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Performance Analysis of 8-channel & 16-channel Optical Fiber Using WDM System

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Abstract **-In this paper wavelength division multiplexing allows the multiple channel to transmit the data at high speed at the same instant. For large distance communication, Single mode fiber is preferred over Multimode fiber. Quality factor decreases as data rate and optical fiber length increases. In this proposed work Optisystem 7.0 simulator is used to analyze dispersion effect on 16 channel dense WDM system at 80 Gbps data rate. A single chirped fiberbragg grating is used to compensate the dispersion in single channel and 16 cascaded chirped FBG for 16 channel. Signal is amplified at each multiple of 80km optical fiber length using Loop control unit. The performance of optical system has been given using BER and eye analyzer.**

Index Terms—Dense wavelength division multiplexing(DWDM), Chirped fiber bragg grating (FBG), Erbium doped fiber amplifier (EDFA), Transimpedence amplifier .

I. INTRODUCTION

Now-a-days with the high-speed internet, low bit error rate optical fiber networks enable high capacity interconnection between transmitter and receiver. To increase the number of channel in optical fiber, we are using dense wave length division multiplexing. An optical signal of different wavelength can be transmitted through the DWDM and there is a large number of channel in WDM. The Gain of EDFA is flatted by an Intrinsic and Extrinsic Method. For small BW requirement system Intrinsic method is preferred and for large bandwidth requirement system Extrinsic method is preferred Chirped Fiber Bragg Grating is used for large bandwidth. Dense WDM has the channel spacing (100- 200Gigahertz). Coarse Dense Wavelength division Multiplexing has the Channel spacing 20nm that does not support EDFA due to the wide spacing between channels. Dispersion compensation is required to compensate the dispersion. Fiber Bragg grating is used for dispersion compensation. Each Input signal is generated by the transmitter at different wave length. Dense WDM integrates different wavelength signal and transmitted to channel. DCF can be used as pre compensation, under compensation and mix compensation scheme. But mix compensation scheme is the best. RZ modulation is preferred as compare to NRZ modulation for large input laser power. Attenuation and chromatic dispersion reduce the performance of the system by pulse Broadening and due to this peak amplitude comes down. For long distance communication EDFA is used. A single EDFA can simultaneously amplify different wavelength signals. Signals is amplified due to interaction with Erbium ions. With the help of different Pumping methods the Gain of EDFA is equalized, But it is chosen due to their properties like high Gain, low noise and large bandwidth. FBG based compensation technology reduce the overall cost of the system. For low-level side lobes Quadratic chirped function can be used. As optical fiber Length increases eye height, maximum quality factor, gain and threshold decrease.

Objectives: The main aim of this research paper is to design a 8 channel and 16channel DWDM system with each channel having 10 Gbps data rate multiplexed with frequency spacing 100 GHz. Methods/Statistical analysis: Dispersion is an important factor to be considered while designing a DWDM system. Dispersion affects the penalties due to various types of fiber nonlinearities. Single mode fiber is preferred for long distance communication over Multimode fiber. In this proposed work Optisystem 7.0 simulator is used to analyze dispersion effect. The system performance is optimized by using Dispersion compensation fiber to compensate for the dispersion produced by single mode fiber. Findings: The system performance is limited by the dispersion. In order to compensate this we have used Dispersion compensation fiber. Between amplifier spans is standard single-mode fiber, but at each amplifier location, dispersion compensating fiber having a negative chromatic dispersion is introduced. By using this we have successfully designed a DWDM system with 8 channels and 16 channel.

Application/Improvements: It is realized that, in upcoming future, DWDM can emerge as a promising technique to increase the capacity and meet the bandwidth requirement. This work can further be extended to more number of channels i.e. 100 channels or more with even smaller frequency spacing. which carries multiple wavelengths carrying user data on each wavelength. DWDM system can handle more numberof users per wavelength. But dispersion compensation plays a key role in DWDM at bit rate greater than 10 Gb/s.It can be compensated by using dispersion compensating fiber. WDM systems suffer from four wave mixing effect. Due to this reason, non-zero dispersion-shifted fibers are preferred. Four wave mixing effect can be minimized using OPC and dispersion compensation. EDFA's are used in addition to DCF's to amplify and regenerate the optical signal. The mix- compensation performance is the best. For long distance, Erbium-Doped Fiber Amplifier (EDFA) is preferred. If EDFA is placed before SMF, it is called pre compensation and if it is used after SMF, it is called post compensation. Both these techniques can be combined to produce and deliver a good quality of optical signal at the transmitter. The noise figure and gain depends on fiber length for an EDFA. Fiber Bragg grating (FBG) is playing significant role in optical fiber communication as filter, stabilizer, gain flattening filter, dispersion compensator, optical router etc. Furthermore, it is also used as sensor for sensing temperature, pressure and strain etc. The FBG is a special form of optical fiber where the refractive index of the core is variable. The WDM transmitter here generates 16 different wavelengths for 16 different channels.The optical signal is transmitted at a frequency of 1555 nm with power 5dbm with NRZ type of modulation. These 8&16 different wavelengths are multiplexed using WDM mux. The various parameters used at the transmitter side are as shown below and are taken from simulation on optisystem software.

II. THEORY

Different carriers which is modulated with different velocities and because of that we get the pulse broadening. Dispersion is proportional to pulse broadening. Larger wavelength signal can take large time to reach receiver. Fiber bragg grating is periodic in nature and it is fabricated inside the core of optical fiber. FBG reflects back the signal which is wavelength dependent.

III. BLOCK DIAGRAM

It consists of 16 channels with cascaded FBG and EDFA. It has 16 channel 16 different wavelength signal which required to generate through Continuous Laser. The 16 transmitters are divided into the four subsystems, and each subsystem has the four transmitters.

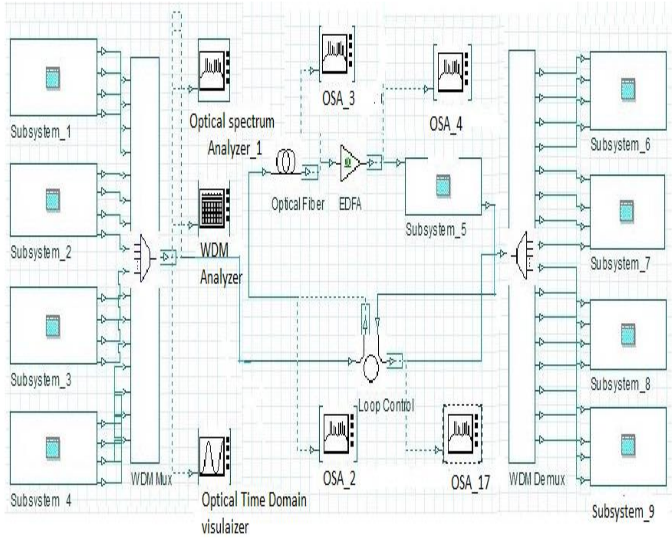

Fig 1.Structure of an 16 channel DWDM system.

Transmitter

A transmitter is that component of a DWDM system which generates the different wavelengths for different channels and multiplexes them or combines them on to a single fiber. The WDM transmitter here generates 16 different wavelengths for 16 different channels with frequency spacing 100 GHz. These 16 different wavelengths are multiplexed using WDM mux. The various parameters used at the transmitter side are as shown below and are taken from simulation on optisystem software.

Optical channel

The multiplexed optical signal consisting of all the 16 wavelengths is transmitted over the channel. We have used Dispersion compensating fiber to counter the dispersion occurring in the system. The optical signal is amplified at various intervals of distance by using EDFA's. For this various EDFA's and DCF are used in such an arrangement that a SMF have an EDFA both in front and back.

Receiver

The receiver consists of WDM de-mux which de-multiplexes or separates the multiplexed signal into its constituent wavelengths. In addition to de-mux, the receiver also has optical receiver and a BER analyzer. The BER analyzer is used to analyze the various parameters of WDM link such as BER, Q factor, eye height etc.

IV. RESULT AND DISCUSSION

A. Analysis at 40km Optical fiber length At the 40km optical fiber length pulse getting start broadening due to this amplitude of the signal decreases. So we need to amplify the signal at 40km. The BER analyzers are shown for channel 8,

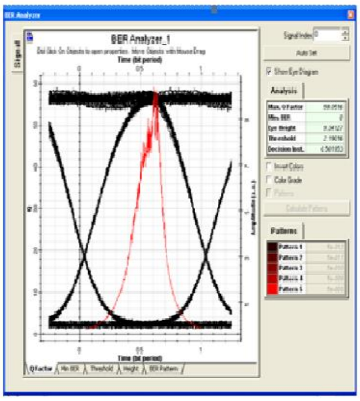

Fig 2. BER analyzer of channel 8 at 40kmOptical fiber length

Table 1. Performance of 8 channels at 40km & 80km

Parameter	At 40 km distance	At 80 km distance
Quality factor	59.0156	34.916
Minimum BER	0	1.78359e-267
Eye height	2.19016	2.40222

B. Analysis at 40km Optical fiber length At the 40km optical fiber length pulse getting start broadening due to this amplitude of the signal decreases. So we need to amplify the signal at 40km. The BER analyzers are shown for channel 16,

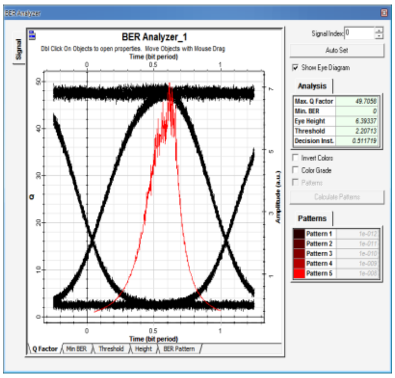

Fig 3. BER analyzer of channel 16 at 40km Optical fiber length

Table 2. Performance of 16 channels at 40km & 80km

Parameter	At 40 km distance	At 80 km distance
Quality factor	49.7058	34.3838
Minimum BER	0	2.09143e-259
Eye height	2.20713	1.77027

CONCLUSION

In proposed work, an optimized DWDM link using DCF for dispersion compensation is presented. The system performance is limited by the dispersion. In order to compensate this we have used Dispersion compensation fiber. Between amplifier spans is standard single-mode fiber, but at each amplifier location, dispersion compensating fiber having a negative chromatic dispersion is introduced. By using this we have successfully designed a DWDM system with 8 channels and 16 channels. Various EDFA's are also used toamplify and regenerate the signal. This work can be further extended to 32 channels and 64 channels in future as well**.**

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