RESEARCH ARTICLE OPEN ACCESS

Quality analysis on Spectral response of a multiplexer combining WDM and SDM and increasing bandwidth efficiency

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Abstract :

Dense wavelength division multiplexing system is a system for coupling and transmitting the optical signals at different wavelength through the single fiber. Such technology is communication system and to meet the growing demands of bandwidth. It is used to provide higher bandwidth ensuring quality of service using WDM and SDM for long distance network communication of more than 80km. OPTISIM tool is used to stimulate the optical communication system using DWDM at the signal propagation level to optimize Bit Error Ratio(BER),power level management and to control traffic for more bandwidth efficiency.

Keywords –

Dense wavelength division multiplexing, power level management, bit error rate, dispersion compensation

I. INTRODUCTION

Fibre optic cable is made up of glass or silica which carries optical signals. Here DWDM(Dense Wavelength Division Multiplexing) is used. There are 5 processes involved In the transmission of the data, let it be P1,P2,P3,P4,P5 P1 - User information encoding, P2 - Modulation (conversion of electrical signal into optical signal), P3 - Optical fibre (Medium), P4 - Demodulation(conversion of optical signal into electrical signal), P5 – Decoding the user data These 5 processes are involved in the optical signal transmission. Total Internal Reflection is the concept used in the transmission of the optical signal (Snell's Law).

Generally, WDM systems are divided into different wavelength patterns, conventional/coarse (CWDM) and dense (DWDM). To meet growing demands for bandwidth, a technology called Dense Wavelength Division Multiplexing (DWDM) has been developed that multiplies the capacity of a single fibre. DWDM technology is used for less spectral width(1530-1565nm). DWDM technology is used for unlimited Transmission capacity. Transmission capabilities is 4-8 times of TDM systems with the help of Ebrium doped optical amplifier. Ebrium doped optical amplifier increases the optical signal and don't have to regenerate signal to boost it strength. Here in DWDM technology the OTM called optical terminal multiplexer is placed at the terminals of the system.

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II. WINDOW USED

The spectrum used in this module D-band(Dense) which range varies from 1530-1565nm. The spectral width of D-band is 35nm. This range specifically used for longer distance. The attenuation loss is 0.3dB/km. The frequencies of spectral width are 0.4,0.8,1.6,3.2 used to analyze the QOS.

III. EXISTING MODEL

In the existing system, amplifiers and optical detectors add the noise.

1. Medium causes dispersion.
2. Attenuation loss is based on distance.
3. The usage of bandwidth efficiency by user is less.

IV. PROPOSED MODEL

In the proposed method, Ebrium doped optical amplifier and avalanche photo diode are used to eradicate the noise. In order to compensate dispersion, the DCF is used. The spectrum used here causes attenuation loss of 0.3dB/km which is efficient for longer transmissions. In order to reduce interference that caused by channels can be controlled by power level management. The TDM technique is used for traffic grooming for bandwidth efficiency.

V. COMPONENTS

A. HARDWARE:

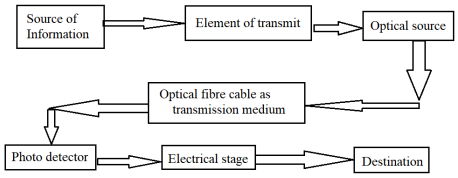


Fig. 1 Block Diagram

1) WDM TRANSMITTER :

WDM transmitter is used to transmit the signal with high speed of different wavelengths to the input of multiplexer.

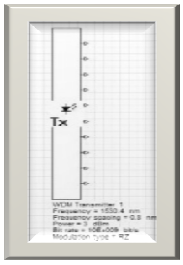


Fig. 2 WDM Transmitter

2) WDM MULTIPLEXER:

Mux is nothing but many to one signal. It is used to mix the different wavelength optical signals to one optical signal.

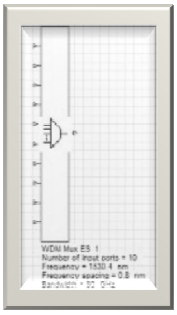


Fig. 3 WDM Multiplexer

3) Optical Amplifiers and Attenuators:

These two are connected after every component to control the signal power. Here the EDFA(Erbium Doped Fibre Amplifier) is used and it can boost the signal upto 22dB. Attenuators are used to control the power range from +3dB to negative power values..

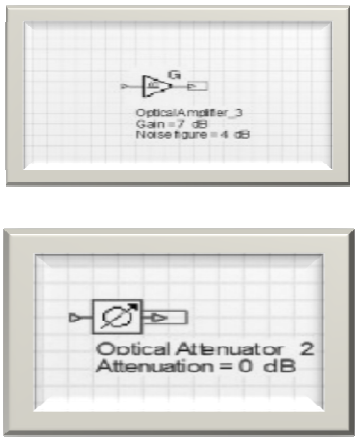


Fig. 4 Optical Amplifiers and Attenuators

4) OPTICAL FIBRE:

Uni-directional optical fibre is used in this project for long distances. The spectrum transmitted in this fibre lose 0.3dB/km. While transmitting signals for long distances dispersion values are increased. In order to compensate the dispersion the fibre with heavily doped by GeO2 is used.

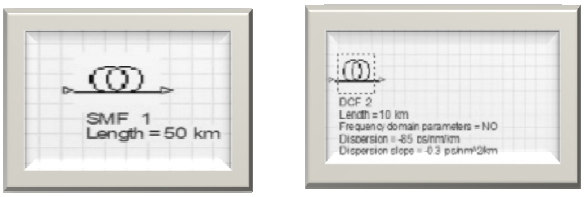


Fig. 5 Optical Fibre

5) WDM DEMULTIPLEXER:

It is used to separate one optical signal into n optical signals(i.e., mux inputs).

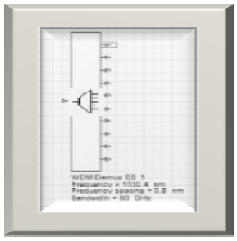


Fig. 6 WDM De-multiplexer

6) OPTICAL RECEIVER:

It is an electro optic device that converts optical into electrical signals.

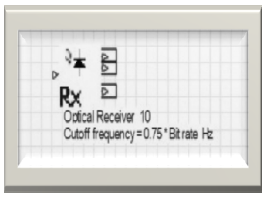


Fig. 7 Optical Receiver

7) OPTICAL POWER METER:

Optical power meter is used to display the power that exists in the circuit.

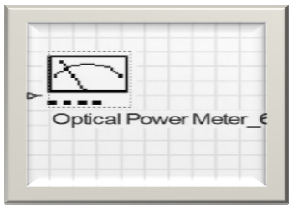


Fig. 8 Optical Power Meter

8) ANALYZERS:

It is used to analyze and display the signals whether received or not and also noise levels are displayed. OSNR (Optical Signal to Noise Ratio) of every optical signal is displayed. It is a ratio of number of bit errors to total number of transferred bits. The performance of digital receiver is measured by BER parameter.

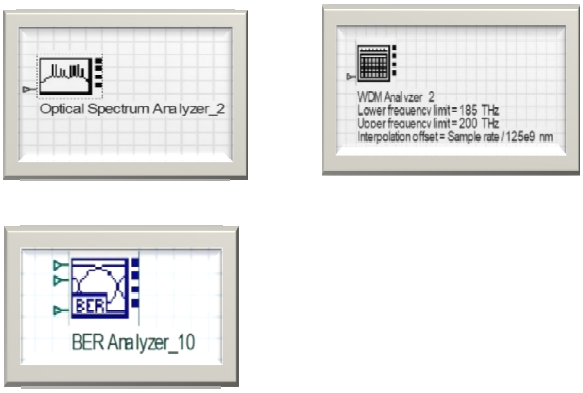


Fig. 9 Analyzers

VI. SOFTWARE

Optisim is a simulation software tool which is used to design optical fibre communication(OFC) model. This software is used to find BER and OSNR which are useful for analyzing quality of service of design. It includes various advanced features like looping the design and creating subsystems to avoid complexities. This software can also supports long distance communications(>80KM). The interface is user-friendly and simulation time is quick with recent development. The tool holds many advantages like power management through various iteration values.

VII. WORKING

Initially, the basic DWDM architecture is designed in order to analyse the different frequencies i.e.,(1.6nm, 0.8nm, 0.4nm) in a desired window

1.6 Frequency(dB)	0.8 Frequency(dB)	0.4 Frequency(dB)
0	0	9.5e^-3
0	0	5.1e^-7
0	0	1.5e^-5
0	5.5e^-2	0.00012
0	6.4e^-9	0.00059

By comparing the above frequencies the 1.6 and 0.8 produce better BER values. 1.6 has more efficiency than 0.8 but by using 1.6 frequency we can accommodate less number of spectral lines .so,0.8 frequency is moderate for the design. The following design is based on 0.8 nm frequency.

i. *POWER LEVEL MANAGEMENT:*

Power management is performed to the active components that are used in the design like WDM transmitter, Amplifier and Attenuators. The range of power values can be altered in the linear box in order to enhance QOS of the design. By varying and analysing with different power values, the best output values are finalized.

ii. *DISPERSION COMPENSATION FIBRE:*

As of now long distance fibre has more dispersion. In case of DCF, negative dispersion coefficients are present. So, the DCF is used to compensate the dispersion present in a fibre cable. The length of DCF is varied according to the dispersion that occur in normal fibre. The attenuation loss in DCF is 0.5dB/km.

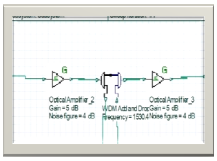
iii. *TRAFFIC GROOMING BANDWIDTH EFFICIENCY:*

Assume every channel supports the data rate of 10Gbps. If user requirement is about 2Gbps, the channel efficiency used is 20%. In order to increase the channel efficiency, TDM technology is used. TDM technology is used to split the data rate as per user requirement. By this maximum bandwidth efficiency is achieved. By using delay the user can be able to use the entire channel data.

Final BER values(dB)
1.2e^-08
3.5e^-05
6.2e^-05
1.4e^-06
0
5.2e^-09
1.1e^-04

iv. *ADD DROP MULTIPLEXER:*

Add Drop mux is used to drop and add the signals to an intermediate station between source and destination. The channel which is dropped to the intermediate station is again added to the mux. Optical Add Drop Multiplexer is placed at intermediate such that adding and dropping of the signals can be achieved.



VIII. OUTPUTS

For the optimum design, the BER value should be <=10^-9.

IX. CONCLUSION

This paper presents the design and implementation of Quality analysis on Spectral response of a multiplexer combining WDM and SDM and increasing bandwidth efficiency .By working with different frequencies, the frequency with 0.8nm fives high bandwidth efficiency and quality of service in order to control traffic grooming an tdm technology is used and also power management among active components ensure high quality. The final value gives 85% efficiency.

X. REFERENCES

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