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# Performance analysis of 32 channels DWDM technique utilizing erbium doped fiber amplifier (EDFA) with the comparison of semiconductor optical amplifier (SOA)

**Dr.G.Karpagarajesh[1], Dr. T.K. Sethuramalingam[2], Dr.P.Revathy[3]**
[1]*Assistant Professor, Department of Electronics and Communication Engineering, Government College of Engineering, Tirunelveli, Tamilnadu.India*
[2]*Associate Professor, Department of Electronics and Communication Engineering, Karpagam College of Engineering, Coimbatore, Tamilnadu .India*
[3]*Professor and Head, Department of Computer Science and Engineering, Einstein College of Engineering, Tirunelveli, Tamilnadu.India*

***Abstract***-Dense Wavelength Division Multiplexing (DWDM) is an optical transmission strategy which is utilized to multiplex optical signs with various wavelengths into a solitary fiber material. Every fiber contains an arrangement of optical channels in parallel frame with particular light wavelengths. DWDM enables light wavelengths to transmit information a little bit at a time in parallel. Here a 32-channel DWDM framework is designed and reproduced and a comparison of the performance of EDFA and travelling wave SOA is shown. The 32-channel DWDM framework is reproduced by considering the two amplifiers specifically EDFA and SOA. The important performance measure results were recorded and compared in the terms of BER and eye diagram.
***KEYWORDS***: *DWDM, EDFA, SOA Amplifiers, Eye Diagram, Q-Factor, Min BER.*

## 1. INTRODUCTION

Fiber optic innovation has been nourished the requirement for wide band transmission. The strategy which consolidates the sources transmitting at various wavelengths λ1, λ2, λ3.... λn inside the same optical fiber and isolates again utilizing certain kind of indicators at the less than desirable end is known as WDM (Wavelength Division Multiplexing). DWDM a sort of WDM is utilized for close spaced frequencies of around 200GHz at wavelength of 1550nm. The transmitting end has a multiplexer to transmit the signs acquired from different sources into the optical fiber medium. De-multiplexer is utilized to separate the wavelengths at the less than desirable end [1].

## 2. MODELLING OF 32-CHANNEL DWDM SYSTEM

The 32-channel DWDM system is split-up into the following sections. Transmission section Channel and Receiving section

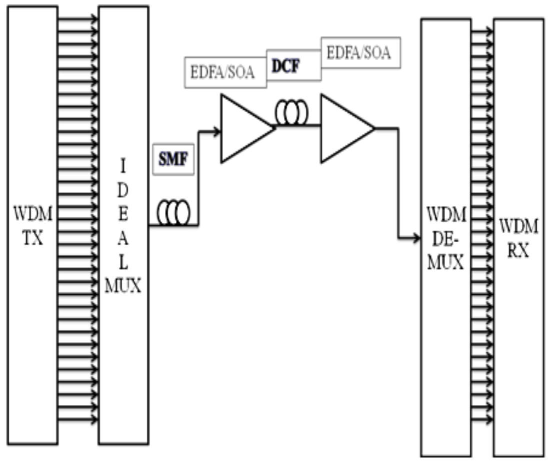


*Fig. 1. Block diagram of 32 Channel DWDM System*

## 2.1. TRANSMISSION SECTION OF DWDM SYSTEM

The DWDM transmission area has an external modulated transmitter. Remotely balanced lasers are perfect and utilized much of the time in DWDM frameworks. Nonlinearity and excessive chirp are avoided in externally modulated laser. By making utilization of external modulators the chirp is limited, by which the optical flag obliges less data transfer capacity. External modulators generally utilize the NRZ balance plot. Here a WDM transmitter which epitomizes DC inclination, NRZ generator, CW laser and modulator is used.WDM Ideal MUX with 32 input ports and 1 yield port is utilized.

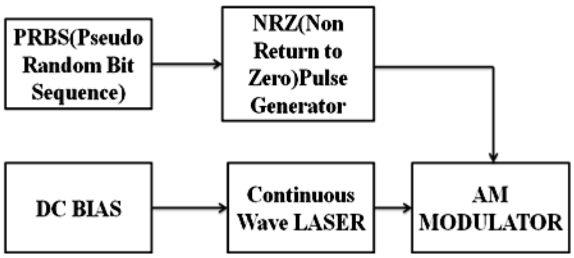


*Fig. 2. Block diagram of Transmitter*

## 2.2. CHANNEL OF DWDM SYSTEM

Here the two channels are examined using the following two different types of amplifiers.
SOA pumped fiber channel
EDFA pumped fiber channel

### 2.2.1 SOA PUMPED FIBER CHANNEL

Here travelling wave SOA is drawn into the fiber channel. The execution of Traveling wave SOA is contrasted with EDFA. Here travelling wave SOA is utilized as an amplifier alongside SMF and DCF. The Traveling Wave SOA is included after a length of 50km to compensate the direct misfortune. The scattering of SMF in 1550 nm window is 16.75ps/nm/km, in this way DCF ought to be utilized to correct the scattering. The chromatic scattering of DCF utilized here is - 90ps/nm/km, Hence if the length of DCF is 1/fifth of the SMF, at that point the scattering estimation of the transmission line will be near to zero[2]. To adapt to the bigger attenuation of DCF, SOA is added again to remunerate the linear loss toward the end of a channel after DCF. Here the Traveling Wave SOAs utilized have an infusion current of 0.15A.

Here the signal to be amplified and an optical pump are superposed. The pump energizes the doping erbium particles to a higher vitality level from which amplification happens through empowered emission. Erbium Doped fiber amplifiers are appropriate for the C and L band of the transmission window [1].

## 2.3 DWDM RECEIVING SECTION

The optical collector is utilized to change the optical sign into an electrical frame and get back the information transmitted through the framework. Optical recipient's plan to a huge degree relies upon the adjustment system of the Transmitter [3]. Its principle part is a photo detector that changes over the electromagnetic wave i.e. light into power through the photoelectric impact. The essentials of a Photo detectors are same as an optical source.

The optical collector ought to have high sensitivity, low noise, quick response, high unwavering quality and ease cost. The size ought to be compatible with the fiber core size. These essentials are best met by photo detectors built utilizing semiconductor materials. It is indeed to have a perfect de-multiplexer having basic parameters with 1 input and 32outputs where beneficiaries distinguish optical pulses and change over them once more into electrical bits at the getting area.

Here PIN photodiode which is extremely straightforward and quick is utilized. Basic decision-making circuit will witherward straight channel yield with the threshold value, settles on choice about the sign in perceiving the 1 and 0, with ongoing clock recuperation circuits.PIN photodiode, Low Pass Bessel channel having 4 × bit rate of transmission capacity and cut off recurrence is 0.75 × bit. 3R Regenerator is typified inside the BER analyzer. The DWDM light beneficiary situation outlined in Optisystem7.0 is
shown in Fig 2.

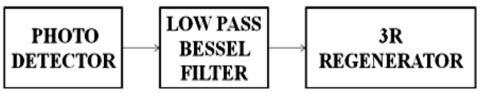


*Fig. 3. Block diagram of Receiver*

# 3 RESULTS AND DISCUSSION

## PERFORMANCE COMPARISON OF SOA AND EDFA AT BIT RATE OF 10GBPS, 30GBPS AND 60GBPS

The figures shown here are the simulation results attained for an EDFA pumped and SOA pumped 32 channels DWDM system at different circumstances

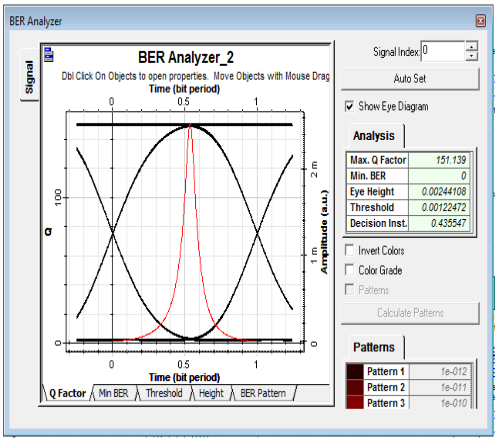


*Fig. 4. Eye diagram of an EDFA pumped 32 channel DWDM system for 10Gbps and at 120km.*

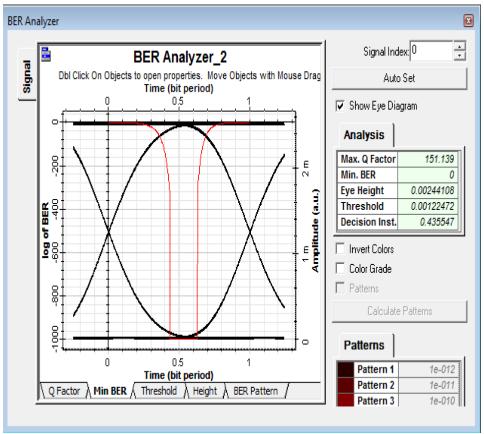


*Fig. 5. Eye diagram of an EDFA pumped 32 channel DWDM system for 10Gbps and at 120km.*

The Fig 4 and Fig 5 show the outputs of a channel when an EDFA is used in the 32 channel DWDM system, at a bit rate of 10Gbps for 120km. The Maximum Q Factor and Minimum BER noted are 151.139 and 0 respectively. The eye patterns noted here show that the channel is free from unwanted signals and ISI.

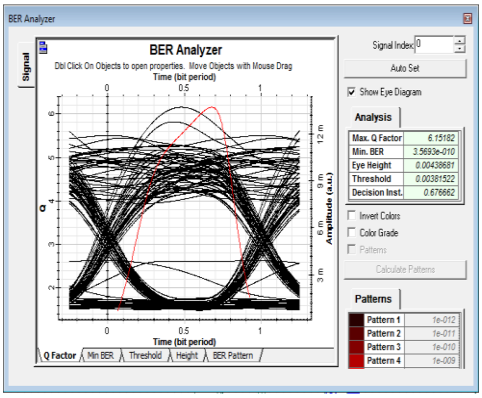


*Fig. 6. Eye diagram of SOA pumped 32 channel DWDM system for 10Gbps and120km.*

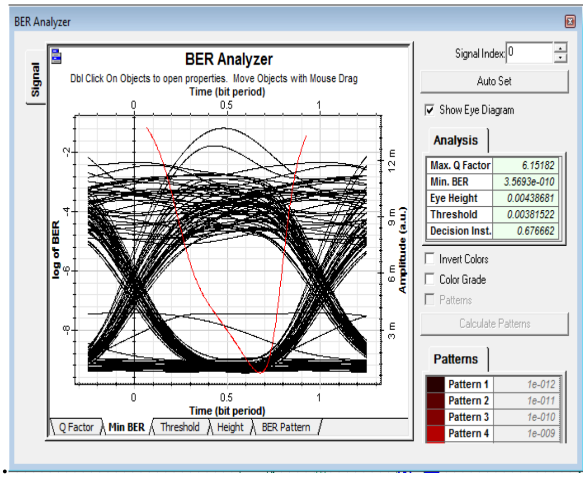


*Fig. 7. Eye diagram of SOA pumped 32 channel DWDM system for 10Gbps and at 120km.*

The Fig 6 and Fig 7 show the outputs of a channel when Travelling Wave SOA is used in the 32 channel DWDM system, at a bit rate of 10Gbps for 120km.The Maximum Q Factor and Minimum BER obtained are 6.15182 and 3.5693e⁻ 010 respectively. The eye patterns noted here show that the channel is affected by ISI and unwanted signals. The Maximum Q Factor obtained here is low when compared to EDFA.

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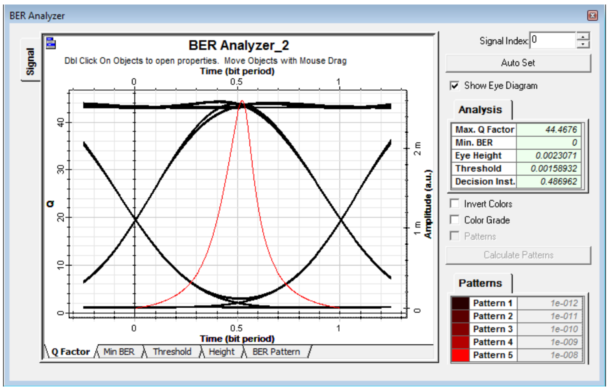


*Fig. 8 .Eye diagram of an EDFA pumped 32 channel DWDM system for 30Gbps and at 120km*

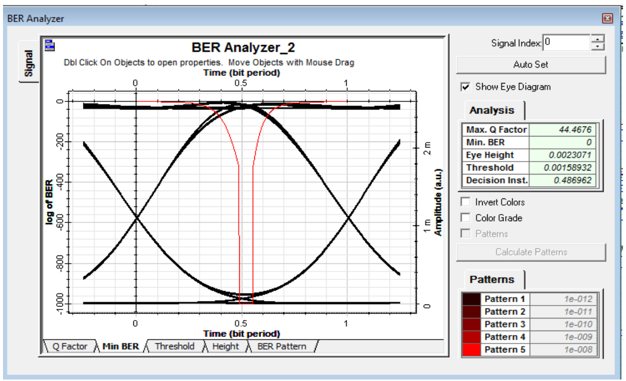


*Fig. 9. Eye diagram of an EDFA pumped 32 channel DWDM system for 30Gbps and at 120km.*

The Fig 8 and Fig 9 show the outputs of a channel when an EDFA is used in the 32 channel DWDM system, at a bit rate of 30Gbps for 120km. The Maximum Q Factor and Minimum BER noted are 44.4676 and 0 respectively. The eye patterns noted here show that the channel is free from unwanted signals and ISI.

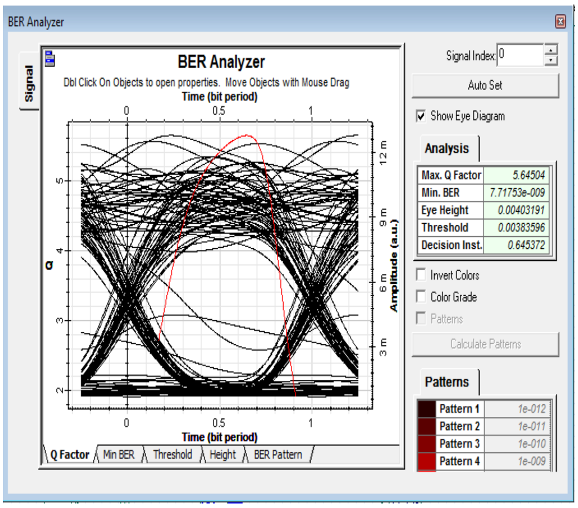

*Fig. 10. Eye diagram of SOA pumped 32 channel DWDM system for 30Gbps and at 120km.*

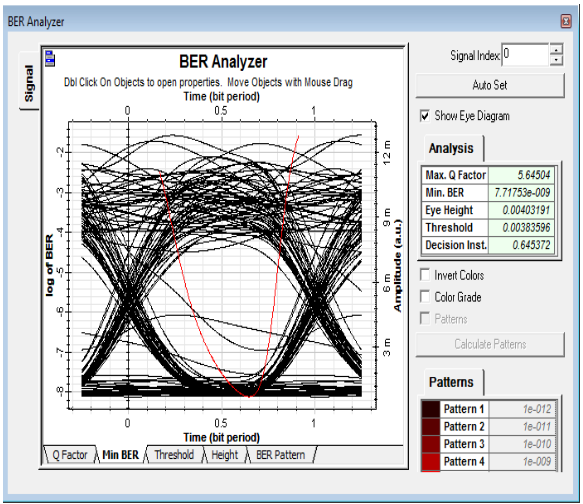


*Fig. 11. Eye diagram of SOA pumped 32 channel DWDM system for 30Gbps and at 120km.*

The Fig 10 and Fig 11 show that the outputs of a channel when Travelling Wave SOA is used in the 32 channel DWDM system, at a bit rate of 30Gbps for 120km. The Maximum Q Factor and Minimum BER obtained are 5.64504 and 7.71753e⁻ 006 respectively. The eye patterns noted here show that the channel is affected by ISI and unwanted signals. The Maximum Q Factor obtained here is low when compared to EDFA.

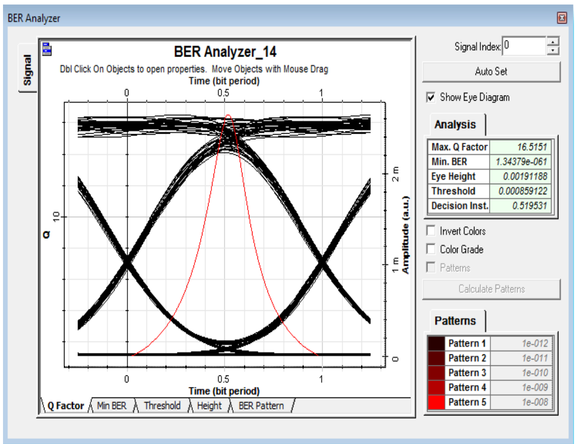


*Fig. 12. Eye diagram of an EDFA pumped 32 channel DWDM system for 60Gbps and at 120km.*

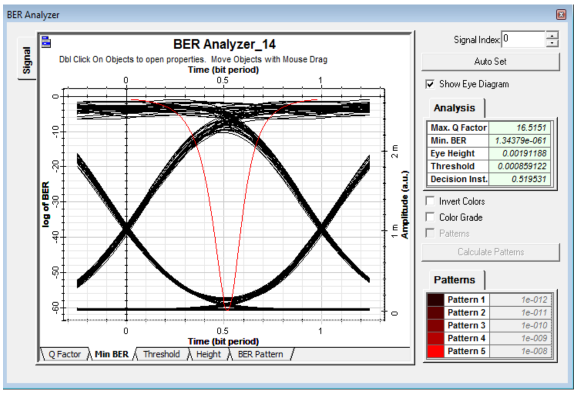


*Fig. 13. Eye diagram of an EDFA pumped 32 channel DWDM system for 60Gbps and at 120km.*

The Fig 12 and Fig 13 show the outputs of a channel when an EDFA is used in the 32 channel DWDM system, at a bit rate of 60Gbps for 120km.The Maximum Q Factor and Minimum BER obtained are 16.515 and 1.34379e⁻ 061 respectively. The eye patterns noted here show that the channel is free from ISI and unwanted signals.

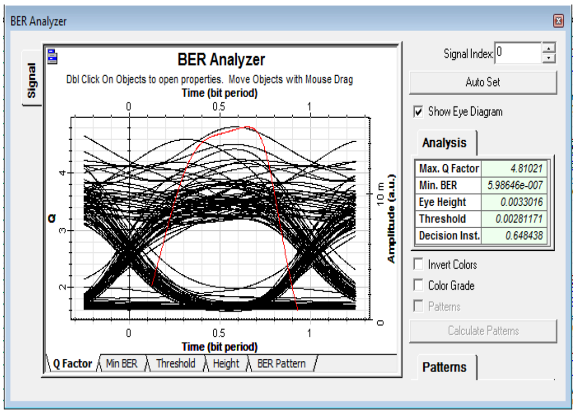


*Fig. 14. Eye diagram of SOA pumped 32 channel DWDM system for60Gbpsandat120km.*

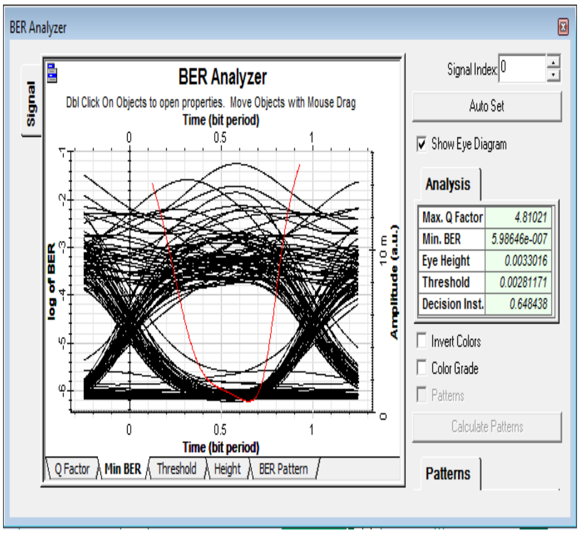


*Fig. 15. Eye diagram of SOA pumped 32 channel DWDM system and for 60Gbps and at 120km.*

The Fig 14 and Fig 15 show that the outputs of a channel when Travelling Wave SOA is used in the 32 channel DWDM system and, at a bit rate of 60Gbps for 120km. The Maximum Q Factor and Minimum BER obtained are 4.81021 and 5.98646e⁻ 007 respectively. The eye patterns noted here show that the channel is affected by ISI and unwanted signals. The Maximum Q Factor obtained here is low when compared to EDFA.

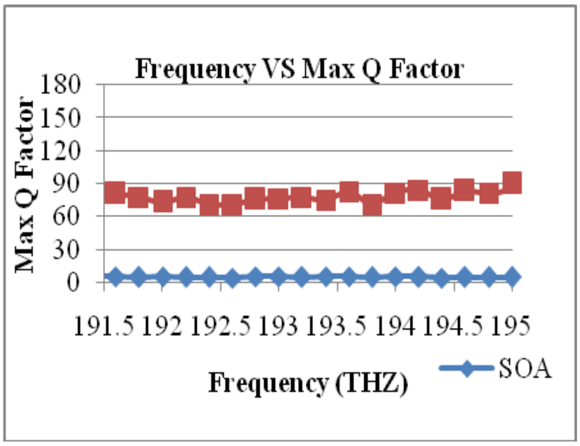


*Fig. 16. Frequency VS Maximum Q factor*

The Fig 16 gives the performance comparison of EDFA and Travelling Wave SOA pumped 32 channel DWDM systems at a data rate of 10Gbps for 120km.The above figure clearly shows that EDFA has high Maximum Q Factor when compared to SOA which is one of the desirable condition for good transmission of the signal.

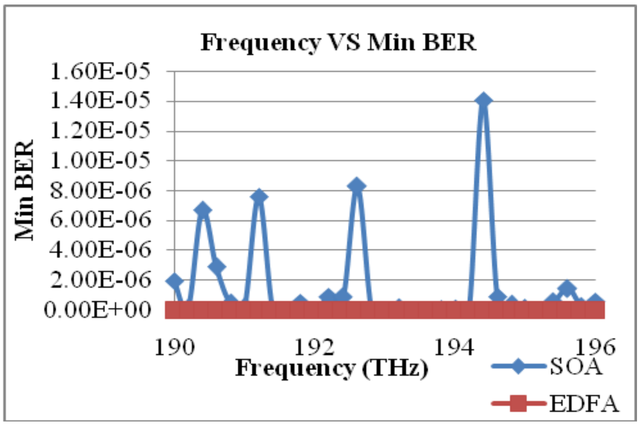


*Fig. 17. Frequency VS Min BER*

The Fig 17 gives the performance comparison of EDFA and Travelling Wave SOA pumped 32 channel DWDM system at a data rate of 10Gbps for 120km.The above figure clearly shows that EDFA has low Minimum BER when compared to SOA which is one of the desirable condition for good transmission of the signal.

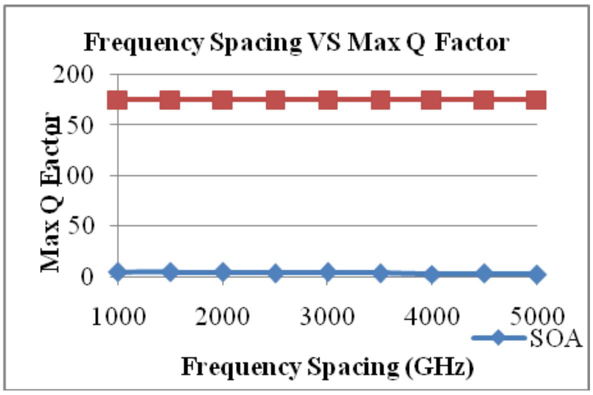


*Fig. 18. Frequency Spacing VS Max Q Factor*

The Fig 18 gives the performance comparison of EDFA and Travelling Wave SOA pumped 32 channel DWDM systems at a data rate of 10Gbps and for120km.The above figure clearly shows that EDFA has Maximum Q Factor when compared to SOA which is one of the desirable condition for good transmission of the signal.

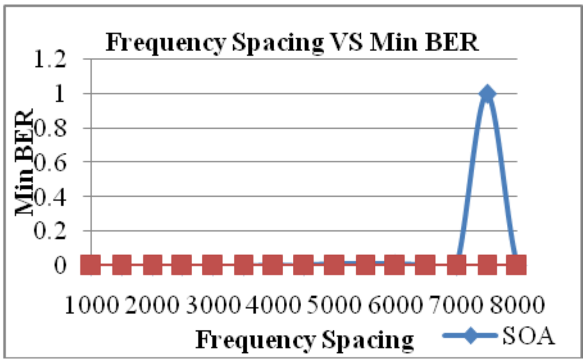


*Fig.19. Frequency Spacing VS Min BER*

The Fig 19 gives the performance comparison of EDFA and Travelling Wave SOA pumped 32 channel DWDM systems at a data rate of 10Gbps and for 120km.The above figure clearly shows that EDFA has low Minimum BER when compared to SOA which is one of the desirable condition for good transmission of the signal.

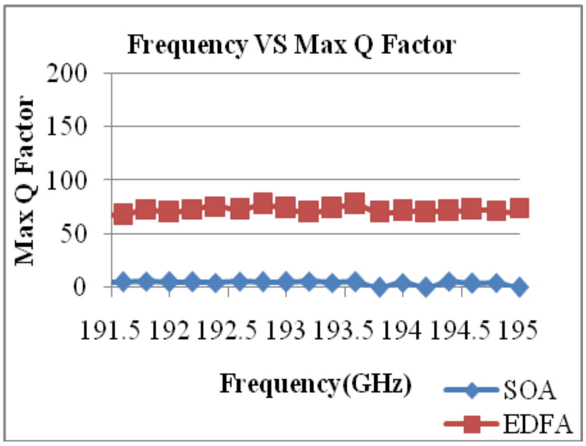


*Fig. 20. Frequency VS Max Q Factor*

The Fig 20 gives the performance comparison of EDFA and Travelling Wave SOA pumped 32 channel DWDM systems at a data rate of 30Gbps and for 120km.The above figure clearly shows that EDFA has high Maximum Q Factor when compared to SOA which is one of the desirable condition for good transmission of the signal.

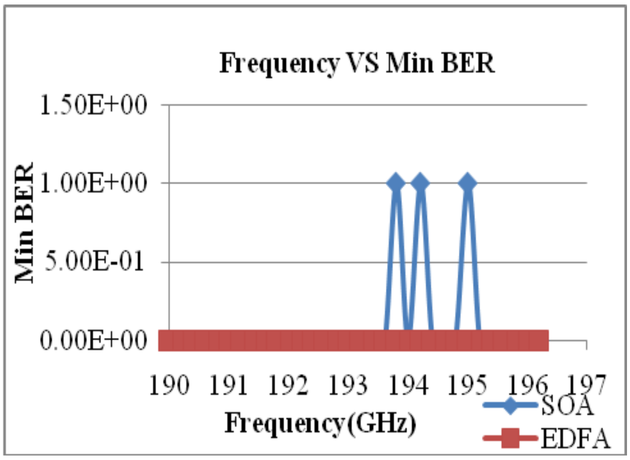


*Fig. 21. Frequency VS Min BER*

The Fig 21 gives the performance comparison of EDFA and Travelling Wave SOA pumped 32 channel DWDM systems at a data rate of 30Gbps for 120km.The above figure clearly shows that EDFA has low Minimum BER when compared to SOA which is one of the desirable condition for good transmission of the signal.

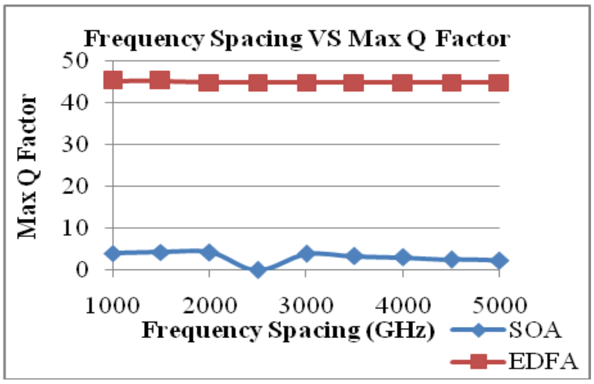


*Fig. 22. Frequency Spacing VS Max Q Factor*

The Fig 22 gives the performance comparison of EDFA and Travelling Wave SOA pumped 32 channel DWDM systems at a data rate of 60Gbps for 120km.The above figure clearly shows that EDFA has high Maximum Q Factor when compared to SOA which is one of the desirable conditions for good transmission of the signal.

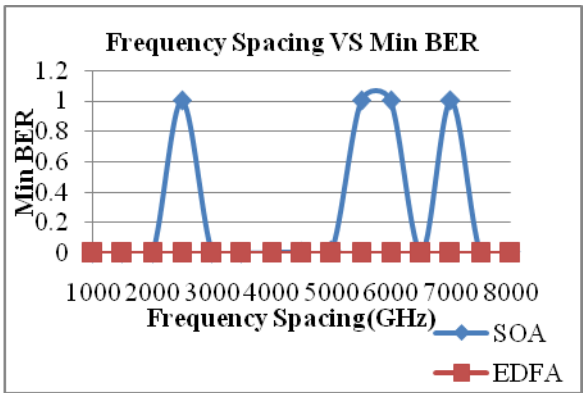


*Fig. 23. Frequency Spacing VS Min BER*

The Fig 23 gives the performance comparison of EDFA and Travelling Wave SOA pumped 32 channel DWDM systems at a data rate of 30Gbps for 120km.The above figure clearly shows that EDFA has low Minimum BER when compared to SOA which is one of the desirable conditions for good transmission of the signal.

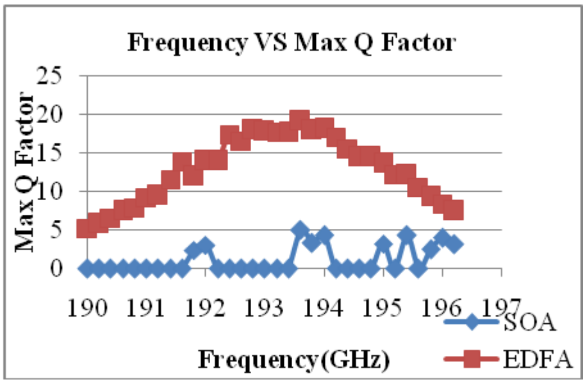


*Fig. 24. Frequency VS Max Q Factor*

The Fig 24 gives the performance comparison of EDFA and Travelling Wave SOA pumped 32 channel DWDM systems at a data rate of 60Gbps for 120km.The above figure clearly shows that EDFA has high Maximum Q Factor when compared to SOA which is one of the desirable conditions for good transmission of the signal.

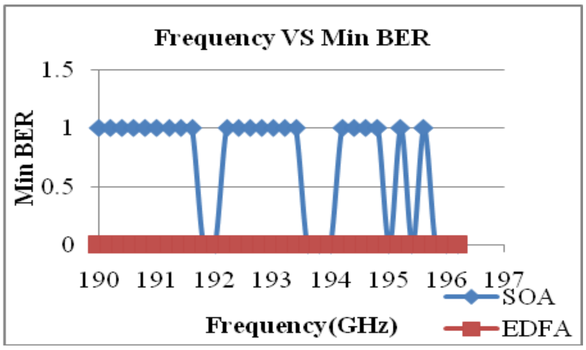

*Fig. 25. Frequency VS Min BER*

The Fig 25 gives the performance comparison of EDFA and Travelling Wave SOA pumped 32 channel DWDM systems at a data rate of 60Gbps for 120km.The above figure clearly shows that EDFA has low Minimum BER when compared to SOA which is one of the desirable conditions for good transmission of the signal.

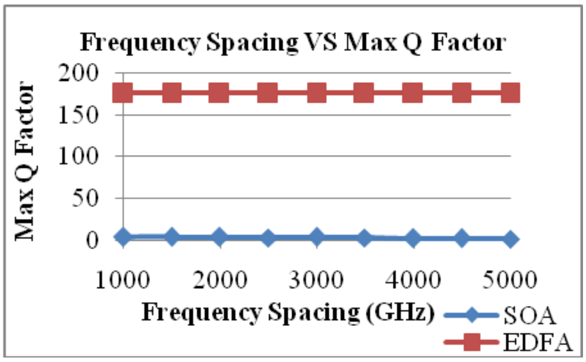


*Fig. 26. Frequency Spacing VS Max Q Factor*

The Fig 26 gives the performance comparison of EDFA and Travelling Wave SOA pumped 32 channel DWDM systems at a data rate of 60Gbps for 120km.The above figure clearly shows that EDFA has high Maximum Q Factor when compared to SOA which is one of the desirable conditions for good transmission of the signal.

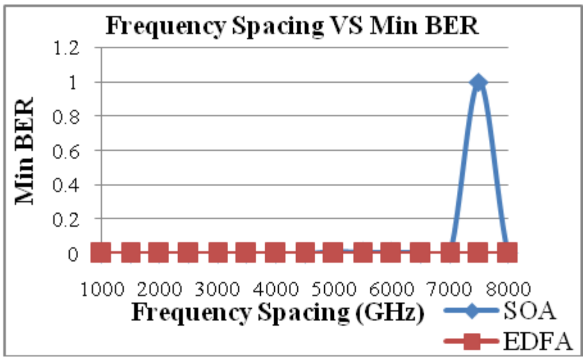


*Fig. 27. Frequency Spacing VS Min BER*

The Fig 27 gives the performance comparison of EDFA and Travelling Wave SOA pumped 32 channel DWDM systems at a data rate of 60Gbps for 120km.The above figure clearly shows that EDFA has low Minimum BER when compared to SOA which is one of the desirable conditions for good transmission of the signal.

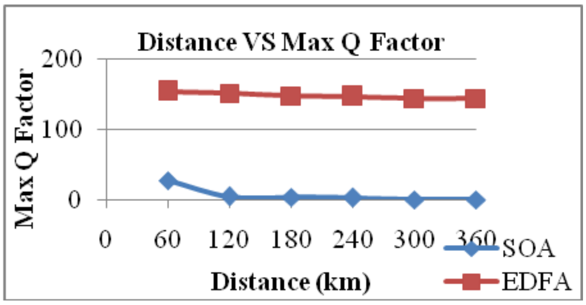


*Fig. 28. Distance VS Max Q Factor*

The Fig 28 gives the performance comparison of EDFA and Travelling Wave SOA pumped 32 channel DWDM systems at a data rate of 10Gbps.The above figure clearly shows that EDFA has high Maximum Q Factor when compared to SOA which is one of the desirable conditions for good transmission of the signal.

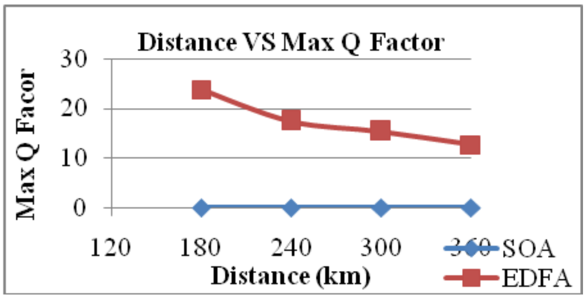


*Fig. 29. Distance VS Max Q Factor*

The Fig 29 gives the performance comparison of EDFA and Travelling Wave SOA pumped 32 channel DWDM systems at a data rate of 30Gbps.The above figure clearly shows that EDFA has high Maximum Q Factor when compared to SOA which is one of the desirable conditions for good transmission of the signal.

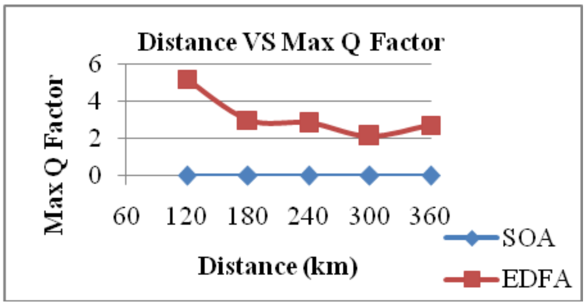


*Fig. 30. Distance VS Max Q Factor*

The Fig 30 gives the performance comparison of EDFA and Travelling Wave SOA pumped 32 channel DWDM systems at a data rate of 60Gbps.The above figure clearly shows that EDFA has high Maximum Q Factor when compared to SOA which is one of the desirable conditions for good transmission of the signal.

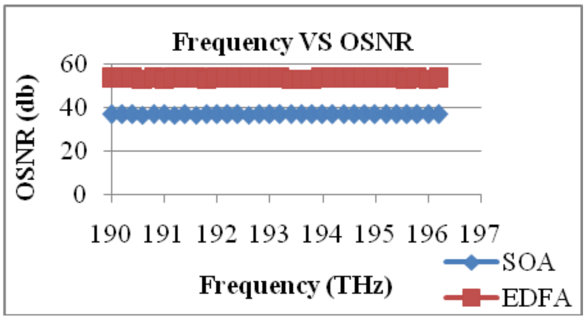


*Fig. 31. Frequency VS OSNR*

The Fig 31 gives the performance comparison of EDFA and Travelling Wave SOA pumped 32 channel DWDM systems at a data rate of 10Gbps.The above figure clearly shows that EDFA has high OSNR when compared to SOA which is one of the desirable conditions for good transmission of the signal.

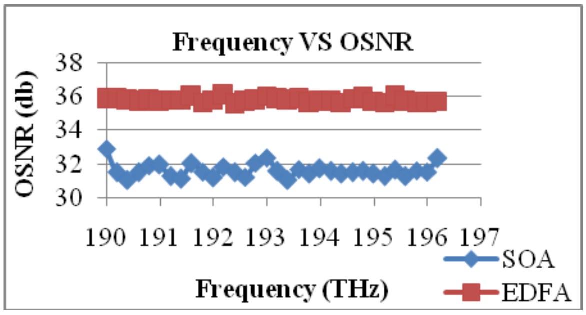


*Fig. 32. Frequency VS OSNR*

The Fig 32 gives the performance comparison of EDFA and Travelling Wave SOA pumped 32 channel DWDM systems at a data rate of 30Gbps.The above figure clearly shows that EDFA has high OSNR when compared to SOA which is one of the desirable conditions for good transmission of the signal.

## 4. CONCLUSION

In the 32-channel DWDM framework unmistakably EDFA outperformed SOA with better eye-opening, greater Q component, better OSNR and least BER. It is acquired that SOAs are great at short separations up to 60km. In any case, execution diminishes when the channel length increments while EDFA was great up to 360km channel length for an information rate of 10 Gbps.

## 5. FUTURE RECOMMENDATIONS

Further work should be possible to enhance the Q component of EDFA pumped 32 channel DWDM frameworks for 60Gbps systems. This investigation can be actualized in a DWDM organize for better transmission within the sight of lossy parts. Reasonable EDFAs with various pumping strategies can be conveyed to compensate the attenuation loss and the transmission separation can be expanded further.

## 6. ACKNOWLEDGEMENT

I thank the god almighty for helping me in writing this paper flawlessly. I thank my parents and family for their support and cooperation throughout the academic carrer

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