ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 3, March 2015

Simulation of 32 × 20 Gb/s WDM and DWDM System at Different Dispersion

Parveen Bagga[1], Himali Sarangal [2]

Student, Department of Electronics and Communication Engineering, GNDU Regional Campus Jalandhar, India [1]

Assistant Professor, Dept., of Electronics and Communication Engineering, GNDU Regional Campus Jalandhar, India[2]

Abstract: In this paper, the 32 channel WDM system at 20 Gb/s has been investigated for the different channel spacing. The performance has been analyzed on the basis of dispersion. The comparison of BER, Q-factor and eye opening for WDM and DWDM systems at different dispersion is done. It is observed that at different dispersion 2-10 ps/nm/km the 32 × 20 Gb/s WDM system provides better results than the 32 × 20 Gb/s DWDM (dense wavelength division multiplexing) system in the presence of nonlinearities. The analysis is done using OptiSystem 7.0 simulator.

Keywords: WDM, DWDM, BER, EDFA, Q Factor, Eye height, OptiSystem 7.0

I. INTRODUCTION

WDM system uses multiple wavelengths to transmit information over a single fiber. Today there is very high demand of network capacity so to increase the network capacity of the system we have new technology i.e WDM system but when we are transmitting the signal there occur degradation of signal, so to decrease this degradation of signal optical amplifiers are used to boost up the signal. An optical amplifier is a device which amplifies the optical signal directly without ever changing it to electricity. Basically WDM system uses a number of multiplexers at the transmitter end, which multiplexes more than one optical signal onto a single fibre and demultiplexer at the receiver to split them apart. Fig. 1 is showing a basic WDM Technology.

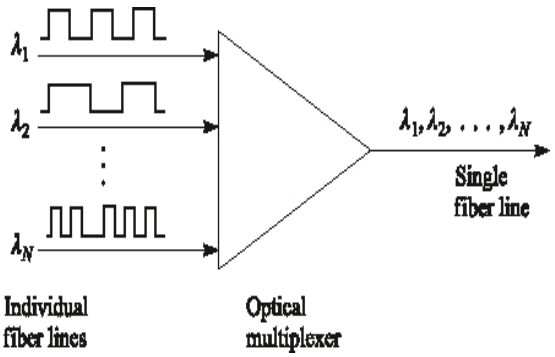

Fig.1.WDM System

Basically we have two systems WDM system and DWDM system .The system which has channel spacing 200GHz or less than 200GHz that system is DWDM system and the system which has channel spacing greater than 200GHz that system is WDM system.

R.S. Kaler[3]observed the performance of 16 channel WDM systems based on optical amplifiers at different transmission distance and dispersion he take bit rate 10Gbits/sec .

In this paper we have extended the work and we have analyzed the performance of 32 channel WDM system at 20Gbits/sec in terms of BER, Q-factor and eye opening at different dispersion. We have examined that we can increase the capacity of the system by reducing the channel spacing. But due to channel spacing less there is server cross- phase modulations (XPM).

II. SYSTEM DESIGN

In this model, 32 channels are transmitted at 20 Gb/s speed with different channel spacing from 100-400Hz. Each input signal is modulated in NRZ format and pre-amplified by a booster. A WDM transmitter having 32 transmitters is used. In WDM transmitter each transmitter section consists of the data source, electrical driver, laser source and external Mach–Zehnder modulator. The data source is generating signal of 20 Gb/s with pseudo random sequence. The electrical driver converts the logical input signal into an electrical signal. The CW laser sources generate the 32 laser beams at 190THz with different channel spacing. The signals from data source and laser are fed to the external Mach–Zehnder modulator and then the modulator output signal is fed to the multiplexer then signal is passed through the optical amplifiers and then demultiplexer convert single input to 32 outputs and then at eye analyzer the eye pattern is analyzed.

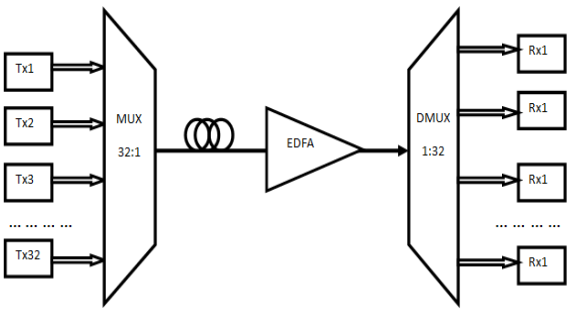

Fig.2.Block diagram for simulation setup

The simulations setup of WDM system using 36 channels at different dispersion are shown in Fig. 2. The optical signal is transmitted and performance is analyzed for 30 km distance at 2 -10ps/nm/km dispersion. Optical power

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meters are used for measuring the signal power at different levels. At the receiver side the modulated signal is converted into original signal with the help of PIN photodiode and electrical filters. 32channel WDM receiver is used to detect all 32 signals and converts these into electrical form. EDFA optical amplifier is used in this system. The different channel spacing is taken in this system .The channel spacing is varying from 100-400GHz. Different components have different operational parameters. Its various parameters are reference frequency is 193.414 THz, attenuation is 0.2dB/km and fibre polarization mode dispersion is 0.2 ps/km. EDFA is used for amplification and its parameters are, gain shape is flat and noise figure is 6 dB and gain is 10 dB. Fig 3 shows the simulation setup of WDM system.

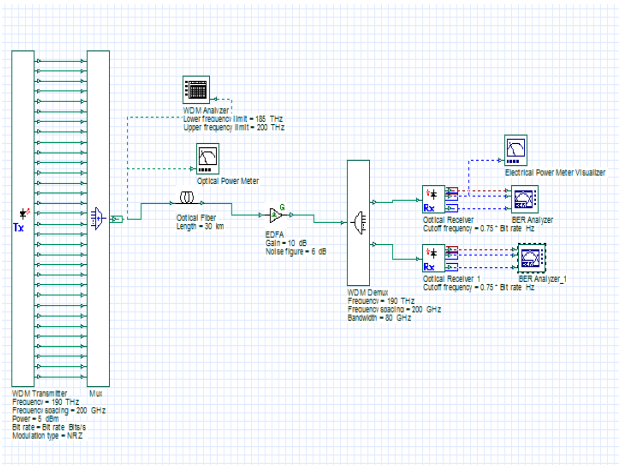

Fig. 3.Simulation setup of WDM system

In Table 1, the parameters used for simulation are tabulated all these values are taken when we are doing simulation of DWDM system in Optisystem 7.0 simulator

TABLE I
SIMULATION PARAMETERS

WDM transmitter Frequency	190 THz
Frequency spacing	100-400 GHz
Input Power	5 dBm
Bit rate	20Gbits/sec
Modulation Type	NRZ
Fiber length	30km
Attenuation coefficient at cable section	0.2 db/km
EDFA Gain	10 db
Reference wavelength	1550 nm
Dispersion	2-10 ps/nm/km
noise figure	6db

III. RESULT & DISCUSSION

Performance of DWDM system and WDM system are analyzed. The graphs for Q-factor and BER v/s dispersion 2-10 ps/nm/km at different channel spacing are shown below. The graph show that as we increase the dispersion from 2-10 ps/nm/km the Q-factor decreases. In other words when we increase the channel spacing Q-factor increases.The variation in the Q-factor is 14.2006 to 6.32581 for channel spacing 100GHz, 20.1705-7.98043 for channel spacing 200GHz, 22.9868 to 8.80097 for channel spacing 300GHz, 24.7195 to 9.8024722 for channel spacing 400GHz as shown in fig 4.

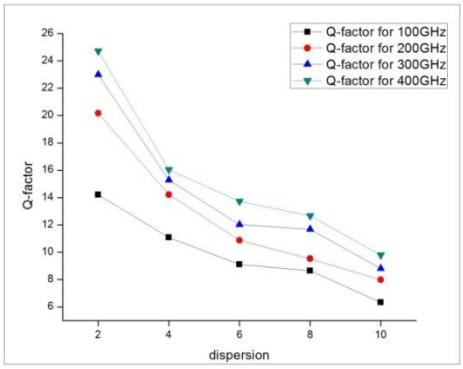

Fig. 4.Q-factor v/s dispersion graph for different channel spacing

The BER increases as we increase the channel spacing .the variation in the BER is from 4.54112E-30 to 1.16735E-10 for channel spacing 100GHz, 8.87104E-32 to 5.4393E-12 for channel spacing 200GHz , 4.3234E-35 to 4.77755E-14 for channel spacing 300GHz, 1.15247E-40 to 4.7499E-17 for channel spacing 400GHz, as shown in Fig.5

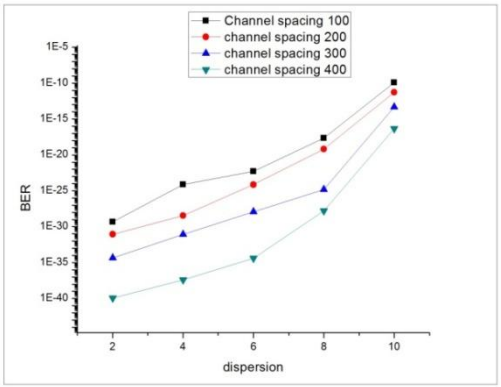

Fig.5.BER v/s dispersion graph for different channel spacing

The Eye height increases as we increase the channel spacing the variations in eye opening is from 6.2 × 10−3 to 3.5 × 10−3 for channel spacing 100GHz, 7.1 × 10−3 to 3.5 × 10−3 for channel spacing 200GHz , 7.6 × 10−3 to 3.9 × 10−3 for channel spacing 300GHz , 7.9 × 10−3 to 4.1 × 10−3 for channel spacing 400GHz as shown in Fig.6

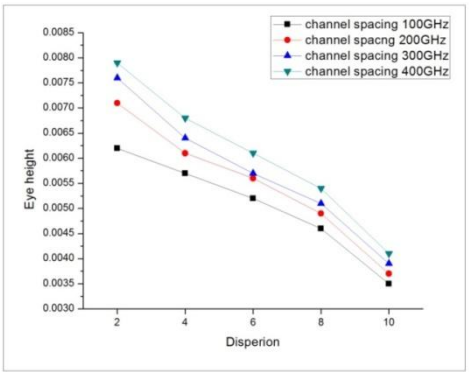

Fig 6.Eye height v/s dispersion graph for different channel spacing

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ISSN (Print) 2319-5940

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IV. CONCLUSION

We have analyzed the 32 channel WDM and DWDM system at 20 Gbps. We observed that with increase in dispersion the Q-factor decreases, Eye opening and BER increases. The system is analyzed at different channel spacing and we have concluded that at 400GHz and 300GHz channel spacing the performance is better i.e WDM is better than the system using channel spacing 100GHz and 200GHz i.e DWDM .the performance is analyzes in terms of Q-Factor , Eye height, and BER .

ACKNOWLEDGMENT

The authors would like to acknowledge the GNDU for providing the Optisystem 7.0 software

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BIOGRAPHY

Parveen Bagga is pursuing his M.Tech degree in Electronics and Communication from GNDU Regional Campus Jalandhar, India. Her special fields of interest is Optical Fiber Communication Systems