance Improvement of Fiber Bragg Grating As Dispersion Compensator on the Receiver Characteristics

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ABSTRACT: Among the promising advancements towards cost effective long-haul transmission is the use of Fiber Bragg Gratings (FBGs) as the dispersion compensating module(DCM).However, the compensation of dispersion method of Fiber Bragg Grating (FBG) can boost significantly the system performance. In this paper we analysed the Performance capacity improvement system. The system design wasperformed using Opti System 7.0 software, which 10 Gb/s Non Return to Zero (NRZ) signal was launched into single Mode Fiber and Fiber Bragg Grating was used as dispersion compensator. Therefore, the system performances are calculated based on the Bit Error Rate (BER) and Q-factors of Positive Intrinsic Negative (PIN) as receiver. The Eye diagram analyzer showed acceptable improvement due to use of Fiber Bragg Grating as a compensator of dispersion. Therefore, the system performances were investigated by comparing the Bit Error Rate (BER) and Q-factors of optical receiver before compensation and after compensation.

KEYWORDS: Fiber Bragg Grating (FBG), dispersion compensation, PIN receiver, EYEDIAGRAM, Q-factor, bit error rate, Optisystem7

I. INTRODUCTION

The new advance communication systems these days, requires a large bandwidth to send the data at high speed to some other destination. The long haul optical communication systems designs are equipped with amplifier and fiber Bragg Grating. The use of power and dispersion compensated fiber (DCF) is an important method to upgrade the already installed links of single mode fiber..However the transmission of light over Dispersion compensating fiber component is limited due to input power to avoid nonlinear impairments that create a high insertion loss over the link.The long haul optical communication systems designs are equipped with amplifier and fiber Bragg Grating. Gain factor is obtained from the fiber Bragg grating provides the fiber dispersion for long distance transmission.

Fibers Bragg Grating (FBG) has negligible nonlinearity, low insertion loss and small size sits can possibly impact the system performance and increases the network capacity as a dispersion compensator for long distance fiber network. Fiber Bragg Grating can easily impact the system performance especially when the grating is chirped [1].In this paper the performance is analyzed by using fiber Bragg grating (FBG) over 50 Km fiber link leading to error free transmission of 10 G/bit NRZ signal. In this study, the simulation of the optical system in optical fiber has been discussed by analyzing the effect ofthe components by using different parameters setting. The value of parameters has been investigated such as Q-Factor and BER [2].

II. PROPOSED SYSTEM

The model illustrates how to compensate fiber dispersion using the realistic fiber grating component.The design model explores dispersion compensating module (DCM) discussing the Fiber Bragg Gratings (FBGs) for the dispersion compensation. A 10 Gb/s Non Return To Zero(NRZ)signal is launched onto a 50 km long standardsingle mode fiber and the power splitter was used tosplit the signal into two channelsas shown in the Fig.2.[3].In transmitter side, each single channel consists of Psuedo Random Bit Sequence (PRBS) generator followed by NRZ pulse generator. Initially

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CW laser having power 0dBm is used. The laser at each channel having different frequenciesranging from 193.1 to 193.8 THz followed by Mach Zehnder modulator.[4].Mach Zehnder Modulator to modulate theinformation pulse with the CW laser source output.Then they transmit over the fiber, the optical fiber we have taken issingle mode (SMF) because it has less distortion occur followed by an optical amplifier with gain of 40 dB. The output of amplifier is passing through a 1:2 splitter . It will divide the incoming optical signal in to two parts ,one is directly connected to PIN photodiode and second part is through fiber Bragg grating.EDFA is the optical amplifier which is the most usedamplifier because of its high capacity and low pumppower[9].

In systems of fiber optic communications, normally is made an evaluation of quality through the BER (Bit Error Rate). This parameter is the ratio between the number of bits with errors and the number of the total bits transmitted during a space of time studied [10].

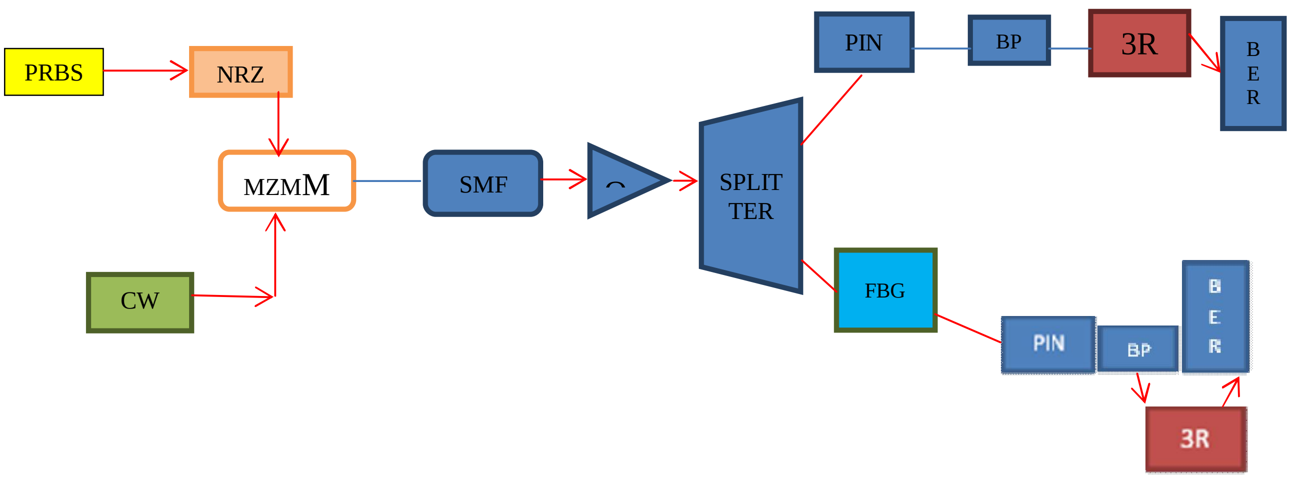

Figure 1 :. Block diagram of our proposed system with FBG.

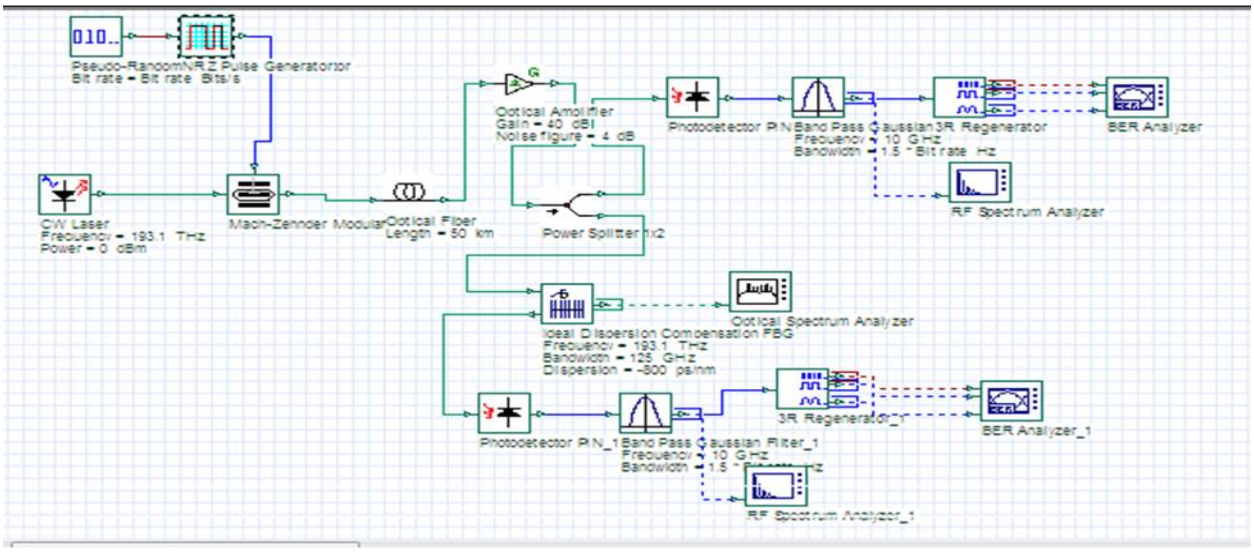

Figure 2. Simulation schematic of transmitter & receiver model

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III. SIMULATION RESULTS

The simulation and optimization of the design is done by Optisystem 7.0 simulation software .The Figure 2 demonstratedthe performance improvement of Fiber Brag Grating when dispersion was compensated atthe Optical receivers. Therefore, at the receivers the results output was analyzed the Q-factor andBit Error Rate of photo detectorwith and without using Fiber Bragg Grating device [2].Figure 3(a) & 3(b) shows the results output based on the eye diagram analyzer of Electrical signal beforeFBG and after using FBG as dispersion compensator.

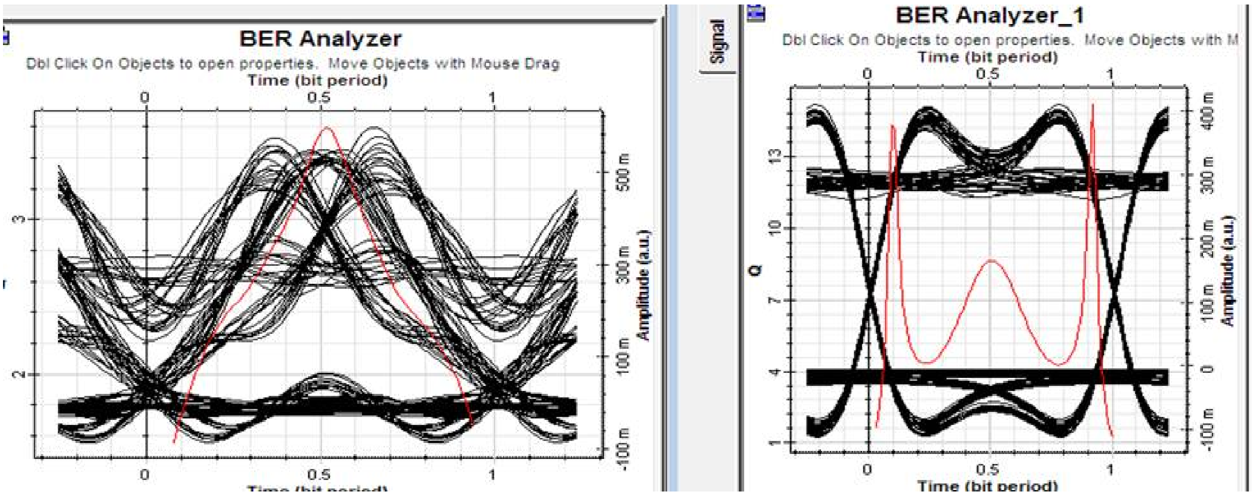

Figure3. Pin receiver output a] before FBG b] after FBG over 50 km NRZ at amplifier gain=40dB

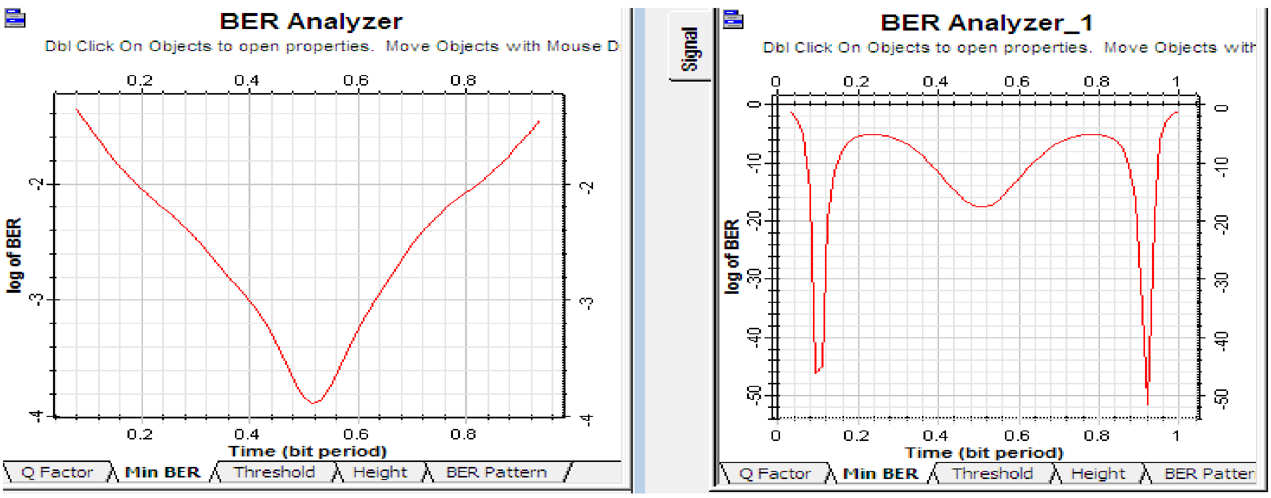

Figure4. MIN BER output a] before FBG b] after FBG at amplifier gain=40dB

The results of Positive Intrinsic Negative (PIN) as the receivers are shown in Table 1 at different amplifier gain. when PIN is used as receiver, the eye diagram has improves by 5 times as illustrated in Figure 3(a) and Figure 3(b) when the results was compared with and without FBG. When amplifier gain increases, min BER value decreases simultaneously as shown in figure 4 (a) & 4(b).

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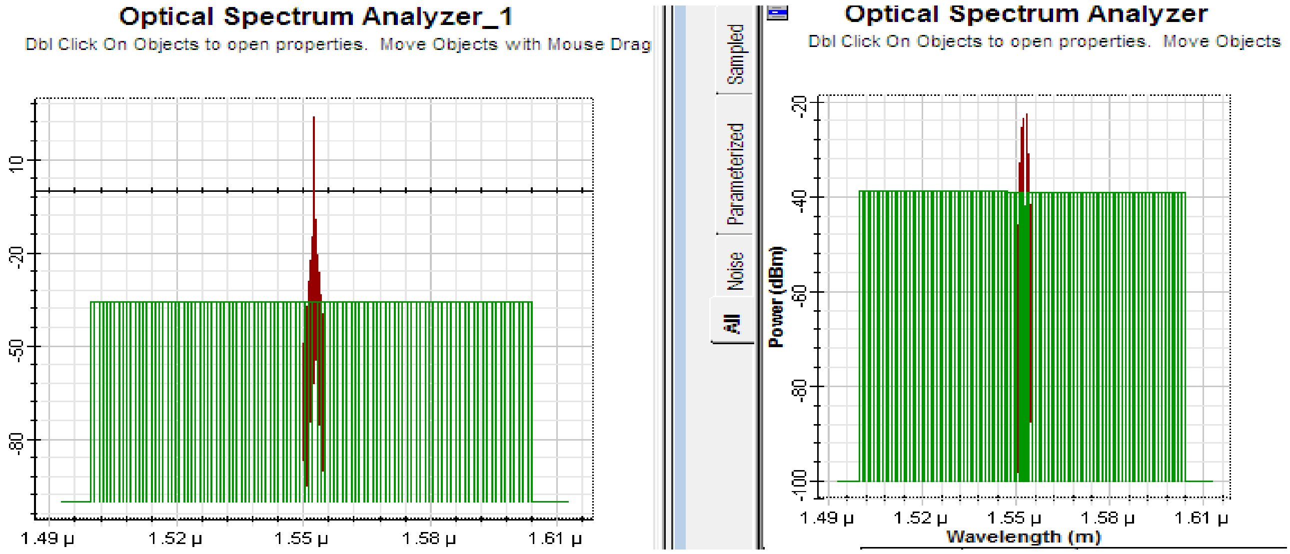

Figure 5.Output of optical spectrum analyzer a] before FBG b] after FBG at amplifier gain=40 dB

Table 1 : output readings of PIN Photodiodes are tabulated by varying amplifier gain(dB)

GAIN(dB)		WITHOUT FBG	WITH FBG
10	Q-FACTOR	3.59128	15.5337
	BER	0.000133324	1.02E-54
20	Q-FACTOR	3.59734	15.2912
	BER	0.000130591	4.34E-53
30	Q-FACTOR	3.59862	15.2017
	BER	0.000129993	1.71E-52
40	Q-FACTOR	3.59904	15.1802
	BER	0.000129787	2.37E-52

IV. Conclusion and Future Work

The system performance is evaluated for a 10 Gb/s system using a ideal grating component for the in line dispersion Compensation. The Q-factor of the system has been increased by 5 times of PIN photodiode, before and after using fiber bragg grating at the receiver .Minimum BER reduced significantly by using Fiber Bragg Grating at different gain, which is shown in Table 1.However, this analysis can be extended byusing Avalanche Photodiode (APD)at the receiver.

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