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Optimization of Long Haul Optical Communication Dispersion Compensation System Based on FBG

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***Abstract*— This paper presents the chromatic dispersion compensation scheme in long haul communication consisting of the single mode fiber with the help of the FBG (fiber Bragg Grating). During the entire optimization process the major concern are provided to the vital parameter of the FBG in which the Duty cycle, the Input power, the Modulation coding, the band width of the of the FBG are deeply considered. By improving the parameter to the extent and incorporating them into the optimization process the output response improved tremendously. The output response is well elaborated with the help of the minimum BER, Q factor and the various plotting process which practically insists the improvement in the output.**

Keywords: Dispersion compensation, FBG, Nonlinear effects, Q factor

I. Introduction

This document is In this scientific era optical fiber is considered to be the backbone of the modern communication system. Recently more and more works in this field are in progress in order to Increase the bit rate, along with the transmission distance and the huge channel capacity. These all things webbed the path of the new problem like the non linear effect, chromatic dispersion, and the fiber losses [1,2]. EDFA provides the solution of the problem to the uttermost level by amplifying the signal and decreasing the fiber losses but, the problem of the chromatic dispersion remains untouched [1]. In order to solve the problem of the chromatic dispersion there are several dispersion compensation technique available but the most appropriate and the recent technique is the dispersion compensation fiber (DCF) and the dispersion compensation Fiber Bragg Grating (FBG). FBG have its own merits over the other dispersion compensation technique specially the features of the compact and polarization-insensitive, cost efficiency are the advantages over the other [3, 4]. Our proposed model is being simulated with the help of the FBG. Different parameters are shown here after the calculation the eye diagram demonstrates the signal quality at the output. Various plotting with the various parameters like Q factor, minimum BER and so on are also elaborated. Comparison result between the RZ & NRZ modulation coding are described.

II. Experimental Set-up

Figure 1 shows the conceptual scheme of an experimental setup for a single mode fiber using FBG as a dispersion compensator. For the modulation of the input signal RZ/NRZ modulation schemes are employed. After passing the signal from the fiber the amplification is done by the EDFA. Received signals are very much dispersed so the signal is allowed to enter into the FBG which behaves as a compensator of the dispersed signal. And allowed to circulate into the loop for the higher distance passage. APD photo detector is use for converting the optical signal into the electrical signal.BER analyser is proposed at the final stage after passing through the Bessel filter. The complete simulation set of the proposed model is demonstrated below with the tabulated value of used parameters:

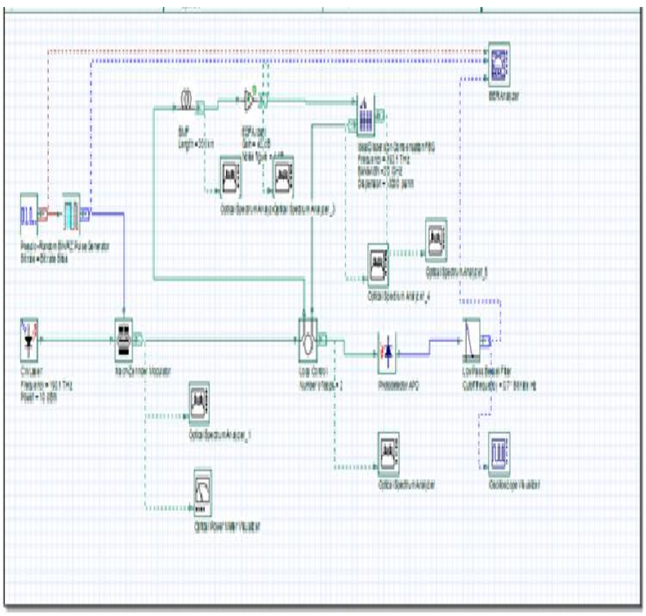

Fig 1 Proposed Simulation Model

III. Results And Discussion

The setup shown in the modulation is simulated with the help of the two different modulation coding technique so called RZ / NRZ technique. Different parameters are described in the table. The input power of the CW laser which is used as a source is set to -2, 0 and +2 distinct values. The minimum distance between the practical use of the two repeater is increased with the use of the FBG in the channel whose band width is fixed to 100GHz. By default the duty cycle of the of RZ modulation coding is set to 0.5. The performance of the system for the distinct modulation format is shown below:

TABLE 1
Parameters used in Proposed Simulation Model at 1550 nm

PARAMETRES	VALUE
Dispersion parameter of SMF (*ps / nm/ km*)	16.75
Dispersion slope of SMF (*ps / nm²/ km*)	0.075
Attenuation coefficient of SMF (*dB/ km*)	0.2
Effective core area of SMF (μm^2)	50
Nonlinear index-coefficient of SMF (nm^2 /W)	2.6×10^{-20}
Bit rate (*Gbit/s*)	10
Total distance of transmission (*km*)	2500

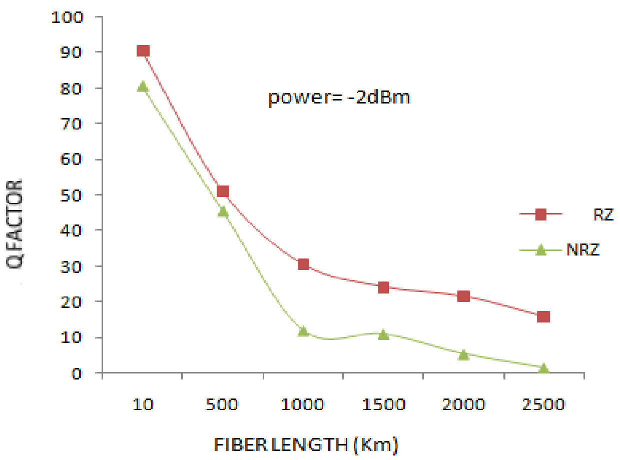

Fig 2 Q factor v/s fiber length (power= -2dBm)

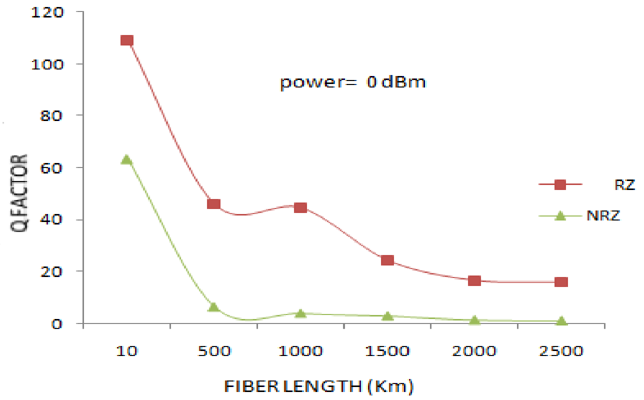

Fig 3 Q factor v/s fiber length (power=0dBm)

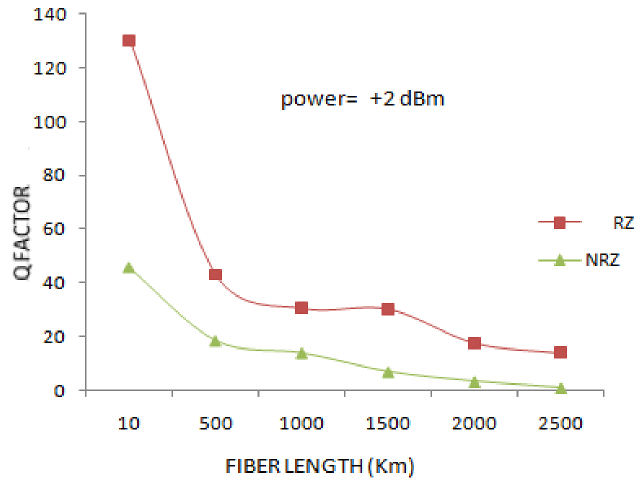

Fig 4 Q factor v/s fiber length (power= 2dBm)

From all these figure(1,2,3) it is quite clear that the performance of the RZ modulation coding is better than that of the NRZ coding even at the different input power and the transmission distance, and also its quite clear that there is a large gap between the two technique . It is only two most significant property of the RZ technique that is the smaller inter-symbol interference and higher nonlinear tolerance than the signal modulated by NRZ.

IV. Optimization Of The FBG Bandwidth

FBG are suitable optical devices not only for wavelength selection elements of fiber lasers but also acts as a dispersion compensator. So particular reflection bandwidth is allowed to the FBG. The deep study of this band width is needed as in this bandwidth only the dispersion compensation takes place. The range of the FBG must be determined. Fig. 5 shows the experimental results that when the FBG bandwidth is from 30GHz to 50GHz, the system performs well. The reading at the different frequency ranging from the 20 to 130 GHz is taken from the experimental model. As the FBG is showing its excellent response to the 30, 40 GHz frequency range. Narrow FBG bandwidth could not reflect the signal effectively. That is to say the FBG bandwidth should be large enough to reflect the whole optical signal. But in practical engineering, the narrower bandwidth of FBG results in the easier production and lower costs. The systematic relation between the quality factor and the FBG bandwidth is shown in the diagram given below:

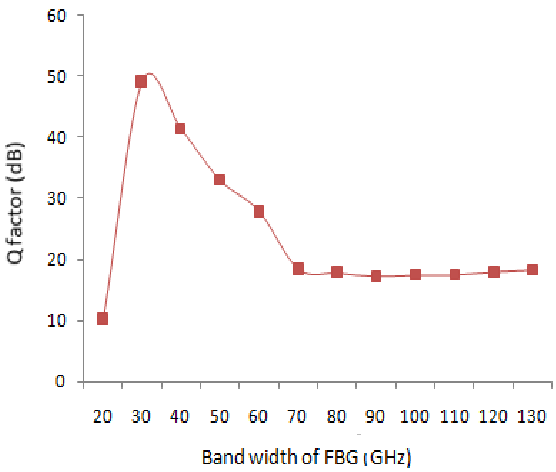

Fig 5 Q factor v/s Bandwidth (GHz)

V. Comparison Between Ariginal Systems And Proposed System

AS the figure 6 clearly demonstrates that the performance of the system improves very much with the increase in the length of the optical fiber. The obtained Q factor of the both of the system are plotted in the graph so that the clear difference them are notified

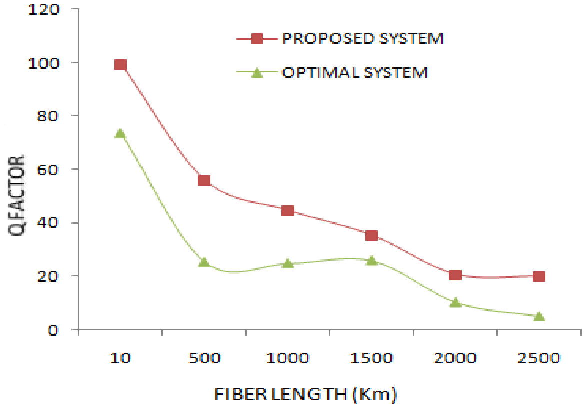

Fig 6 Performance of two different systems

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VI. Conclusion

We have used the FBG in our proposed model although other dispersion compensation devices are also available. We have used device for the long haul communication compensation purpose. From the experimental analysis at the different input power it is clear that the RZ modulation coding technique is the best suited technique for our model. The frequency ranging from 30 to 50 the Q factor is almost 50 which are considered to be the best among the several values.

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