STUDY OF DISPERSION COMPENSATION IN 50GBPS WDM OPTICAL COMMUNICATION NETWORK

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ABSTRACT

Communication through optical network is becoming very important need for the present internet communication due to good bandwidth provided by optical fibre. The throughputs provided by these networks are of the order of tetra bits per second, which is tremendously high. It also provides low error rates and low delays, and can also satisfy upcoming application like supercomputer visualizations, medical imaging and distributed CPU interconnect. In this, various transmitters and receivers are interconnected with various optical fibre based components and to further analyze their performance on the basis of Quality factor and the bit error rate and all considerable parameters are considered by altering the length of fibre and other parameters in the system. Analysis is being done on the basis by dispersion compensation schemes using different compensators and most suitable quantities are picked up for the work to be elaborated stated that by only using the specified quantities the results comes out to be in the form of considerations. So that we would get high Quality factor and low bit error rate.

Keywords:Optical Communication, Dispersion, Quality factor, Dispersion Compensating Fibre (DCF), WDM Network

I.INTRODUCTION

Communication is an important part of our daily life. Every day, we are using different types of communication services such as voice, video, images and data communication. In order to fulfil the increasing demand for large transmission capacity network for higher data rate and larger bandwidth, light wave technology has been developed. The combination of photons and glass fibres provides a tremendous transmission capability improvement compared to transmission lines through electrons and copper wires. As a result, fibre optical transmission systems are widely used in the backbone of network. This technology was accepted by the telecommunication industry starting in the 1970. Wavelength-division multiplexing (WDM) is a method of combining multiple signals on laser beams at various infrared (IR) wavelengths for transmission along fiber optic media.Currently, it is widely applied in different types of communication systems, such as internet and cable TV networks. This is due to the ever increasing demand for "more data, less time" in transmission of voice, image, video and so forth. The transmission capacity of commercialized optical communication system had reached 560 Mb/s in 1985 [1] and 1.6 Gb/ s in 1987. A modern communication system consists of four main components: the optical transmitter, the optical receiver, the optical fibre, the optical amplifier. The optical transmitter is used to generate the light signals, the optical receiver receives the transmitted signal and converts it back into the carried information, the optical fibre is the transmission medium of light, and the optical fibre is used to extend the transmission distance. Benefit of optical fibre is that though they are laid down across road or run alongside each other for long distance coverage. Even then they have no effect of crosstalk, in contrast to the electrical transmission lines. Fibre-Optic technology can meet the all needs of huge bandwidths, low signal attenuation, low signal distortion, low cost and low power requirements [2]. While transmitting the signal, there are several approaches to ensure network survivability against fibre link failures. Survivable network architectures are designed in such a way that it reserves the backup resources in advance called protection, or the process of discovering the spare backup resources in an arranged or online manner called restoration.Depending upon these approaches, an optical signal pulse travelling inside the fibre, there are several factors which degrade the data transmission. But the longer distance the optical pulse goes, the less the chance the data can get to the receiver end. These are due to attenuation and dispersion of the propagating light wave. The attenuation effect decreases the signal power and the dispersion effects distort the shape of the pulse propagating through the fibre. Dispersion compensation schemes affect the system performance. The pulse broadening effect of chromatic dispersion causes the signals in the adjacent bit periods to overlap. This is called inter symbol interference (ISI). Broadening is a function of distance as well as dispersion parameter 'D'. The dispersion parameter is given in ps/nm/km and changes from fibre to fibre. It is also a function of wavelength. D is usually about 17 ps /nm/km in the 1.55 µm wavelength range for a standard single mode fibre (SMF). It is at a maximum of 3.3 ps /nm/km in the same window for a dispersion-shifted fibre (DSF). Nonzero dispersion fibre (NDF) has a chromatic dispersion between 1 and 6 ps /nm/km. It is the technique used in fibre optic communication system designed to cope with the dispersion introduced by the optical fibre. Due to ISI, the receiver is unable to distinguish between two symbols. This leads to error in symbol detection. It is the reason for the necessity of dispersion compensation. There are various methods for dispersion compensation namely, Dispersion Compensating Fibre (DCF), Optical filter, Fibre Bragg Grating (FBG), Optical Phase Conjugation, Electrical Dispersion Compensation, etc. In this thesis, there mainly about DCF and FBG as these are widely used techniques[5].

II. RESULTS AND DISCUSSION

The performance of dispersion compensation management using ideal dispersion compensation FBG is shownin Fig. 1. The shape was generated in the Optical Gaussian pulse generator with an initial 40 ps/nm pulse within different distance limit and global parameters of a 50 Gb/s bit rate:

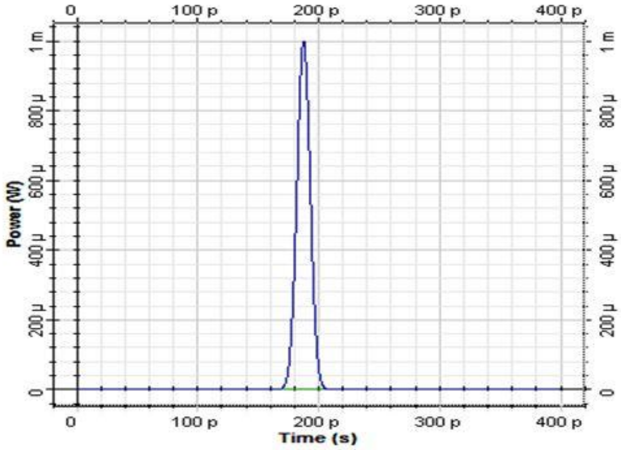
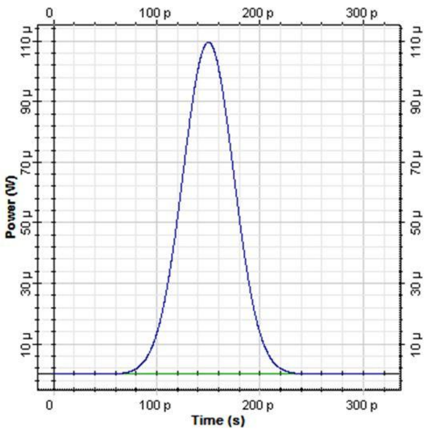


Figure 1: initial pulse

The pulse was launched in 10 km SMF. As a result of this propagation, the width of the pulse increases approximately four times.



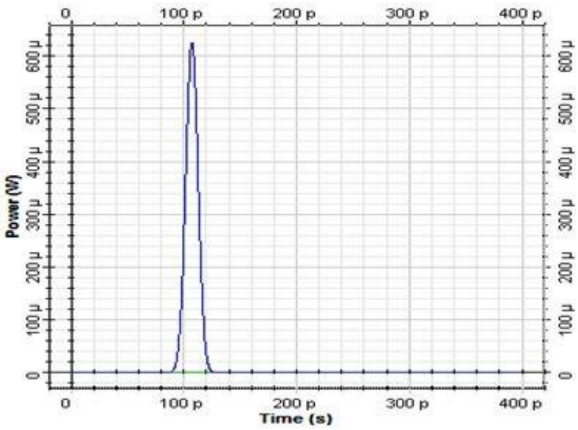


Figure 2(a)10 km propagation without compensator

Figure 2(b) 10 km propagation with dispersion dispersion compensator

- At 10 km propagation in SMF, the accumulated dispersion is 160 ps /nm. In order to compensate for this accumulated dispersion, Ideal Dispersion Compensation component is fixed as - 160 ps /nm. Therefore, we get the pulse after compensation which is same as that of the initial pulse.
- At 20 km, the signal becomes 6 times the initial pulse and accumulated dispersion is 240ps/nm. With the help of dispersion compensator (-160ps/nm) the dispersion is reduced to three times of the initial pulse.

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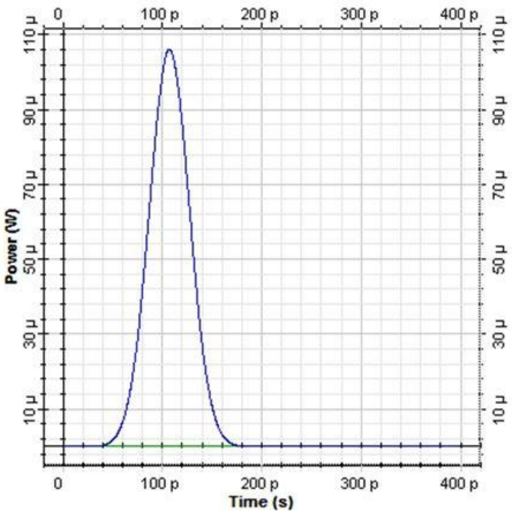


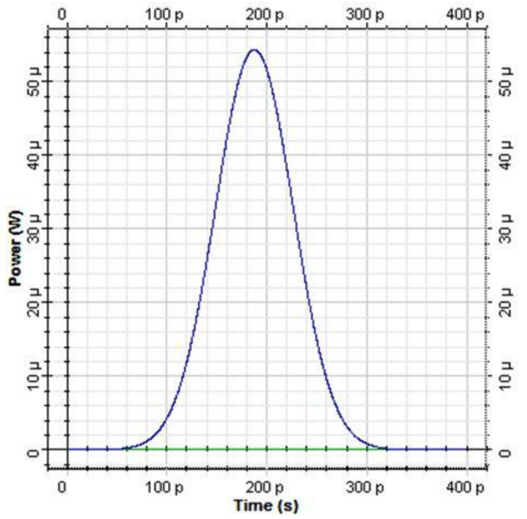
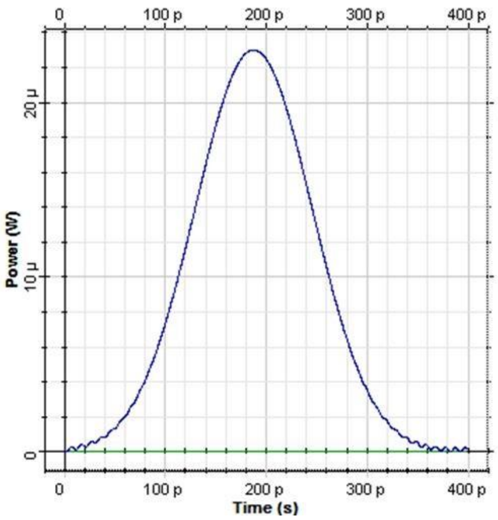


Figure 3(a) 20 km propagation with dispersion compensator

Figure 3(b) 20 km propagation with dispersion compensator

- At 30 km, the signal becomes 8.5 times the initial pulse and accumulated dispersion is 380 ps /nm.On compensating it, it becomes 5.5 times the initial pulse.



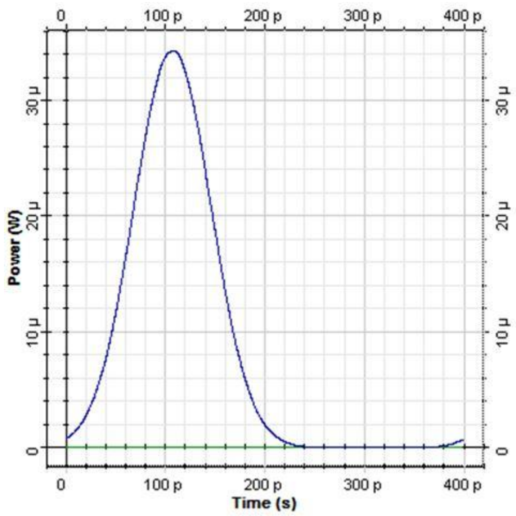


Figure 4(a): 30 km propagation with dispersion

Figure 4(b): 30 km propagation withcompensator

dispersioncompensator

- At 40km, the signal becomes 9 times the initial pulse and itself got fluctuated.On compensating, the signal become 8 times the initial signal with fluctuations.

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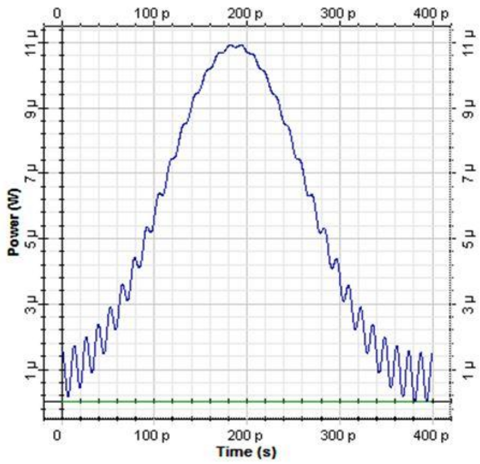

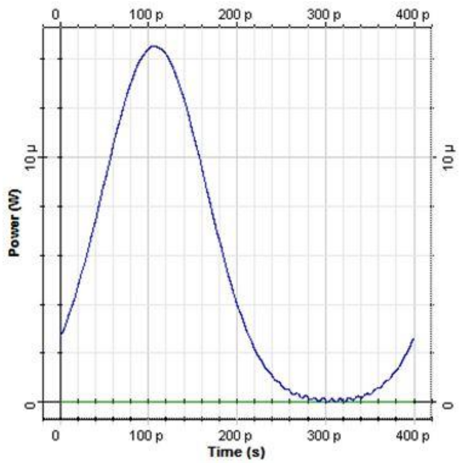

Figure 5(a): 40 km propagation with dispersion compensator

Figure 5(b): 40 km propagation with dispersioncompensator

- At 50km, the signal got dispersed by the same value but here the fluctuations are more from the previous one. After compensation, compensator effect becomes so poor that the signal becomes 8.5 times the initial pulse. On placing anther compensator after 50 km, effective result of compensation is found whose layout is given in Fig. 2.9. On compensation, with the newly layout the signal get rise to its better value.

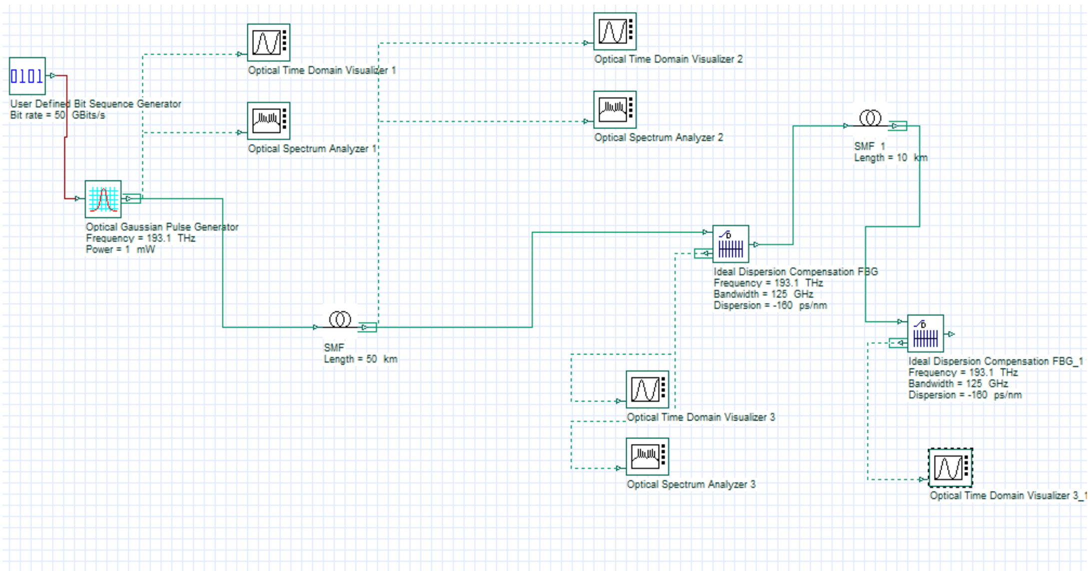

Figure 2.9: double compensator layout

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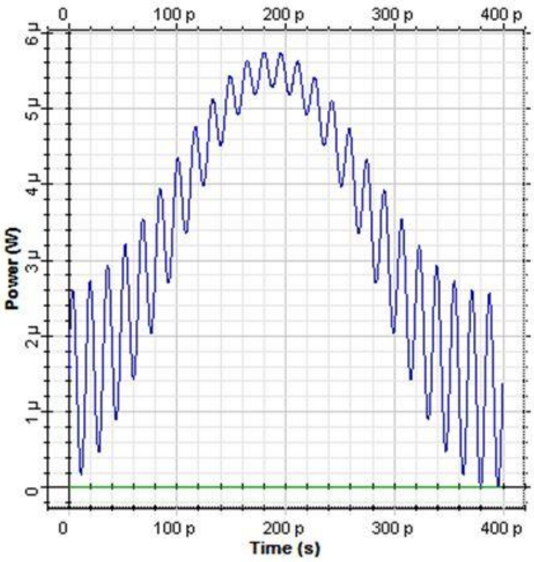


Figure 6(a): 50 km propagation with dispersion compensator

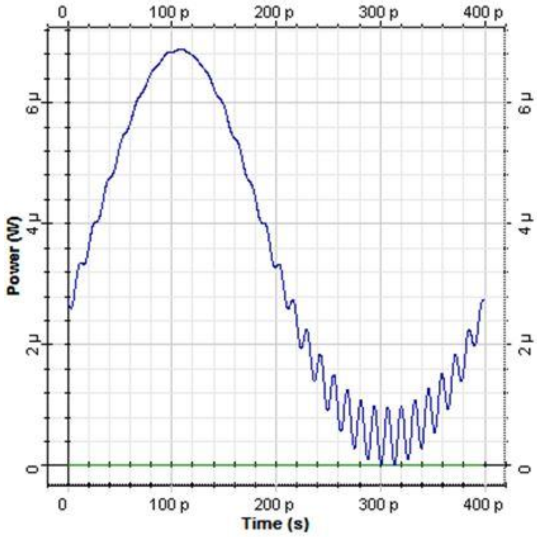
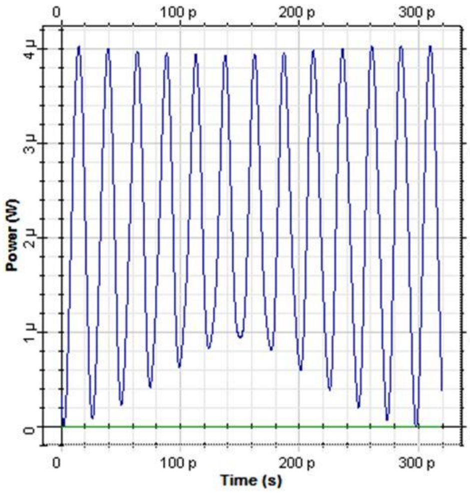


Figure 6(b): 50 km propagation with dispersion compensator

- At 60 km, the compensator stops to reduce the effect of dispersion. The signal gets fluctuated 9 times the initial pulse.



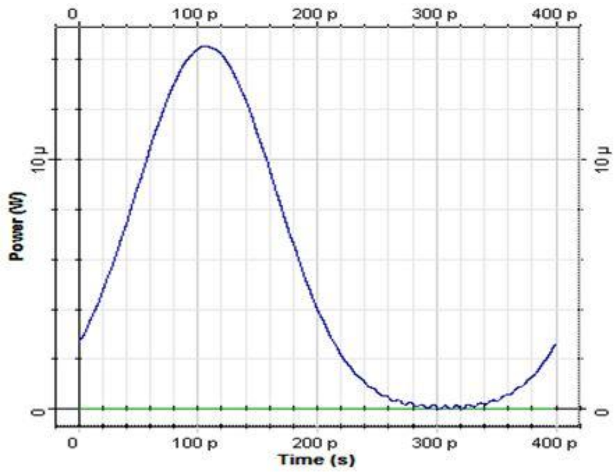


Figure 2.10(a): 60 km propagation with dispersion compensator

Figure 2.10(b): 60 km propagation with dispersion compensator

These results are enlisted in the Table 1:

Table 1: Comparison of Results

Distance(km)	Number of times of dispersion(dB)		Fluctuations in Signal Removed
	Increased	Compensated	
10	4 times	4 times	--------

20	6 times	3 times	-------
30	8.5 times	5.5 times	--------
40	9 times	8.0 times	Removed
50	9 times	8.5 times	Removed
60	9 times	No compensation	Removed

III. CONCLUSION

Dispersion is the function of distance. With larger distance the compensator stops to reduce the dispersion effect. In order to compensate at larger distance another ideal dispersion compensator is placed after 50 km. Thus poor value can be rise to its appropriate value.

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