Simulation And Analysis of 10 Gbps APD Receiver with Dispersion Compensation

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Abstract

In this paper, a scheme is suggested to improve the bit error rate. By increasing the length of fiber dispersion increase.. To reduce dispersion, different compensation techniques are used. In this paper, APD receiver is used. There are three things to compensate dispersion such as Dispersion Compensation Fiber, Fiber Bragg Gratings and Phase Conjugator. By using Dispersion Compensation Fiber there is improvement of BER using APD receiver. Analysis of bitrate V/s bit error rate.

Keywords: SMF,DCF,Dispersion,BER,Q-factor,Power.

1. Introduction

Communication is broadly defined as a transfer of information from one place to another Now-a-days people want speed in communication so there is use of optical fiber .In optical fiber there is a speed but by increasing distance so there is a chance of dispersion.so some techniques are used to reduce dispersion such as dispersion compensation fiber, fiber bragg gratings and phase conjugator.by increasing length of fiber dispersion may increase.dispersion causes distortion for both analog and digital transmission along optical fibers.dispersion means broadening of pulses when the optical signal transmitted through channel.when the optical signal passes through channel ,the pulses may be broadened and overlap with its neighbours. So the receiver cannot identify what the data are transmitted.so intersymbol interference occurs. . it is also effected SNR at the receiver side. There are different types of receiver such as PIN photodiode,APD etc.In order to extermly high field electrical region APD has a more sophisticated structure than the PIN photodiode. therefore in the depletion region and primary carrier pairs are generated there is a high field region in which holes and electrons can acquire sufficient energy to excite new electrons-holes pairs. This process is known as impact ionization and is the phenomenon that leads to avalanche breakdown in ordinary reverse biased diodes. It requires high reverse bias voltage. most of photons are absorbed. the internal mechanism of APD is to increase signal current into the amplifier because of amplifier noise is unaffected.there are three limiting factors for the device.

1. The transit time of the carriers across the absorption region.
2. The time taken by the carriers to perform the avalanche multiplication process.
3. The RC time constant incurred by the junction capacitance of the diode and its load.

APD has advantages over PIN photodiode without internal gain for the detection of the very low light levels often encounters in optical fiber communication. They generally provide an increase in sensitivity over PIN diode. APDs however have several drawbacks.

1. Fabrication difficulties due to their more complex structure and hence increased cost.
2. The random nature of the gain mechanism which gives an additional noise contribution.
3. The often high bias voltage is required which are wavelength dependent.

The temperature compensation is necessary to stabilize the operation of the device

2. Literature Review

Hadj Bourdoucen and Amer Alhabsi discussed the Improvement of Bit-Error-Rate in Optical Fiber Receivers.the optical fiber operating system with non-return-to-zero format transmission rate at 10 Gbps [1].there is the use of single mode fiber.single mode fiber has an attenuation 0.2 dB/Km and wavelength is 1550 nm.equation for bit error rate is

$$BER = \frac{1}{2} erfc \frac{Q}{\sqrt{2}}$$

This system has been evaluated by using bit error rate and Quality factor and also from eye diagram.

B U Rindhe ,S K Narayankhedkar and Sanjay Dudul proposed that modeling of SMF for optical networks. In this paper different modulation techniques are used so as to avoid practical demonstration.mainly there are two types of dispersion :polarization mode dispersion and chromatic dispersion.in this paper chromatic dispersion discussed[2] and also fiber losses induced. As distance increases dispersion is also increasing. there is bit error due to noise,interference,distortion or bit synchronization error.BER is the number of bit errors divided by the total number of transfer bytes .there is a used of the lumped amplifier to compensate fiber losses over longer distances.Distributed amplification help overcome signal attenuation.

P. C. Won, W. Zhang, and J. A. R. Williams proposed that the joint effect of dispersion and nonlinearity onto SSB DSB radio-over-links is investigated.there is modulation suppression caused by chromatic dispersion eliminated in both schemes by using linear regime. In this paper conclude that power fluctuations occur in both scheme when high power transmission is employed.these power fluctuations generate new frequency.fluctuations power is proportional to the optical incident power.

J.-N. Maran, Radan Slavík, Sophie LaRochelle, and Miroslav Karásek discussed that fiber laser emitting several wavelengths and it is used for many applications.so there is a problem of coverage ,is not sufficient to meet current requirements[4]. In this paper source emitting 17 wavelengths spread over the whole C-band.there are the three methods to measure chromatic dispersion:time-of-flight,phase-shift and interferometric method.among three techniques there is a use of time-of-flight technique.they proposed that the application of newly multiwavelength fiber laser for chromatic dispersion. measurement system was tested by measuring the chromatic dispersion using three different optical fibers:single mode fiber,LEAF corning fiber and DCF module.

Nelson M. S. Costa and Adolfo V. T. Cartaxo discussed that Influence of the Channel Number on the Optimal Dispersion Map Due to XPM in WDM Links.XPM is a nonlinear effect where one wavelength of light can affect the phase of another wavelength of light[5].

3. Results And Discussion

The simulation of single mode fiber in optsim and with the help of this it is shown that at 80 Km there is a more dispersion and bit error rate is high.

As shown in figure(1) there is a use of single mode fiber using length as 80 Km.so there is a more dispersion.and receiver is APD.As shown in figure (2) DCF is used to compensate the dispersion.there are components such as PRBS data,electrical generaor,CW laser,modulator,single mode fiber,dispersion compensation fiber,optical amplifier,APD receiver and BER tester.Above diagram show relationship between BER Vs bitrate, in this paper DCF is used to compensate the dispersion.dispersion is one type of loss means at receiver side data isnot received perfectly. as shown in figure in DCF also there is a same diagram as SMF.there is a use of span means it is one type of loop.there is a use of DCF with 20 Km and amplifier

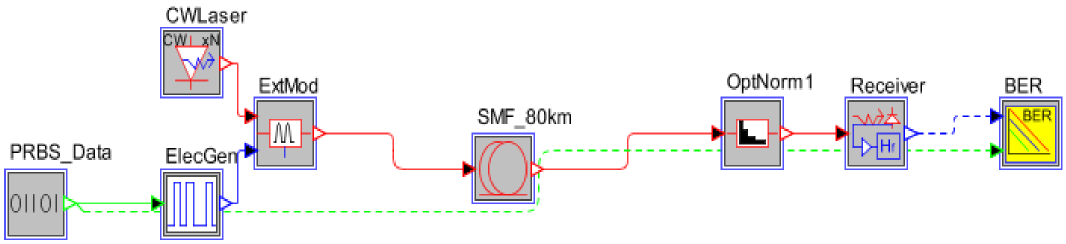

Fig 1:Simulation set up for optical communication without dispersion compensation

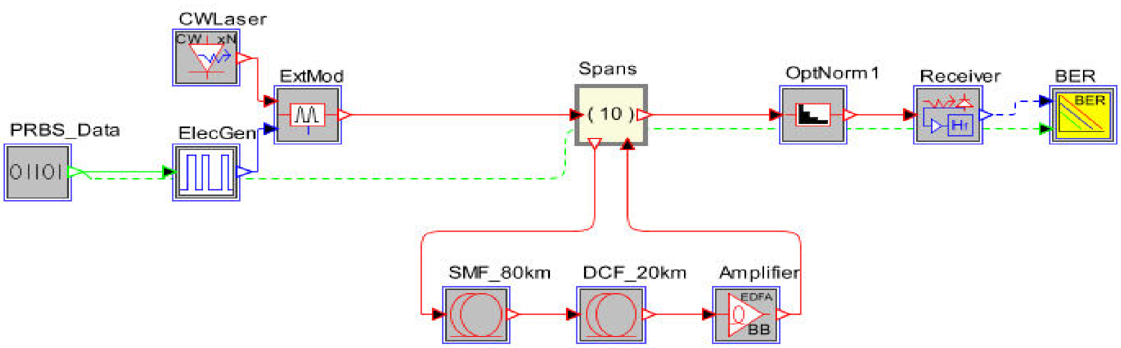

Fig 2**:** simulation set up for optical communication with dispersion compensation

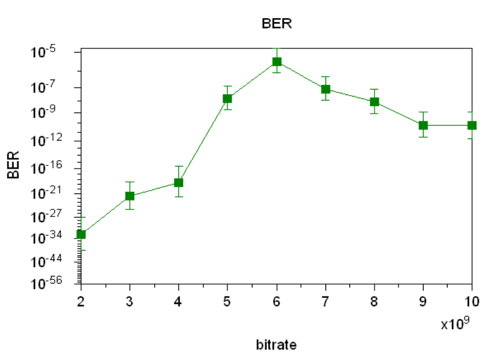

Fig a. BER Vs bitrate

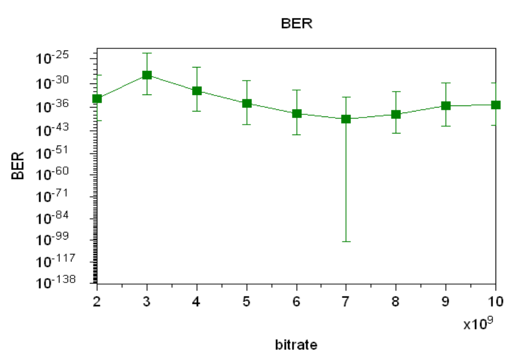

Fig d. BER Vs bitrate

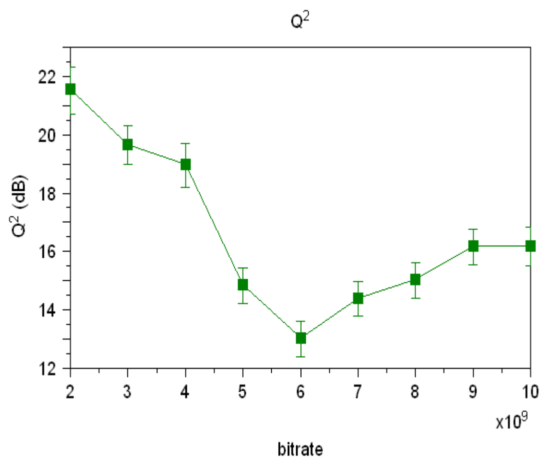

Fig. b.. BER Vs Power

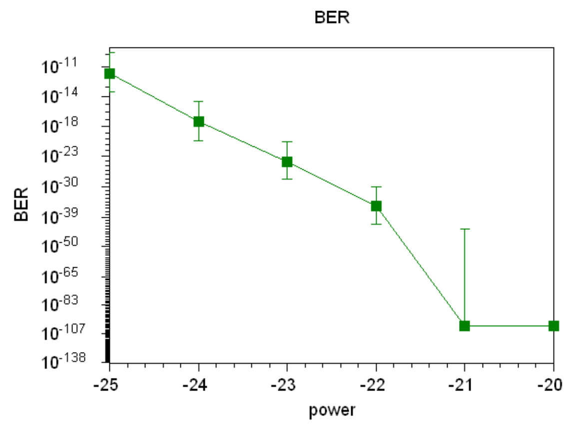

Fig. e. BER Vs Power

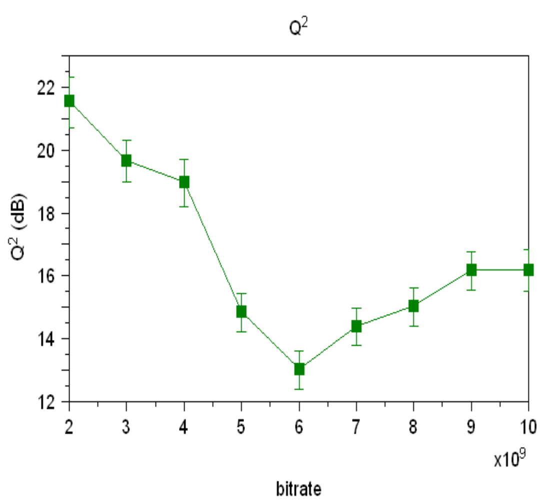

Fig c. Q-factor Vs bitrate

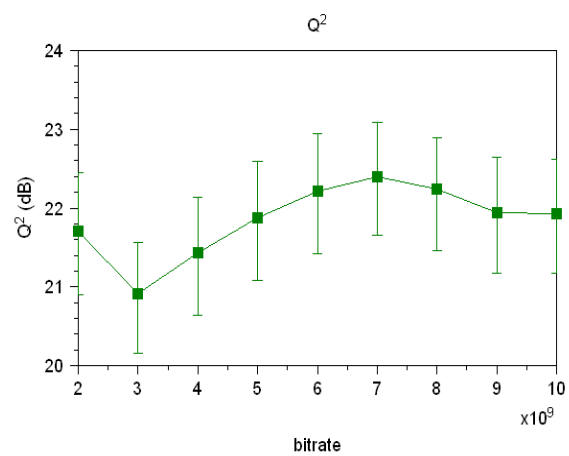

Fig. f. Q-factor Vs bitrate

4. Conclusion

Dispersion is the main limiting factor in optical communication.because of dispersion system performance decreases. To avoid dispersion there are different techniques.among them DCF is good technology to avoid dispersion.it is easy to understand

and implement.by using DCF,the BER is reduced and quality factor has improved.

5. Future Scope

Instead of using DCF there is a chance to use FBG and interferometric method.by using different receiver also find out BER,Q-factor etc.and also use different types of modulation formats.

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