

## PARAMETRIC ANALYSIS OF HYBRID AMPLIFIERS (EDFA AND RAMAN AMPLIFIER) ON 40GBPS ON 8 USERS WDM SYSTEM

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### ABSTRACT

To fulfill the need of higher bandwidth, increased number of users, increased speed of communication of current users, the WDM and fiber optic concept was developed. WDM stands for wavelength division multiplexing where many input signals are combined together and transfers as a single input. Multiplexing and de-multiplexing concepts are used in WDM. WDM system consist of amplifiers that are used to increase the performance of the optical fiber system. This study give information about the working of Hybrid amplifiers i.e. EDFA (Erbium Doped Fiber Amplifier) and Raman Fiber amplifier on 40 Gbps on 8 users WDM system. Optisystem is used to do the simulation of the proposed work . The objective of this study is to analyze the various parameters of 40 Gbps WDM with 8 users. The result section shows the results such a system

### INTRODUCTION

An optical fiber which is flexible in nature and made up of translucent silica glass is a communication medium which consists of a thicker diameter such as human hair. Optical fiber is a communication medium which is used in current scenario and it transmits the data in the form of light waves. Fiber optic is one of the fastest medium for communication over a long distance as comparative to communication using wires. It also has a wide range of bandwidth to transmit the data. It make use of the fibers as compared to metallic wires. Data transmits with lesser chances of loss in fiber optics. Another good feature of fiber optic cables is that they are resistant to electromagnetic interference whereas the wired cables are more prone to electromagnetic interference. Optical fibers are used in various range of fields and have many applications such as it is used for illumination in which it is windup into a group so that they can easily carry the image. An example of application of fiber optic which comprised of special kind of fiber optic cables are Fiber optic sensors and fiber lasers. Optical amplifiers also make their usage in optical fiber data links in order to increase the performance.

Figure 1 depicts various means by which optical amplifiers can be deployed in fiber optic data links. In figure below three types of amplifiers are used which are as below: Booster

**Amplifier:** Booster amplifier enhances the output of the optical transmitter before the optical signal is introduced to it. It attenuates the optical signal as signal enters in the transmission media. Inline

**Amplifier:** It regenerates the optical signal to its original power.

**Pre-Amplifier:** It is used at last after implementing all amplifiers to the optical fiber. Its purpose is to increase the sensitivity corresponding to an optical receiver.

#### Types of Amplifier

##### The amplifiers are of following types

##### *Erbium Doped Fiber Amplifier*

It is called as EDFA and shown in figure 2 below. In this amplifier the amplifying media is made up of glass optical fiber covered with erbium ions.

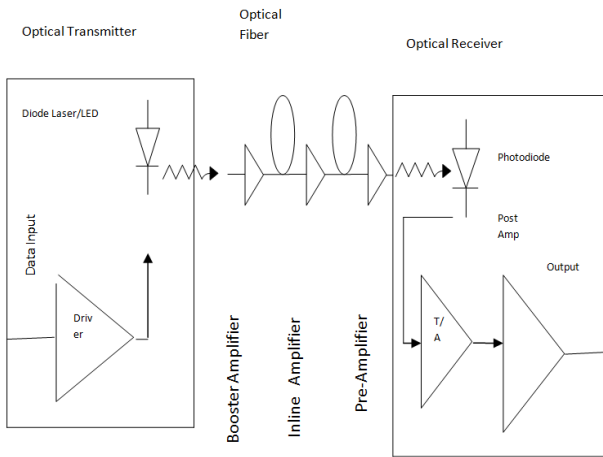


Figure 1. Optical amplifiers in a fiber optic data link

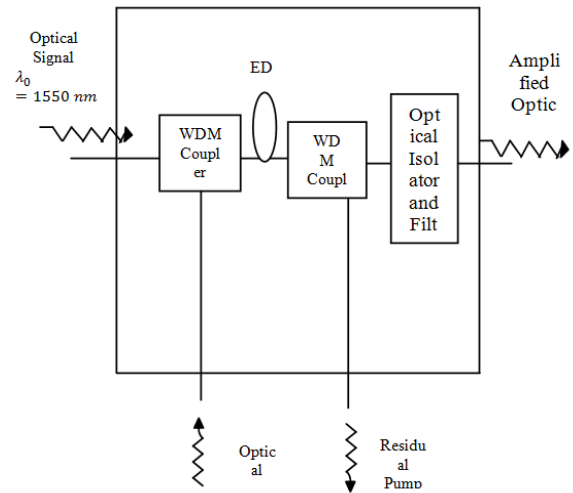


Figure 3. An EDFA for which the optical signal and optical pump are co-propagating

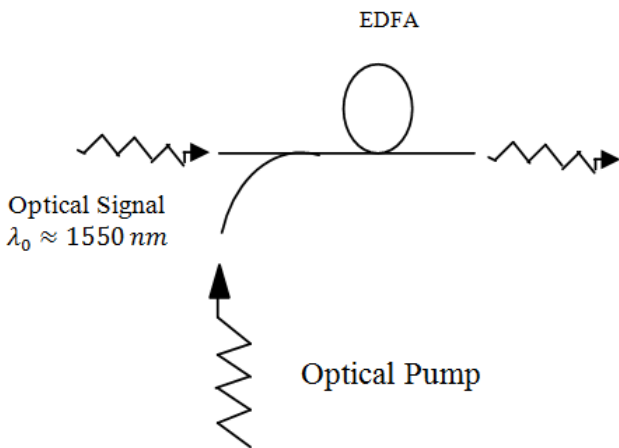


Figure 2. An erbium-doped fiber amplifier

The erbium is jumped to a level of population transposition with disconnected optical input. As depicted in figure 2 the erbium coated with erbium ions absorbs light waves at a distance from 1550 nm. EDFA shields the signals from noise as it is a low noise amplifier and have the capability to amplify many wavelength at a given period of time. EDFA amplifier is widely used for applications of optical communications.

**EDFA Configurations**

The configuration of EDFA is discussed in this section. The optical pump is connected with the wave signal with erbium coated fiber cable which is further connected to WDM i.e. Wavelength Division Multiplexing as shown in figure 3. Then a second multiplexer is attached to eliminate remaining pump light from optic fiber. An inline optical filter is attached which restrict the pump light to reach optical amplifiers. The purpose behind deploying the isolator is to prevent the optical wave light to collapse with signals of amplifiers.

**Fiber Raman Amplifier**

Fiber Raman Amplifier is referred as undoped optical fiber amplifier. Following figure4 shows the structure of Raman amplifier. In Raman the power is transmitted over the signal by using nonlinear optical process which is known as Raman Effect. Optical pump is used to supply the energy to the optical gain.

The wavelength of the signals which suffers amplifier from optical gain are considered as wave of optical pump, hence Raman amplifier is employed to amplify the wave of given signal on the basis of proper election of optical pump. In this amplifier the optical gain is dispersed over a long distance on optical fiber. Raman amplifier and EDFA can be collaborated in order to achieve optical gain in optical fiber at the end of fiber and to generate a uniform power profile along the length of the optical fiber signal.

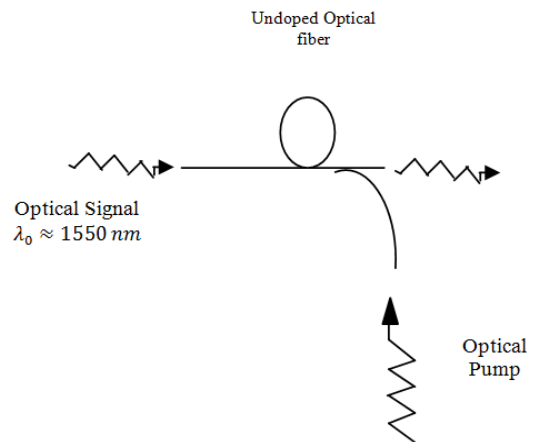


Figure 4. A fiber Raman optical amplifier

**PROBLEM FORMULATION**

With the increased network technology and the internet, the need of the users also increases. The need of high bandwidth, high data transmission rate also enhances. The concept of WDM and fiber optic was developed to fulfill this need. WDM is a wavelength division multiplexing in which various input signals are combined together and transfers as a single input. It uses the concept of multiplexing and de-multiplexing. Many methods have been developed in last few years which are able to enhance the number of users and data speed of the system but still the number of supported users are nearby 8 which is quite low in number. Another issue faced in previous developed systems was that it supports only the speed of data rate which is limited to 10Gbps. Many amplifiers were merged together to develop a proper solution to the problem but still was not quite capable to meet the requirements or difficulties faced by the users.

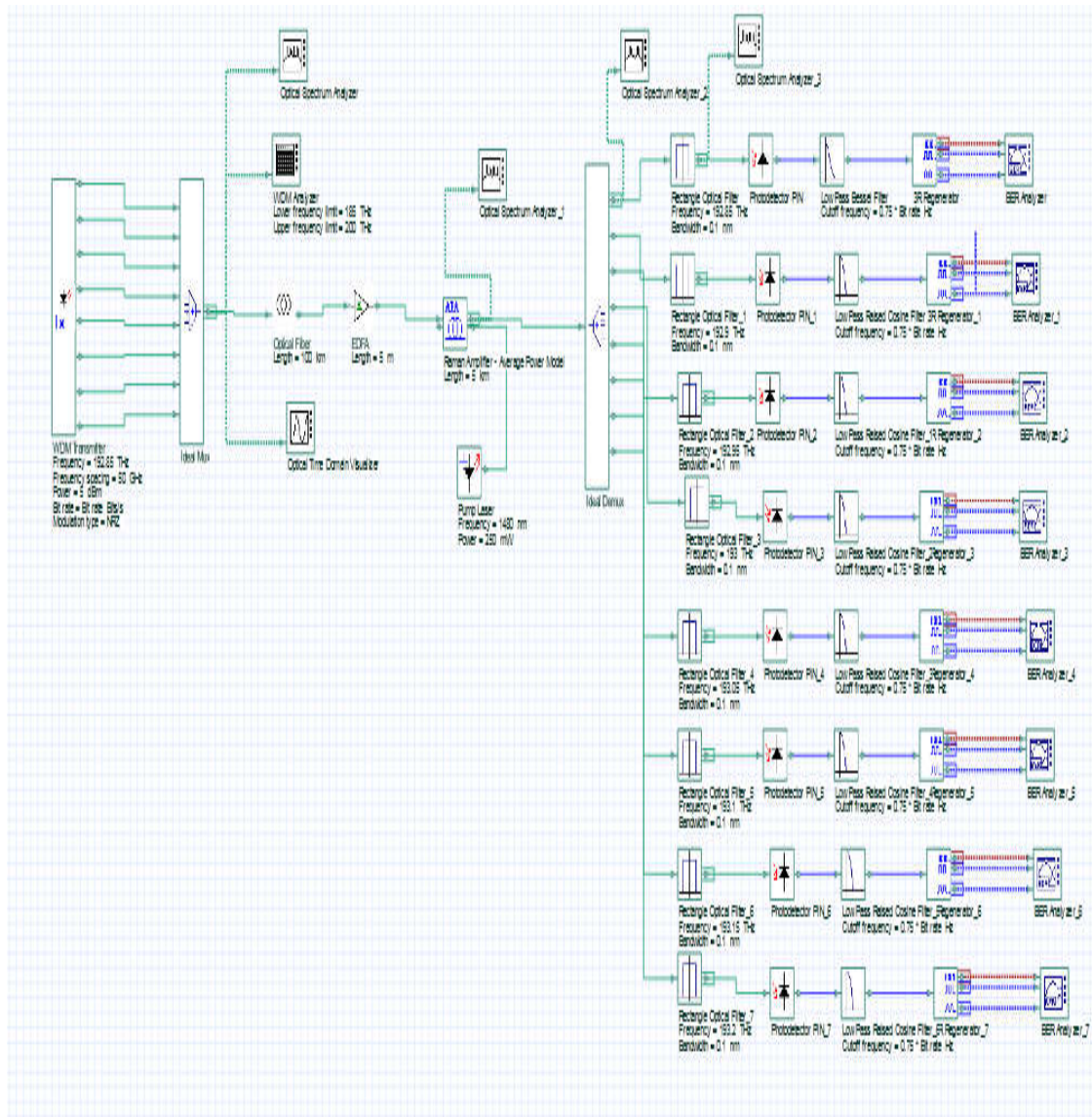


Figure 5. Simulink Model of 8 users WDM (40 Gbps)

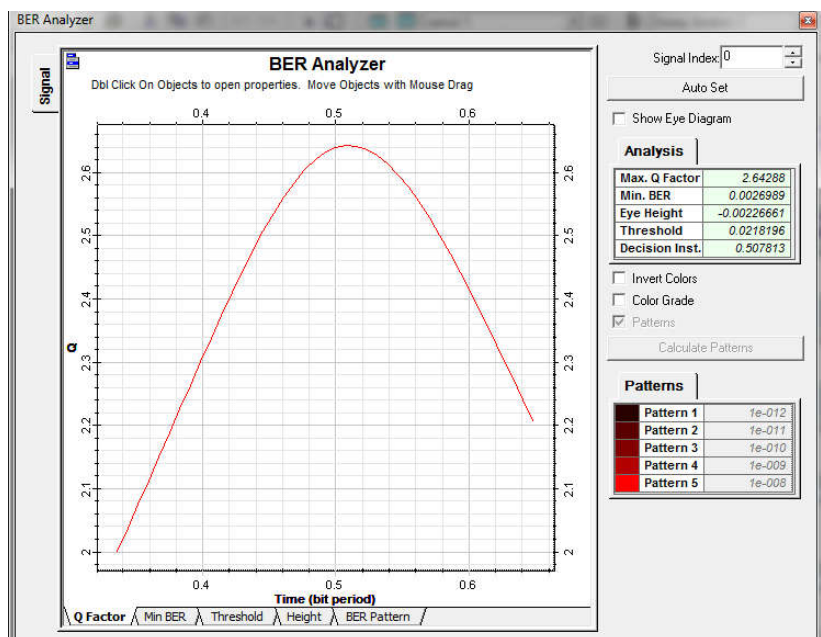


Figure 6. Q factor of 40 Gbps WDM system with 8 users

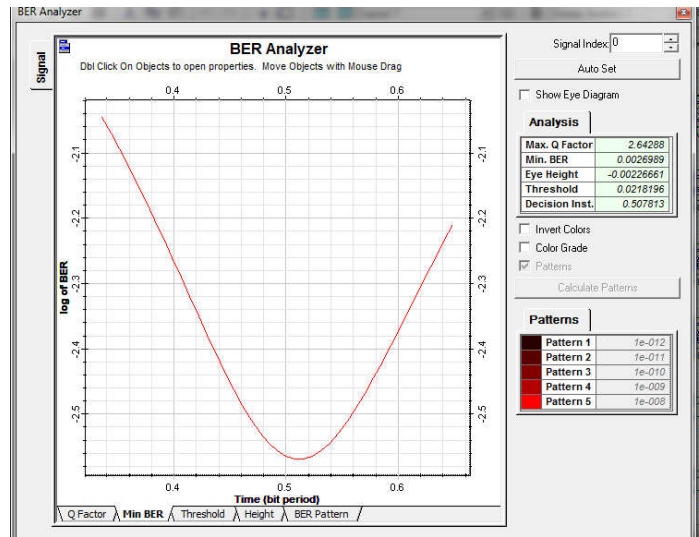


Figure 7. Min. BER of 40 Gbps WDM system with 8 users

ENGLT	EDFA AND RAMAN AMP.	MAX. Q FACTOR	BER	EYE HEIGHT
10	10	4.17441	1.48767e-005	.00311833

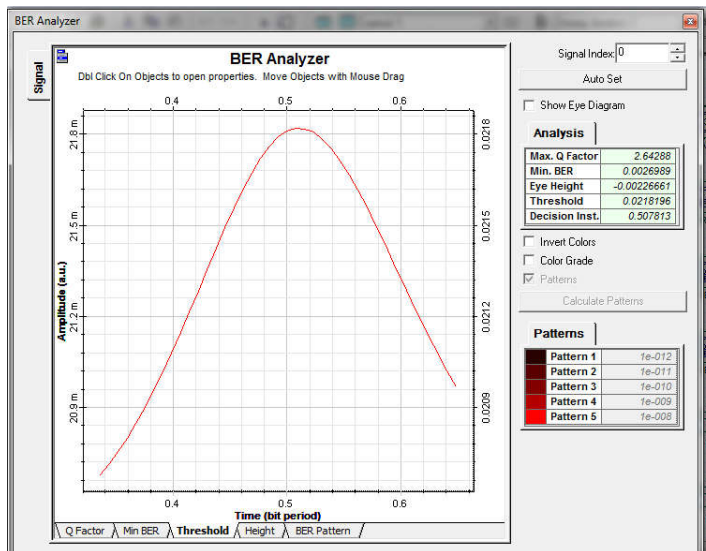


Figure 8. Table representing various parameters

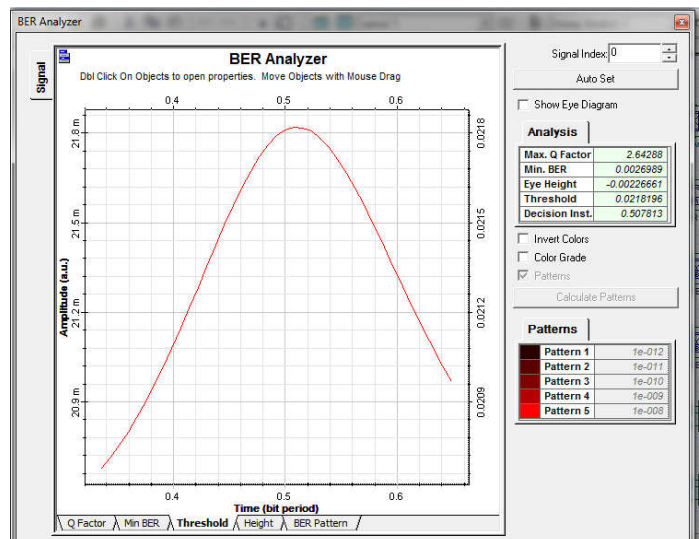


Figure 9. Threshold of 40Gbps WDM system with 8 users

Hence there is a requirement to develop such a system which can support the more than 8 users at a time and also opt to access the higher bandwidth.

## PROPOSED WORK

The previous section gives a brief revelation to the existing inventions that has been done in the field of optical networks or WDM to make it advantageous to the users. But after getting more profound into the inventions many inabilities were bring up the existence which were related to the less number users supported at a given time and low bandwidth which did not support higher data transmission rate over the connection. Hence it is necessary to flourish such a mechanism which can surpass the previous limitations. The proposed work is decided to implement a hybridization of two amplifiers such as EDFA-RAMAN-EDFA. This proposal also analyses the various parameters of the 8 user WDM system. 40Gbps bandwidth will be considered to entertain the data.

## RESULTS

Wavelength division multiplexing system is a communication system which is based on fiber optic communication medium. In this study the analysis of various parameters of WDM systems has been done. WDM systems with 8 users is performed. This section depicts the results obtained after simulating the WDM system. The following figure shows the simulink model of WDM with 8 users. Here there are 8 users connected to a multiplexer. The multiplexer is further attached to the analyzers i.e. WDM analyzer, optical analyzer and amplifiers such as Raman and EDFA amplifier. In figure6 the bit error rate is depicted. From the eye diagram it is observed that the BER is 0.00410652. This diagram depicts the value of BER corresponding to 8 user WDM system with EDFA and Raman Amplifier. The quality factor is evaluated 2.642288.

## Conclusion

Optical Fiber communication is one of the emerging communication technology. WDM is an example of optical fiber communication which is widely used in various fields of networking in order to provide fast data transmission and higher bandwidth. This study gives an overview to the concepts of amplifiers and detailed information regarding EDFA and RAMAN amplifier and a hybrid amplifier which comprised of EDFA and RAMAN amplifier is analyzed. The analysis study is evaluated on 40 Gbps WDM with 8 users. The results are calculated in the form of BER and Quality factor. Further enhancements can be done by using further hybridization of EDFA, RAMAN and EDFA to enhance the performance of WDM system.

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