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Transmission System Using Fiber Bragg Grating (FBG) in Optical Communication

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Abstract *– Optical fiber inside the communication system has become one amongst the most cabling attractive and usually used to protection and safely and in addition transmission longer distance is possible in addition contain a large kind of data rate and additionally the demand for digital communication is growing quickly due to the increasing quality of the web and different factors. So on satisfy the growing demands for bandwidth, however, there ar some limiting factors for optical fibers throughout the transmission of the signal to Distance long of these problems is dispersion. Throughout this study, the simulation of the optical system in optical fibre has been mentioned by analyzing the effect of the elements by using whole totally different parameters setting. The value of parameters has been investigated like Signal power (dBm), output power (dbm), Q-Factor.*

Keywords*: Optical Transmission System, Fiber Bragg Grating (FBG), dispersion compensation, Optisystem simulator, parameters.*

I. Introduction

Communication is very important a part of our daily life. Every day, we tend to are using differing types of communication services, like voice, video, pictures and data communication. As desires for those services increase, demands for large transmission capability networks additionally increase. So as to satisfy the increasing demand for higher rate and larger bandwidth, lightweight wave technology has been developed. The mixture of photons and glass fibers provides an incredible transmission capability improvement compared to the transmission through the electrons and copper wires. As a result, fiber optical transmission systems are currently widely developed within the backbone network. Clearly, fiber optic transmission technology can remain the key communication technology foreseeable future [1].

In fiber optic communication is transmitted pulses of light through an optical fibre, wherever the light forms an electromagnetic carrier wave that's modulated to move data. This way the fiber optic is that the medium, and also the light pulses the message. Fiber optics could be a medium for carrying data from one purpose to a different within the variety of light. Unlike, the copper variety of transmission, fiber optics isn't electrical in nature. A basic fiber optic system consists of a transmitting device that converts an electrical signal into a light-weight signal, an optical fibre cable that carries the light, and a receiver that accepts the light signal and converts it back to an electrical signal .Fiber bragg gratings (FBGs) are widely applied in optical Sensors and optical communications because of the promising Performances with electro-magnetic immunity, compactness, Remote sensing, ease of fabrication and wavelength selectivity [3].

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Optisystem is an innovative optical communication system simulation package that designs tests and optimizes virtually any type of optical link in the physical layer of a broad spectrum of optical networks, from analog video broadcasting systems to intercontinental backbones. It is a system level simulator based on the realistic modeling of fiber-optic communication systems.

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II. Optical Fiber

The Fiber optic communication may be a methodology of transmission data from one place to a different by sending pulses of light through a glass fiber. The light forms an electromagnetic carrier wave that's modulated to carry data. 1st developed within the 1970s, fiber-optic communication systems have revolutionized the telecommunication industry and have played a serious role within the advent of the data Age. Due to its benefits over electrical transmission, optical fibers have mostly replaced copper wire communications in core networks within the developed world.

The process of communication using fiber-optics involves the subsequent basic steps: making the optical signal involving the utilization of a transmitter, relaying the signal on the fiber, ensuring that the signal doesn't become too distorted or weak, receiving the optical signal, and converting it into an electrical signal. Optical fibre is used by several telecommunications companies to transmit telephone signals, web communication, and cable tv signals. Because of a lot of lower attenuation and interference. Optical fibre has large benefits over existing copper wire in long-distance and high-demand applications. However, infrastructure development inside cities was relatively difficult and time-consuming, and fiber-optic systems were complicated and expensive to put in and operate. Because of these difficulties, fiber-optic communication systems have primarily been put in long-distance applications, wherever they will be used to their full transmission capability, offsetting the increased value. Since 2000, the costs for fiber-optic communications have dropped considerably. The value for rolling out fiber to the house has presently become more cost effective than that of rolling out a copper primarily based network. Costs have dropped to $850 per subscriber within the us and lower in countries just like the netherlands, wherever digging costs are low.

Since 1990, once optical-amplification systems became commercially offered, the telecommunications industry has set a huge network of intercity and transoceanic fiber communication lines. By 2002, an intercontinental network of 250,000 kilometre of submarine communications cable with a capability of 2.56 Tb/s was completed, and though specific network capacities are privileged data, telecommunications investment reports indicate that network capability has increased dramatically since 2004.

II.1. Advantages of optical fiber communication

• Optical fibers are low-cost than the conventional wires.

• Optical fiber cables are flexible and simple to install.

• Optical fibers are less affected by fire.

• In optical fibre cables signal will propagate longer transmission distances like 50km or additional (single mode fiber cables) while not the necessity to regenerate the signal anyplace in-between.

• The optical fibre cables don't have speed limitations or bandwidth limitations.

• They will support variable speed and bandwidth depending only on optics quality used at each end.

• Easily upgradable for higher speed and high bandwidth.

• Optical fiber cables support duplex communications, bidirectional transmission from transmitter to receiver and vice versa.

• Optical fiber cables don't suffer from electromagnetic interference as they carry light.

• Optical fibers support bandwidth of up to 40Gbps to 100Gbps.

As an optical signal pulse traveling within a fiber, there are many factors which will degrade the information transmission. The longer distance an optical pulse goes the less probability the information will get to the receiver end the faster pulse is being transmitted the worse the data are often recognized with success. These are because of the attenuation and dispersion of the propagating light wave. The attenuation effect decreases the signal power and also the dispersion effect distorts.

III. Tables and Figures

III.1. Transmission system Use FBG

The transmission system model includes a user defined bit sequence generator, return-zero (RZ), a continuous wave (CW) laser with frequency 193.1 and output power 1MW and an AM modulator. The modulation of signal done with a return-zero user defined sequence in AM modulator. The output of system1 is fed into optical fiber whose length is 80km, dispersion is 16.75ps/km/nm, dispersion slope is 0.050pm/nm2/km, and attenuation index is 0.20km. Now to get a better result or to achieve a better signal the dispersed wave goes into the chirp fiber Bragg grating.

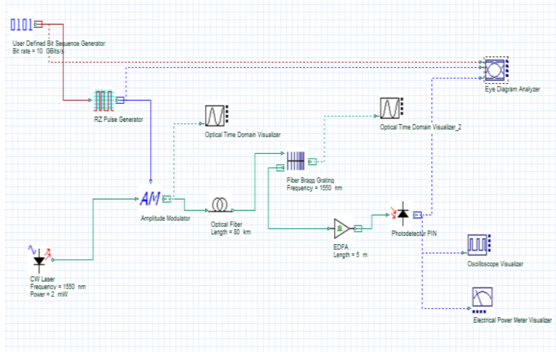

Fig.1 use of BG model

The parameters involved in chirp FBG are frequency, effective refractive index, length of grating, apodization function, tanh parameter, chirp function. Linear parameter and their values are 193.1THz, 1.45, 6, Tanh, 5, linear and 0.0001 respectively. The amplification of signal done through EDFA amplifier which has a gain amount of 6dB. The receiver side consists of a photo detector (PIN) and eye diagram analyzer.

III.2. Principle of FBG

The Fig.1.2 shows the fundamental FBG fabrication method.

If a hydrogen loaded fiber core is exposed to intense ultra violate beam, the ratio of the fiber gets changed permanently.

Now, creating 2 coherent ultra violate beams interfere on the core of the fiber, the fiber is exposed to periodic ultra violate intensity variation. This then causes a permanent periodic variation of the ratio of the core.

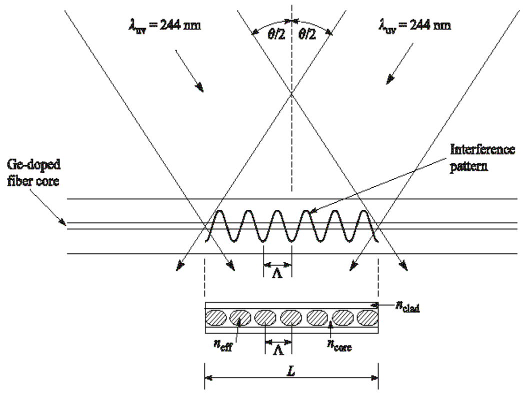

Fig.1.2 FBG fabrication process

IV. Result

We design transmission system to achieve best output of optical system each system has best result. We design firstly without FBG system is can provide communication only 60km without dispersion and then we use FBG and very length of optical fiber and we achieve length 80km no more losses.

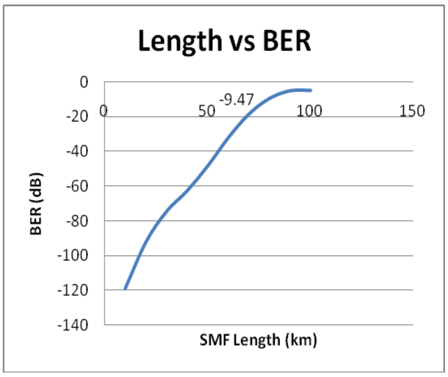

Fig.1.3 Graph of comparison between Length of single mode fiber and BER

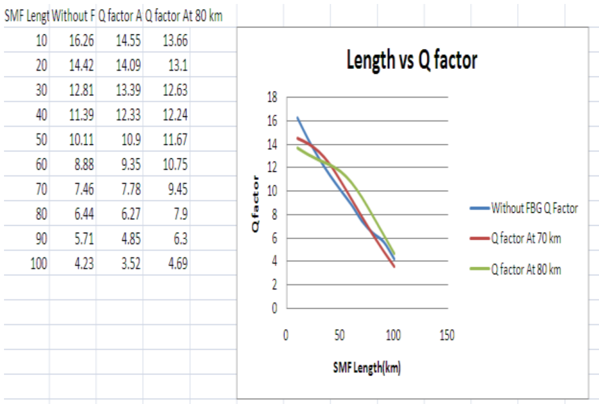

Fig.1.4 Q factor comparison plot between without FBG, with FBG 70km SMF and With FBG 80km SMF

Table 1 Comparison result

PARAMETERS		BASE PAPER DESIGN	PROPOSED DESIGN
LENGTH	SMF	25 km	80 km
	FBG	2 m	27 mm
Q-factor		22.3704	19.97
BER		-	$4.82e^{-89}$
Eye Height		-	0.0712

V. Conclusion

To induce higher result chromatic dispersion ought to be compensated in fiber. We tend to increase the length of fiber to transmit the signal to long length with less dispersion. The length we tend to gained is 80 kilometres that is better for the system than the opposite. The transmission model includes a user defined bit sequence generator, return-zero (RZ), a continuous wave (CW) laser with frequency 193.1 and output power 1MW and an AM modulator. every part have unique 1st use user defined Bit sequence generate that is generate bi 10GB/s, Its then are available RZ pulse generate part its give return to zero pulse width signal and so pass is amplitude modulator, it additionally connect with continue wave optical maser that is give waves. AM modulator modulates each RZ pulse and CW pulse and transmit it with the help of 80km fiber and so it's pass by FBG and EDFA laser and Receive By photo detector pin Diode and spectrum diagram to live output. The modulation of signal done with a return-zero user defined sequence in AM modulator.

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