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Simulation of Hybrid Amplifiers(EDFA and Raman Amplifier) on 40GBPS on 8 and 16 Users WDM System

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AbstractL: ***To fulfill the need of higher bandwidth, enhanced number of users, enhanced speed of communication of today's users, the concept of WDM and fiber optic was developed. WDM is a wavelength division multiplexing. In which the multiple input signals are combined together and transfers as a single input. It uses the concept of multiplexing and de-multiplexing. WDM system comprises of amplifiers that are used to enhance the performance of the optical fiber system. This study analyzes the working of Hybrid amplifiers i.e. EDFA (Erbium Doped Fiber Amplifier) and Raman Fiber amplifier on 40 Gbps on 8 and 16 users WDM system. The simulation of the proposed work is done by using optisystem. The objective of this study is to analyze the performance of 40 Gbps WDM with 8 users and 16 users. The result section shows the results of both systems.***
Keywords—Wavelength Division Multiplexing, Optical Fiber Communication, Amplifiers, Erbium Doped Fiber Amplifier, RAMAN Amplifier .

I. INTRODUCTION

An optical fiber is a communication medium which is flexible in nature and made up of translucent silica glass which poses a thicker diameter as human hair. Optical fiber is a communication media which is widely used nowadays and it transmits the data in the form of light waves. Fiber optic is considered as the fastest medium for communication over a long distance as compare to wired communication. It also facilitates the user with a wide range of bandwidth to transmit the data. It utilizes the fibers as compare to metallic wires. In fiber optic, data transmits with lesser chances of loss. Another feature of fiber optic cables is this that they are electromagnetic interference resistance whereas the wired cables are more prone to electromagnetic interference. Optical fibers are used in wide range of fields and have various applications such as it is used for illumination in which it is wrapped into a group so that they can easily carry the image easily. Fiber optic sensors and fiber laser are an example of application of fiber optic which comprised of special kind of fiber optic cables. Optical amplifiers are used in optical fiber data links in order to enhance the performance. Figure 1 depicts the different means by which optical amplifiers can deployed in fiber optic data links. In figure below three types of amplifiers are used which are as below: Booster Amplifier: the purpose of this amplifier is to enhance the output of the optical transmitter before optical signal introduced to it. It attenuates the optical signal as signal enters to the transmission media. Inline Amplifier: It is used to regenerate the optical signal to its initial or original power. Pre-Amplifier: It is used at last after implementing all amplifiers to the optical fiber. Its purpose is to enhance the sensitivity of corresponding to an optical receiver.

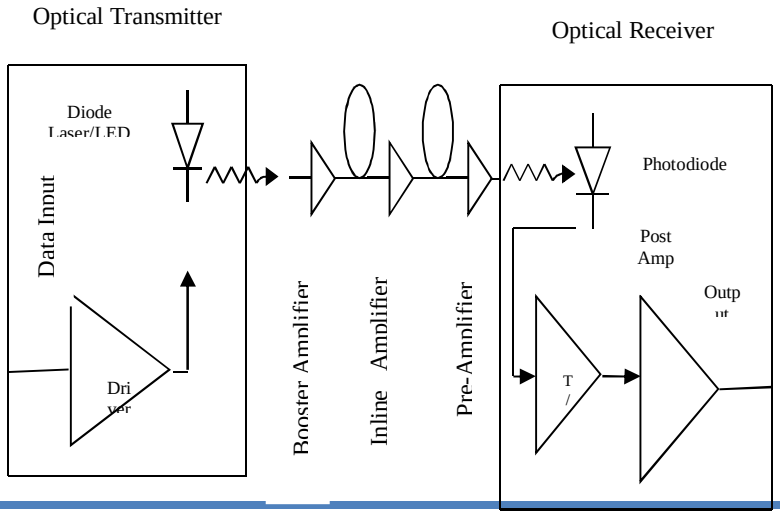

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Figure 1 Optical amplifiers in a fiber optic data link

Types of Amplifier

The amplifiers are of following types

A. Erbium Doped Fiber Amplifier

It is also known 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. 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 absorb light waves at a distance from 1550 nm. EDFA protects the signals from noise as it is a low noise amplifier and also have the capability to amplify more than one wavelength at a given period of time. EDFA is an amplifier which is widely used for applications of optical communications.

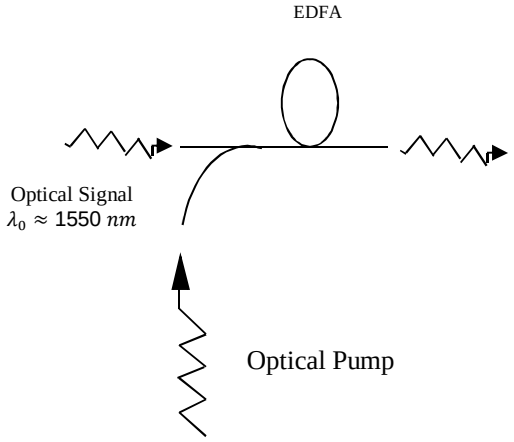

Figure2. An erbium-doped fiber amplifier

B. 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.

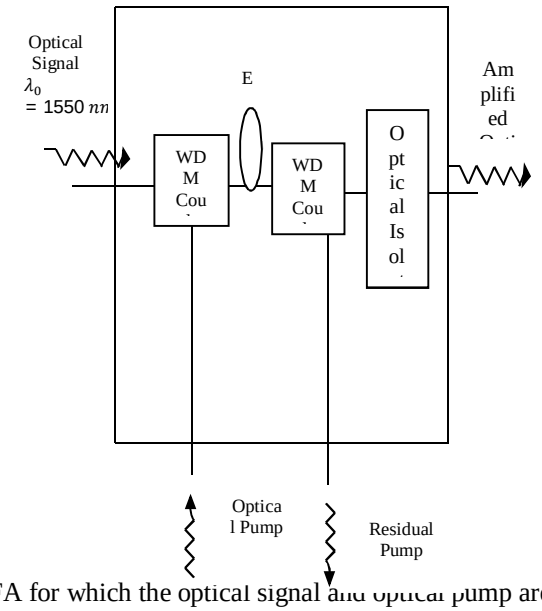

Figure 3 An EDFA for which the optical signal and optical pump are co-propagating

C. Fiber Raman Amplifier

Fiber Raman Amplifier is referred as undoped optical fiber amplifier. Following figure4 represents the structure if Raman amplifier. In Raman amplifier 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 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.

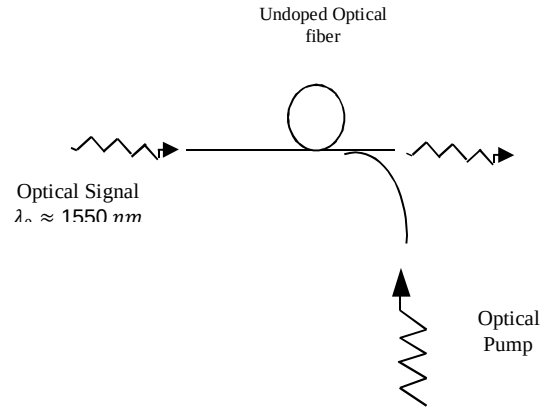

Figure 4. A fiber Raman optical amplifier

II. PROBLEM FORMULATION

With the increase in the technology of networks and the internet, the need of the users also increases. The requirement of high bandwidth, high data transmission rate etc increases. To fulfill this need the concept of WDM and fiber optic was developed. WDM is a wavelength division multiplexing. In which the multiple input signals are combined together and transfers as a single input. It uses the concept of multiplexing and de-multiplexing. Various methods have been developed in last few years which can be able to increase the number of users and speed of data travelling over the system but still the number of supported users are nearby 8 which is quite low in number. Another issue that were faced in earlier developed systems was that it supports only the speed of data rate which is limited to 10Gbps. Various 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. 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.

III. 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 engaged into the inventions various inabilities were bring up to the existence which were related to the less of number users supported at a given interval and lower bandwidth which did not support higher data transmission rate over the connection. Hence it is adjudicate to flourish such a mechanism which can overcome the previous limitations. The proposed work is decided to implement a hybridization of two amplifiers such as EDFA-RAMAN-EDFA. This proposal also enhances the number of users from 8 up to 16 and the 40Gbps bandwidth will be considered to entertain the data.

IV. RESULTS

Wavelength division multiplexing system is a communication system based on fiber optic communication medium. In this study the analysis of two different WDM systems i.e. 40 Gbps WDM systems with 8 users and 16 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

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amplifier.

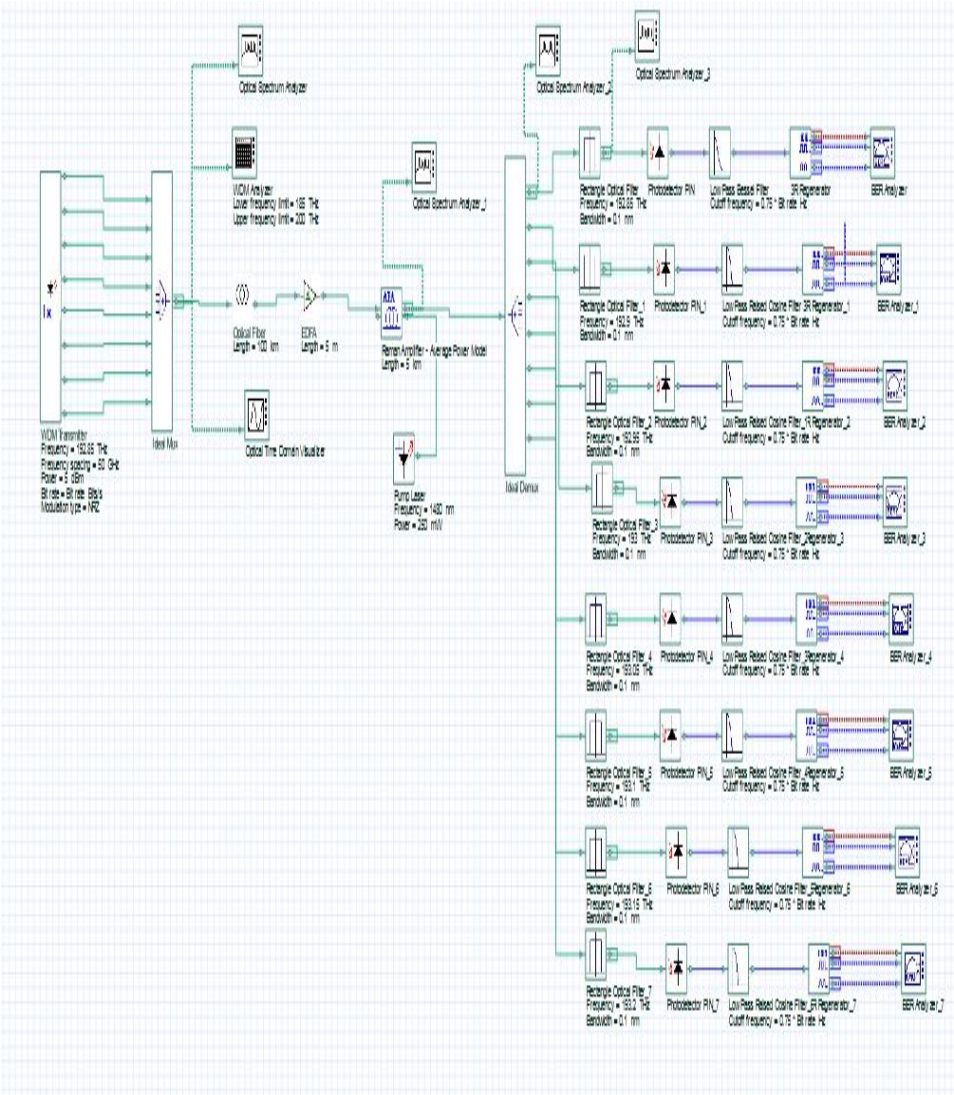
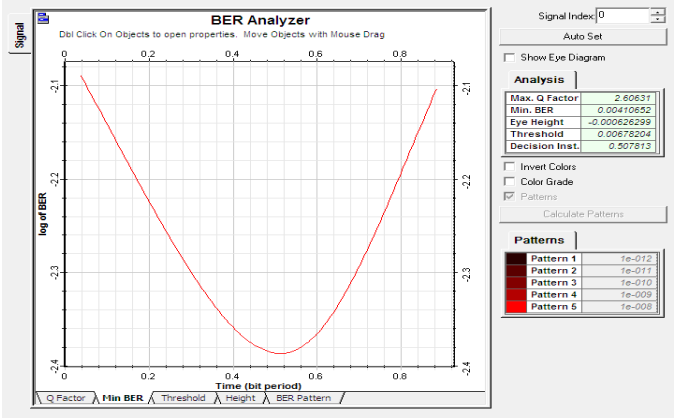


Figure 5 Simulink Model of 8 users WDM (40 Gbps)

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.

In figure 7 the Q factor of 40 Gbps 8 users WDM system. The quality factor is evaluated 2.60631.



Volume 5 Issue VI, June 2017
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Figure 6 BER of 40 Gbps WDM system with 8 users.

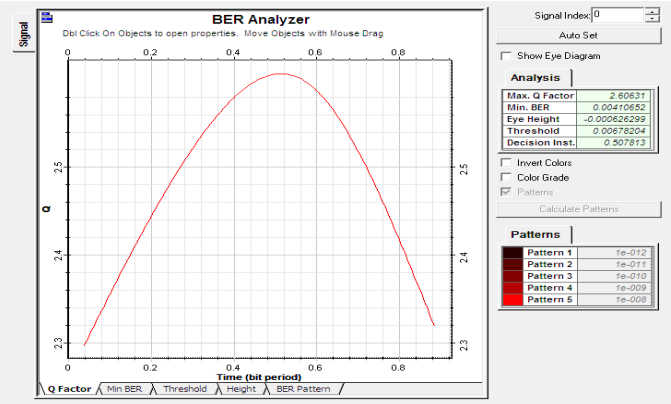

Figure 7 Q Factor of 40 Gbps WDM system with 8 users

The simulink model of 40 Gbps WDM systems with 16 users is defined in figure 8. In this there are 16 users connected to the communication system.

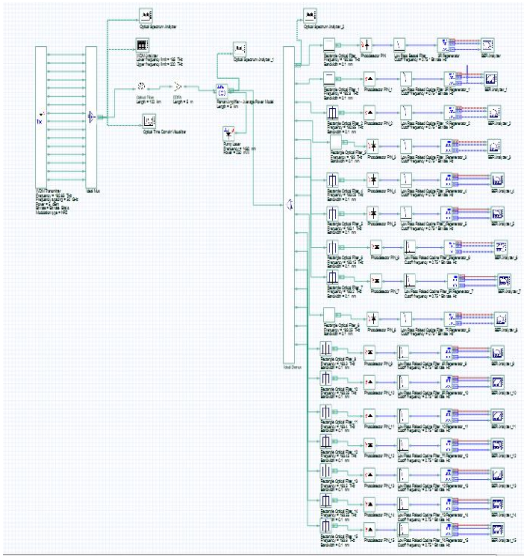

Figure 8 Simulink Model of 16 users WDM (40 Gbps)

The figure9 below represents the BER obtained in system WDM system. The evaluated BER is 0.00516323.

Volume 5 Issue VI, June 2017
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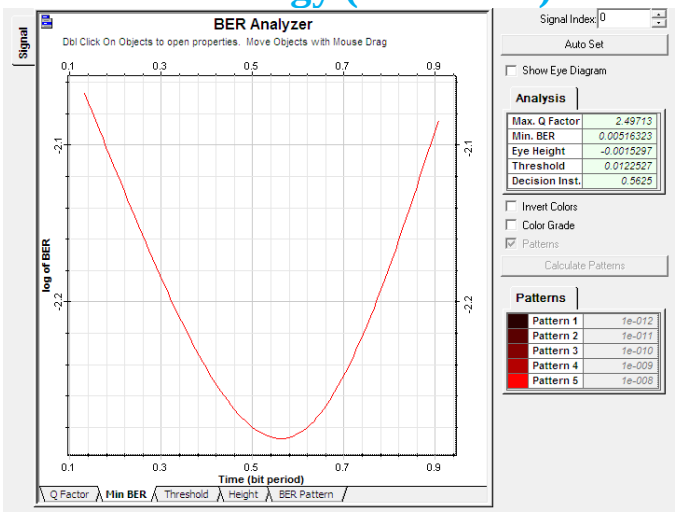

Figure 9 BER of 40 Gbps WDM systems with 8 users.

The Q factor of 16 users WDM is 2.49713 as shown in figure10 below.

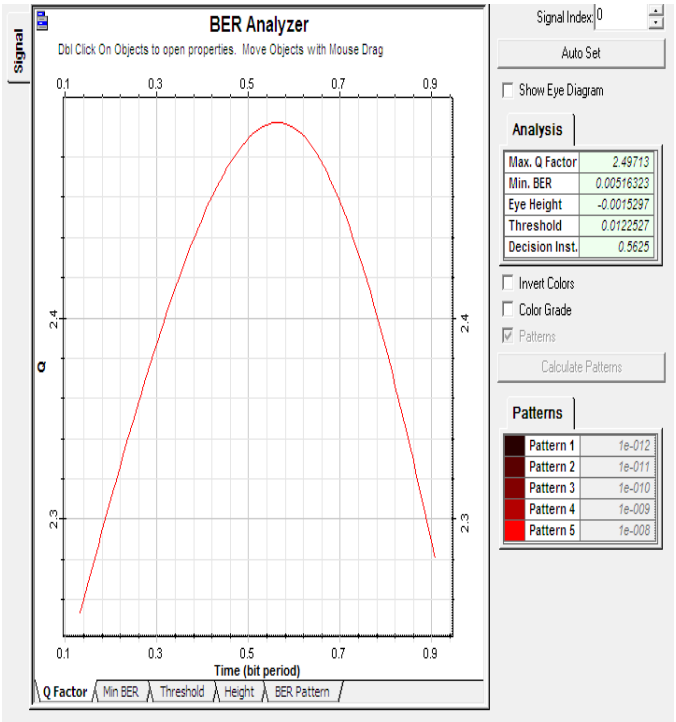

Figure 10 Q Factor of 40 Gbps WDM systems with 8 users

V. 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 and 16 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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Volume 5 Issue VI, June 2017
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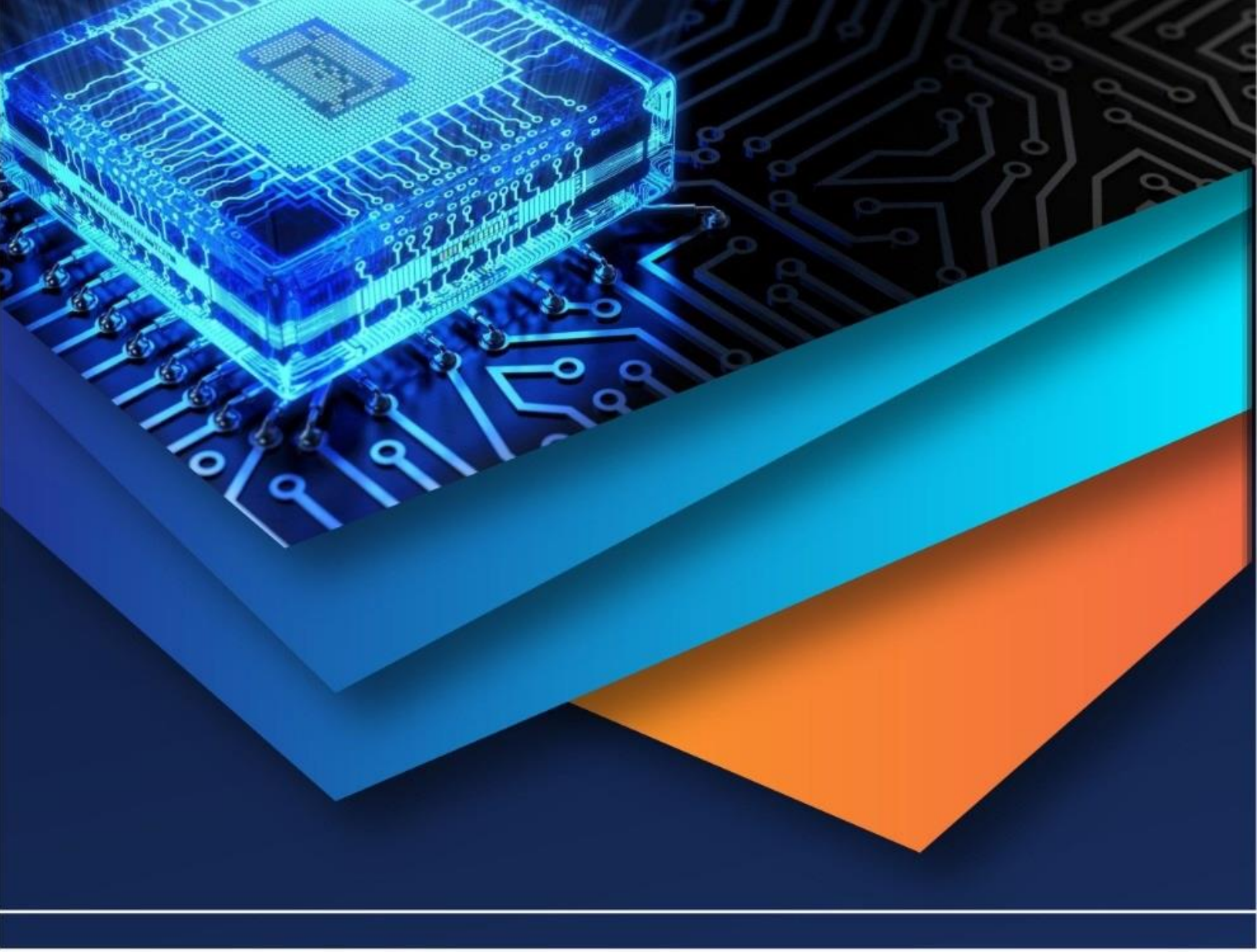

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