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L - BAND VARIABLE GAIN AMPLIFIER WITH ERBIUM DOPED FIBER SWITCHING

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Abstract-Optical network that configure with the wavelength division multiplexing (WDM) is currently widely used in existing telecommunicationsinfrastructures and is expected to play a significant role in next generation networks and the future Internet supporting a large variety ofservices having very different requirements in terms of bandwidth, reliability, more gain feature and other features.Design, numerical experimental and analysis of Variable gain amplifier with Erbium doped fiber range with the switches by using the WDM technology and a small noise figure (NF) and increased Variable Gain. The EDFA can change the total erbium-doped fiber length by selecting many combinations of five EDFs with optical switches (SWs) and WDM technology. Basic and principle of the EDFA is based on the spontaneous emission absorption energy level. Design and analysis of the numerical calculation of the NF and the pump power using the analytical model of an EDFA indicates that such a variable gain EDFA has an advantage over a conventional multi stage EDFA in terms of Gain variation and required pump power. L band spectrum is the high and more wavelength that is manufacture the more gain with using more amplifiers. These characteristics are demonstrated by constructing a variable gain EDFA that employs SWs and variable optical attenuators (VOAs) by using the software MATLAB. The variable gain EDFA exhibits a smaller NF variation of 3.9 dB for the 105dB variable gain range than conventional and more EDFAs amplifiers.
Keywords- Erbium doped fiber amplifier (EDFA), Wavelength division multiplexing (WDM), and Optical fiber length, VOA (variable optical attenuator), SWs (optical switches).

I. INTRODUCTION

Fiber based systems have mostly replaced radio transmitter systems for long-haul optical data transmission. They are widely used for telephony, but also for Internet traffic, long high-speed local area networks (LANs), cable TV and increasingly also for shorter distances within buildings. In most cases, silica fibers are used, except for very short distances, where optical fibers can be advantageous to use in very long distances. In the present time amplifiers is use very much in the telecom and other electronics fields also.An optical amplifier is a device that amplifies an optical signal directly, without the used to first convert it to an electrical signal. An optical amplifier may be passed as a laser without an optical cavity, or one in which feedback from the cavity is suppressed.

There are various different physical mechanisms that can be used to amplify a light signal, which correspond to the major types of optical amplifiers. There are many types of optical fiber used to amplify the light signal. In doped fiber amplifiers and bulk lasers, stimulated emission in the amplifier's gain mediumcauses amplification of incoming light by using the doping power in the system. Almost any laser active gain medium can be pumped to produce higher gain for light at the wavelength of a laser made with the same material as its gain medium.

In fiber optic communications wavelength division multiplexing (WDM) is a technology is play an important role. which is working on the multiplexes a number of optical carrier signals onto a single optical fiber by using different wavelengths of laser light. WDM technology employing erbium doped fiber amplifiers (EDFAs) provides a platform for significant improvement in network bandwidth capacity. WDM will play an important role in backbone infrastructure supporting the next generation of high-speed networks. An erbium-doped fiber amplifier (EDFA) is an in line optical amplifier system that is currently widely used in wavelength-division multiplexing (WDM) optical networks [3].

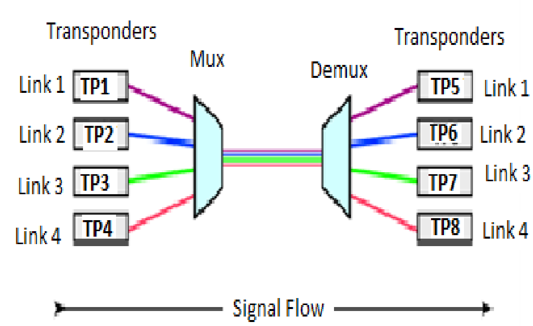

Figure1: Wavelength Division multiplexing structure

An Amplifier configuration is by using the WDM technology in Cascade method mostly used. Figure 1 shownthe method number of multiple signals transmitted at the same time by using the multiplexer, by using the de multiplexermodify signals in the from cascade method than output will be

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produced in WDM technology. Implementing a WDM system including the EDFA does not have to amplify the wavelength of the channels equally and frequently to have equalized gain spectra in order to obtain uniform output power and similar signal to noise ratio. WDM also using by the switching technology in this paper, switching technology used to increase the area and network of the system and more router connect with the optical fiber cables. Switching method is the latest method to increase the network of the system and increase the Gain of the amplifiers.

To propose EDFAs with the optical amplifier communication network system. We have to modify EDFAs with WDM technology with the using switches provide improved gain.The EDFA employs by using the SWs and VOAs, Software using MATLAB to change the ways in which EDFs combine by using coding and numerical analysis. First we describe the WDM basic structure, working with the signal using multiplexer or de multiplexers. Introduction of the WDM and EDF functions with the WDM methodology using simple virtual fiber.II. Section defined the methodology of the EDFA by using the doped fiber. There are the signal flow using the pump power and doped fiber than more gain is produce.Numerical analysis of the noise figure, pump power and wavelength is experimentally shown by the section III.We compare the SW-EDFA experimentally with a conventional variable gain EDFA in terms of NF and required pump power by using an analytical model of the EDFA. Since the SW-EDFA can have many different EDF combinations, the pump power requirement of the EDFA will differ from the variable gain in, which also clarifies the pump power needed to obtain variablegain, with the using convolution method by using more number of EDFAs with VOA,we describe the Numerical and theoretical configuration of EDFA gain characteristics with the wavelengths. In section IV, Design and analysis of EDFA is using the switches and WDM technology for the wide area network. In this section we increased the gain by using the different wavelengths and pump power and gain value is changed. In V, VI, and VII is Experimental Results and Discussions are with the using of wavelength and different pump power, noise figure. Experimental set up shown the NF is reduced and gain of the design is increased. The conclusions and future scope are summarized result of this paper in Section VIII.Analysis and design of configuration by the EDF is improved the gain of the fiber.

II. METHODOLOGYOF EDFA

An erbium-doped fiber is an optical fiber of which the core is doped with rare-earth element erbium ions Er3 that is rare earth material [3]. When a 990 nm pump laser diode beam is fed into an erbium-doped fiber, Er3+ will be excited from the ground state Lower Level to the higher level. The excited Er3+ ions on higher Level will rapidly decay to energy level lower through nonradioactive emission. The excited ions on middle Level eventually return to ground state lower Level through spontaneous emission, which produces photons in the wavelength band 1561.61–1610.61nm (L band). The spontaneous emission will be amplified as it propagates through the fiber, especially when the pump laser power is increasing rapidly. As amplified spontaneous emission (ASE) covers a wide wavelength range 1562-1620 nm, we can use it as a broadband light source also. EDFA principle based on the ASE fundamentals[7].

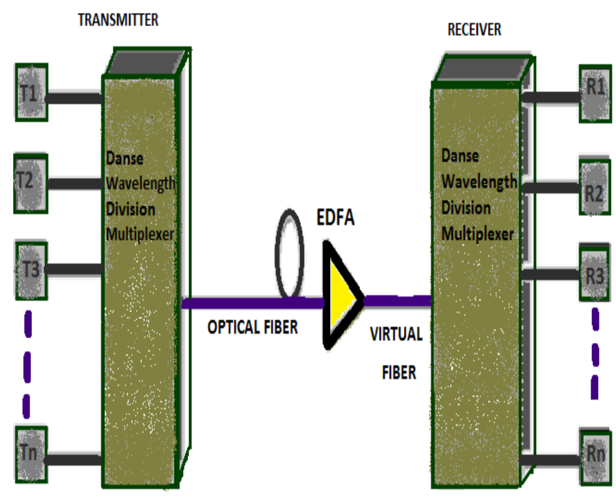

Figure 2:Methodology of the EDFA system

If a laser signal with a wavelength between 1560 and 1661 nm or L band, and a 990 pump laser are fed into an erbium-doped fiber simultaneously and emission provide the higher range of the gain value.The basic configuration of EDFA configuration is shown the figure 2. Number of many Transmitter signal transmitted at the time by using the DWDM methodology. Optical fiber is used as a fiber cable, EDFA amplifier is used to produce the high gain and reduce the noise figure. Receiver Dense Wavelength division de multiplexer used to configure the signal produced signal output.

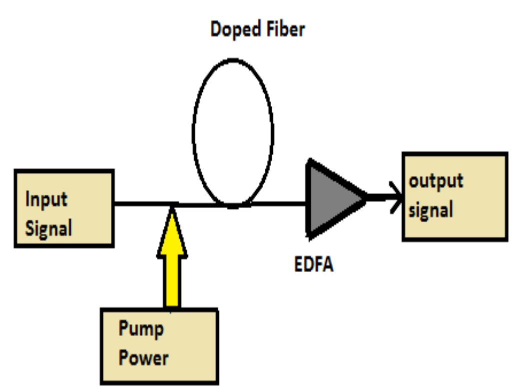

Figure 3: EDFA methodology with Pump power

The Methodology of the EDFA shown in Figure 3, than basic configuration for the EDFA with an optical fiber is shown in Figure 2 EDFA existed of a short length of optical fiber whose core has been doped with less than 0.1 % of erbium, an

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optically active rare earth element that has many unique intrinsic properties for optical amplification. For example, the erbium atom has a metastable state with the remarkable long lifetime. This makes it possible to obtain an optical gain which takes a long time to saturate, and increased the gain also. The EDF is compatible with conventional fiber system and may be fusion spliced to other components. The signal Power and pump Power are combined and through a WDM coupler and launched into an erbium doped. Its core is the erbium doped optical fiber system with the Erbium type material, which is typically a single-mode fiber. Pump light propagating along the EDF is depleted as erbium ions are raised to an excited state. As the signal propagates in the EDF, it stimulates emission of light from the excited ions, there by amplifying the signal power by using EDF. The erbium-doped fiber is compatible with conventional fiber and may be fusion spliced to other components also. EDFA is constructed by fusion splicing discrete fiber pigtailed component. EDF amplifier configurations with Pump the isolator at the input prevents light originating from amplified spontaneous emission from disturbing any previous stages, whereas that at the output suppresses shortly, if output light is reflected back to the amplifier. Without isolators, fiber amplifiers can be sensitive to back-reflections of the laser. There are optical isolators in input, and various other components can be also contained in a commercial fiber amplifier. In order to pump the erbium ions up to an upper energy level, there are several pump wavelength bands. At present, 1640 nm and 990 nm high power laser diodeshave proved to be the two most efficient pump wavelengths.

III. NUMERICAL ANALYSIS OF PUMP POWER, NOISE FIGURE AND GAIN CALCULATION WITH RESPECT TO WAVELENGTH

Variable gain of the EDF amplifier with the switching technology is based on the variable gain and noise figure. There is saturation pump power ratio of the doped core area and the pump wavelength equation 3.1 is saturation power of the pump.

$$PumpPower = P_{sat} = \frac{(A.hv)/_{\lambda}}{(\text{sap} + \text{sep}) * \tau Qe} \quad (1.1)$$

Where Sap and sep is erbium spectrum at pump wavelength, A is doped core area,Qe is quantum efficiency of pump, which is less than one for Er doping.τ =0.77e-3 is spontaneous decay rate of excited ions.

$$A = \pi(\frac{d_{core}}{2})^2 \quad (1.2)$$

Frequency of pump photons is given by the equation 1.3

$$\text{nup} = \frac{c}{w_{lp}} \quad (1.3)$$

There isw_{lp} is pump wavelength, d_{core} doped core diameter.h = 6.62606957x$10^{-34}$is planck's number, c = 3x10^8 is speed of light in vacuumand Gain at different wavelength.

$$G = 4.34\frac{Q_e(s_{al}(\lambda)+s_{el}(\lambda))\tau.Pa}{Ahv-\gamma N s_{al}(\lambda).L-loss} \quad (1.4)$$

Where Pa is change in pump power i.e. absorbed power, L length of EDFA doped fiber.

$$\gamma = 1 - e^{-(2(b/w)^2)} \quad (1.5)$$

That is overlap integral assuming Gaussian flux distribution, b = dCore/2 is radius of doping in core, and width is w = dField/2 is radius of flux field travelling along corevalue is define by this equation

$$N = \frac{doping}{10^6}N_{glass} \quad (1.6)$$

Where doping is 85, at the different pump power and wavelength L band.

$$N_{glass\ AL_2O_3} = \frac{4\text{x}10^6}{102\text{x}1.6726\text{x}10^{-24}} \quad (1.7)$$

These equations find the graph between the Gain and pump power, Gain and different wavelengths and graph between the noise figure and gain in 2 and 4 stages. First Plot between, Gain and Pump Power: by the figure shown the plot between them. There are length is L= 9.2 m and L= 20m, at the pump power is 990 nm.

The analysis of noise in optical systems is sufficiently complex that it can be characterized either with simple engineering formulae or by a thorough quantum theoretical approach. The optical noise figure is a parameter used for quantifying the noise penalty added to a signal due to the insertion of an optical amplifier. That is, before light enters an amplifier the signal to noise ratio SNRin, after amplification it is SNRout. Thus, optical noise figure can be defined as [12].

$$NF = 10log_{10}\frac{SNR_{in}}{SNR_{out}} \quad (1.8)$$

$$SNR_{in} = \frac{I_s^2}{\sigma_{sn}^2} = \frac{(RP_s)^2}{2qRP_sB_e} = \frac{P_s}{2h\vartheta B_e} \quad (1.9)$$

The optimum bandwidth of the electrical filter following the photodiode is determined by the measurement time interval T.

$$B_e[Hz] = \frac{1}{2T} \quad (1.10)$$

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$$SNR_{in} = \frac{P_s T}{h\vartheta}$$
(1.11)

The shot noise due to the implied signal and the signal-spontaneous beat noise are retained; the SNRout is given by the equation.

$$SNR_{out} = \frac{I_{out}^2}{\sigma_{sn}^2 + \sigma_s^2 - ASE} \text{1.12)}$$

Then, it is easy to show that the noise factor is given by the equation 1.13, figure of noise factor.

$$F = \frac{2\rho_{ASE}}{Gh\vartheta} + \frac{1}{G} \quad (1.13)$$

Where the first term is the signal-spontaneous beat noise contribution and the second term is the shot-noise contribution.In the linear operating region of an optical amplifier, the noise power is given by [17].

$$P_{ASE} = 2n_{sp} h\vartheta (G-1) B_0 \quad (1.14)$$

Where the spontaneous emission factor nsp is a measure of the quality of inversion and is always greater than 1. Linear in this context means that the output signal is proportional to the input signal (i.e., constant gain), and the ASE statistics is not affected by the input signal statistics or power. What is important in this equation is that the minimum achievable noise power is deterministically related to the optical gain. Noise factor is reduced by this equation.

$$F = 2n_{sp} \frac{(G-1)}{G} + \frac{1}{G} \quad (1.15)$$

Therefore, for large gain (G > 10), the noise factor is approximately given as F = 2nsp. Since the spontaneous emission factor is always larger than 1, the minimum noise factor can be obtained for nsp = 1 which corresponds to complete inversion of the gain medium. The corresponding noise figure is then given as NF = 10log102 = 3.01dB.Ions in the ground state are excited to higher energy levels by injected energy. The wavelength dependent absorption cross section$\sigma_a(\lambda)$, describes the probability of occurring. The probability of stimulated emission taking place at specific wavelength is described by the emission cross section$\sigma_e(\lambda)$.

$$NF = 2\mu_{eff} \frac{G-1}{G} + \frac{1}{G} (1.16)$$

These values can be calculated by measuring absorption spectrum α_k , the gain spectrum g_k^* , the saturation power of fibre P_k^{sat} and the back ground loss l_k for the k^{th}optical beam propagating in the amplifier. They are then related to the emission and absorption cross sections by equations.

$$g_k^* = \sigma_{ek} \ulcorner_k n_t (1.17)$$

$$\alpha_k = \sigma_{ak} \ulcorner_k n_t (1.18)$$

$$P_k^{sat} = \frac{h v_k A_{eff}}{(\alpha_k + g_k^*)\tau} = \frac{h v_k \varepsilon}{\alpha_k + g_k^*} \quad (1.19)$$

Where $n_t is$concentration of the erbium ions total, $v_k$is k^{th} beam frequency, h is plank's constant, and the equation $\varepsilon = \frac{\pi b_{eff}^2 n_t}{\tau}$ $\tau$is metastable lifetime. A combination of the absorption and emission cross sections can also describe the spectral dependence of the amplifier gain, given by the equation.

$$G_{dB}(\lambda) = 4.343\{n_2\sigma_e(\lambda) + n_1\sigma_e(\lambda)\} \ulcorner L (1.20)$$

$$G_{dB}(\lambda) = 4.343\{n_2\sigma_e(\lambda) + n_1\sigma_e(\lambda)\} \ulcorner L \quad (1.21)$$

IV. DESIGN AND ANALYSIS OF EDFA WITH SWITCHING TECHNOLOGY

An SW-EDFAsubsistsof multiple amplifier stages, SWs, and VOAs, and each amplifier stage has one EDF as an amplification medium. Changing the direction of the optical switches changes the active EDF combinationsin the network [13]. The different combinations with different discrete EDF lengths change the amplifier discretely gain. The VOAs adjust the gain so that a continuous gain is obtained between the discrete gains. VOA is as attenuator used the optical network. Figure 4 shows the concept of the SW-EDFA (Switching Erbium doped fiber amplifier) with VOAs, An SW-EDFA consists of multiple amplifier stages, SWs, and VOAs, used for the amplification medium, and make a large network. The different combinations with different discrete EDF lengths change the amplifier gain and noise figure also and by using the switching the coverage area is increase. The VOAs adjust the gain so that a continuous gain is obtained between the discrete gains. The SW-EDFA varies the total EDF length by using switching the signal route and EDF combination also.

The combination of the five EDF amplifiers with switches is shown by the figure 4. There are combination of the switches increase the length of the fiber and increase of the network area and produced the more gain. The basic concept is that number of amplifiers increased the losses of the fiber but by using the EDF amplifiers reduced the losses also and increased the gain of the system. 2 ×2, 2×3, 1×3, 4×1 type of switches combination used in this design. At the different wavelength (L band) and pump power to find the values of the gain and the noise figure.Large Network is cover the more area and more amplifiers produced the high gain and reduced the NF.

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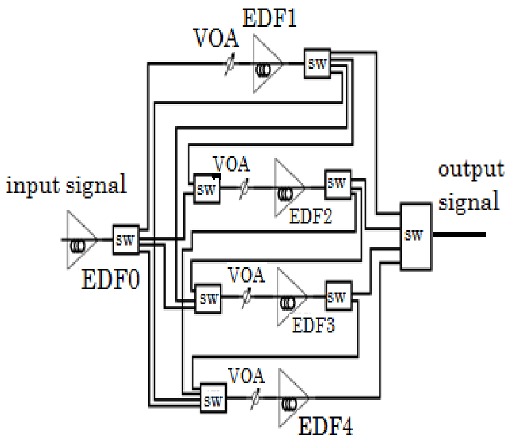

Figure 4:Design and analysis of EDFA with Switches methodology

In this paper we calculate the NF and the pump power with the different wavelength for an SW-EDFA with the configuration shown in Figure 4 and compare them with those for conventional system, by using two-stage , three-stage and four- EDFAs cascade systems. The conventional EDFAs consist of multiple amplifier stages and VOAs located with the every amplifier, and achieve a high variable gain by adjusting the attenuation of those VOAs. The calculation parameters for EDF are listed in Table I. The EDF used in the calculation is assumed to be an Al-Ge-Er-doped fiber [10], and design parameters for the simulation. EDF lengths of amplifier stages 0, 1, 2,3 and 4 of the SW-EDFA are 8.2, 6.8, 9.5,4.2 m and 2.2 m respectively. The range of the four amplifiers is shown in the Table II. The signal routes with switches for different EDF combinations are shown in Table III, the range of the combination of the routers also shown in table IV. The EDF length of the first amplifier stage of the conventional two- and four-stage EDFAs are set at the same length as stage 0 of the SW-EDFA. The second amplifier stage of the two-stage EDFA has a 10.4 m long EDF. The remaining amplifier stages of the four-stage EDFA all have 19.2 m long EDFs. Each EDF is forward by the pumped power with 990 nm. The main aim of the paper to reduce the NF and increased the Gain of the input signal power.The range of the EDF to use in the structure of the figure 4 is the different. There is using the 5 amplifiers and the range of the amplifier in the dB.

Table I: Simulation Parameters for Design of the structure

No.	Parameters	Range
1	Technology	Switching Technology
2	Wavelength Range (nm)	1561.61 – 1610 (L band)
3	Pump Wavelength	990 nm, 1485 nm
4	Cut-off Wavelength	1640nm
5	Pump Power (mW)	55-250mW
6	Doping Concentration	85 ppm

Table II: Variable Gain range of the EDF amplifiers

EDF AMPLIFIER	Gain (Range) in (dB)
EDF0	8.2 dB
EDF1	6.8 dB
EDF2	9.5 dB
EDF3	4.2 dB
EDF4	2.2 dB

Table III: EDF combinations of the amplifiers

Combinations	Signal Routing
A	EDF0 – EDF1
B	EDF0 – EDF2
C	EDF0 – EDF3
D	EDF0-EDF4
E	EDF0– EDF1 – EDF2
F	EDF0– EDF1 – EDF3
G	EDF0– EDF1 – EDF4
H	EDF0– EDF2 – EDF3
I	EDF0– EDF3 – EDF4
J	EDF0– EDF1 – EDF2– EDF3
K	EDF0– EDF1 – EDF2– EDF4
M	EDF0– EDF1 – EDF3– EDF4
N	EDF0– EDF2 – EDF3– EDF4
P	EDF0– EDF1 – EDF2– EDF3– EDF4

Table IV: Variable Gain range of the each EDF combination

Combinations	Signal Routing	Combination Length
A	EDF0 – EDF1	15.15m
B	EDF0 – EDF2	18.0 m
C	EDF0 – EDF3	13.2m
D	EDF0-EDF4	11.0m
E	EDF0– EDF1 – EDF2	23.0m
F	EDF0– EDF1 – EDF3	19.2m

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G	EDF0– EDF1 – EDF4	16.0m
H	EDF0– EDF2 – EDF3	22 .0m
I	EDF0– EDF3 – EDF4	16.0m
J	EDF0– EDF1 – EDF2– EDF3	29.0m
K	EDF0– EDF1 – EDF2– EDF4	28.0m
M	EDF0– EDF1 – EDF3– EDF4	23.3 m
N	EDF0– EDF2 – EDF3– EDF4	25.0m
P	EDF0– EDF1 – EDF2– EDF3– EDF4	32.5m

V. RESULTS AND DISSCUSSIONOF NOISE FIGURE AND AMPLIFIER GAIN

Figure 5 and 6 respectively, shows the amplifier dependence of the NF at the signal wavelength of 1640nm(L band), at the two stages and four stages amplifier configuration.There is a 2 stage and 4 stages, i.e. number of amplifier value is 2 and 4 used as a cased method and the NF is more reduced when number of amplifier is increased.In Figure 5 shows that when noise figure is 8.5 dB then the gain is increase 55 mw. The total power of the signal is addition of the total amplifiers power so the power of the four stages is more than the two stages. In the graph 6, noise figure is 5.6 dB then gain is 55 mw, it is shown that the NF is decreased than the Gain of the signal increased.

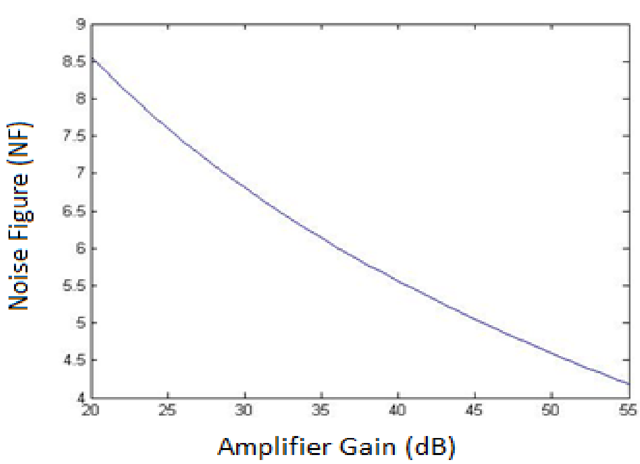

Figure 5:Graph between noise figure and Amplifier Gain for stage 2

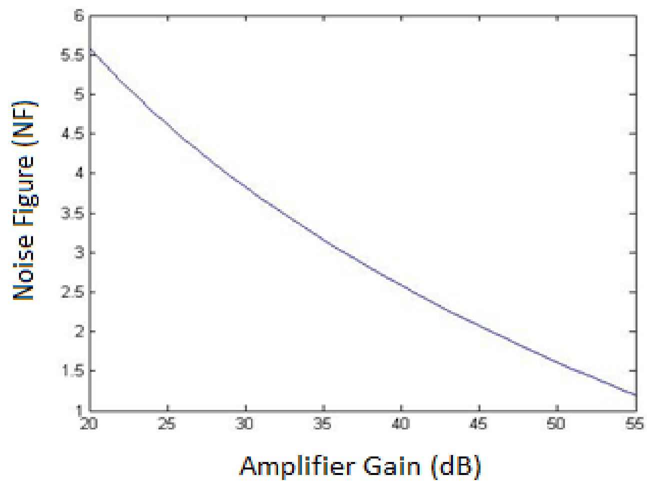

Figure 6:Graph between noise figure and Amplifier Gain for stage 4

Figure 7 shows the configuration by using the switches. Combination of the four amplifiers with the using of switches power of the combination is increased. We are using the amplification gain is 55dB and noise figure is 8.5 dB for Two stage amplifier. Noise Figure for Four stage amplifier is 5.6dB and the Gain is the 55dB. In this configuration number of amplifiers are four switching EDFA noise figure is 4.5 dB with using gain is 55 dB.Figure 8 concludes that system performance is better for SW-EDFA Respectively, Pump Power is 55- 250 mw and the Wavelength is 990nm. Combination of the four amplifiers with the using of switches power of the combination is increased. We are using the more amplifier (five) than the amplification gain is more than 55 dB and noise figure is 8.7 dB for first amplifier. Noise Figure for second amplifier is 5.5dB and the Gain is the 55 dB. In this configuration number of amplifiers are five switching EDFA noise figure is 3.9 dB with using gain is 55dB for the last and third amplifier configuration. Figure 8, concludes that system performance is better for SW-EDFA Respectively, Pump Power is 55-250 mw and the Wavelength is 990nm.

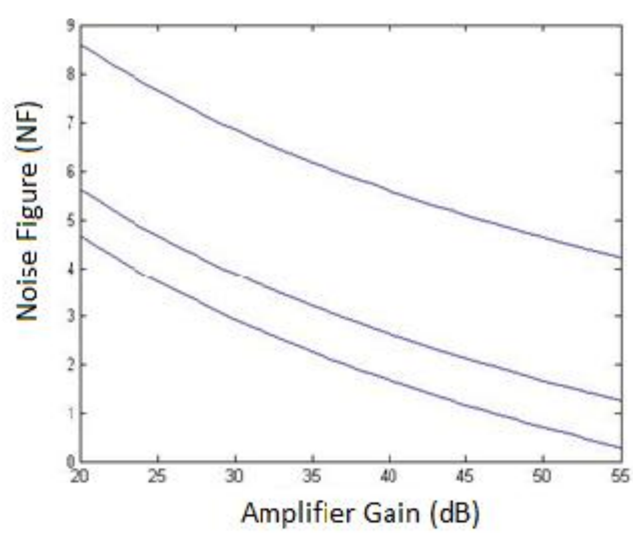

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Figure 7:Graph between noise figure and amplifier gain by using switches

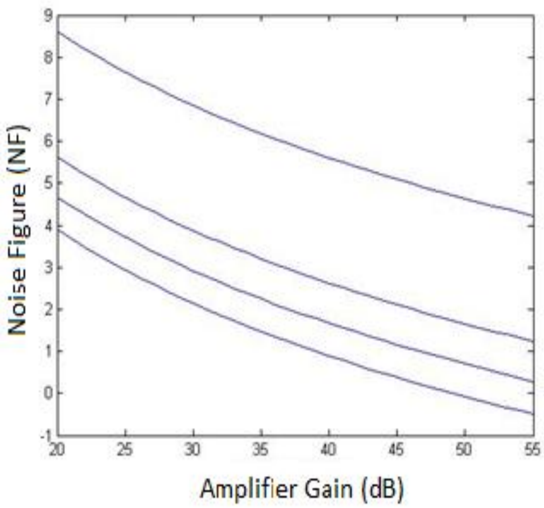

Figure 8:Graph between noise figure and amplifier gain by using more amplifiers by using switching method

In this figure we are using the five amplifiers with the switching method. When we increased the number of amplifier than the main aim to reduce the losses of the networks so by using the switching and different values of pump power and wavelengths losses will be reduced and gain will be increased in the network. Increased the amplifiers than first amplifier noise figure is 8.9 dB , second amplifier is 5.5 dB , third amplifier value is the 4.5 then fourth and last amplifier value is the 3.7 dB at the gain value is the more than 55 dB for all amplifiers.

VI. RESULT AND DISCUSSION OF POWER CONSUMPTION WITH AMPLIFIER GAIN

Figure.9 shows the amplifier gain dependence of the total pump powers and the conventional two- and four stage EDFAs without switches configuration. The amplifier Gain and wavelength by using pump power with different doping concentrations is shown in Figure 9. The Pump wave length is 900 nm. Pump power for the amplifier is 250 mw and the doping of the system is 850 ppm. In this configuration shown that the pump power is increased than the Gain of the amplifier also increased at the different doping values.

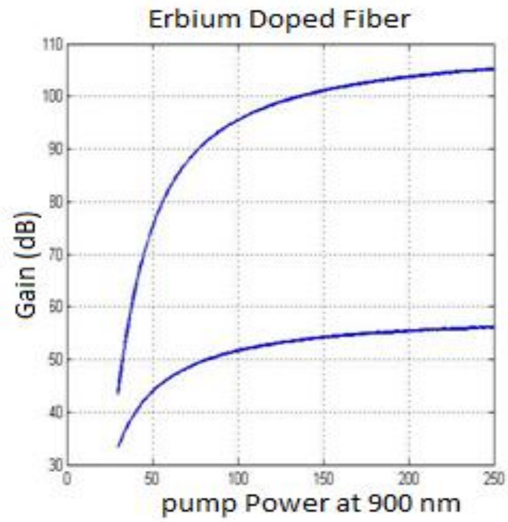

Figure 9:Graph between the Gain and Pump power at the different fiber length

Figure 9 shows that the Gain is against wavelength at fiber length L is 9.2m and other fiber length L is 20 m. When the length is 9.2m gain is 57 dB and length is the 20 m then the gain is goes to 105 dB, so by this shows when the length is increase then the gain is also increase of the fiber.

Figure 10 shows the amplifier dependence with the switches. Convolution method is using by the four EDF amplifiers with the switches and VOA. In the figure 10 shown the amplifier gain is increased at the different pump power. L band is the high range of the optical fiber band. When we are using the L band than losses of the fiber and system is also increased so switches method is used to wide network area. VOA is used as attenuator, so reduced the losses to increase the number of amplifier. Figure 10, graph based on the four EDF amplifiers that areconnecting in the form of convolution method.

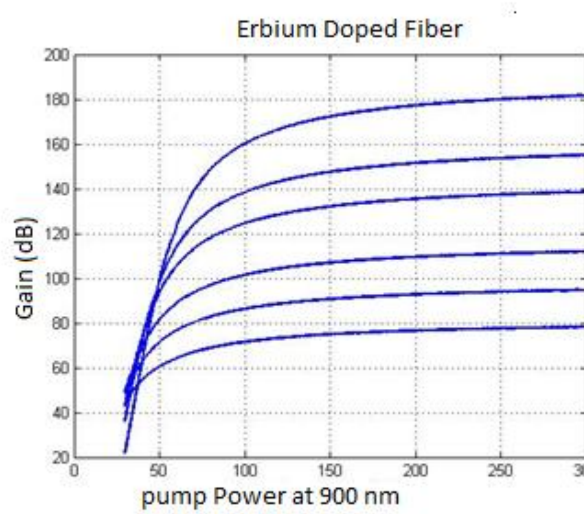

Figure 10:Graph between the Gain and Pump power by using switching method

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Figure 11 shows the amplifier dependence with the switches. Convolution method is using by the five EDF amplifiers with the switches and VOA, Figure 4 shows the designing and combination of the EDF with the switches and VOA. The Gain of amplifier is the EDF0, EDF1, EDF2, EDF3 and EDF4 is 8.2 dB, 6.8 dB, 9.5 dB,4.2 dB and 2.2dB.

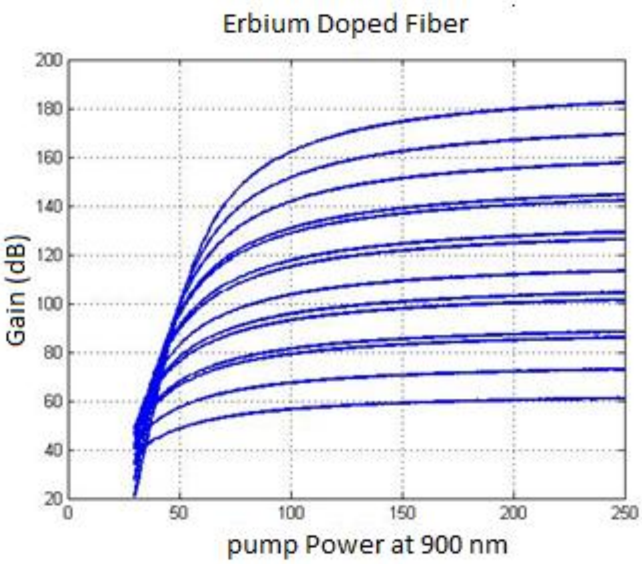

Figure 11:Graph between Gain and Pump Power by using more amplifier using switching method

Pump Wavelength for simulation is the 976nm.Combination of the logic is shown by the A, B, C, D, E, F, G, H, I, K and N. A= EDF0 - EDF1 this is logical combination of A. B=EDF0 - EDF2 this is logical combination of B. C=EDF0 - EDF3 this is logical combination of C. D=EDF0 - EDF4 this is logical combination of D. E=EDF0 - EDF1 - EDF2 this is logical combination of E. F=EDF0 - EDF1 - EDF3 this is logical combination of F. G=EDF0 - EDF1 - EDF4 this is logical combination of G. H=EDF0 - EDF2 - EDF3 this is logical combination of H. I=EDF0 - EDF3 - EDF4 this is logical combination of I. J=EDF0 - EDF1 - EDF2 – EDF3 this is logical combination of J. K=EDF0 - EDF1 - EDF2 - EDF4 this is logical combination of K. M=EDF0 - EDF1 - EDF3 - EDF4 this is logical combination of M. N=EDF0 - EDF2 - EDF3 - EDF4 this is logical combination of N. P=EDF0 - EDF1 - EDF2 - EDF3 - EDF4 this is logical combination of P. From above combination we can examine that as EDF length increases gain increases and the gain is increase by using the logic of the EDF combinations.

VII: RESULT AND DISCUSSION WAVELENGTH WITH AMPLIFIER GAIN

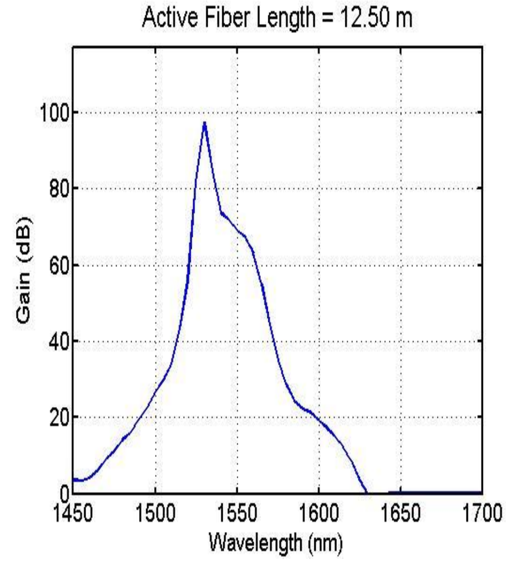

Figure 12:Graph between the Gain and wavelength by using L band

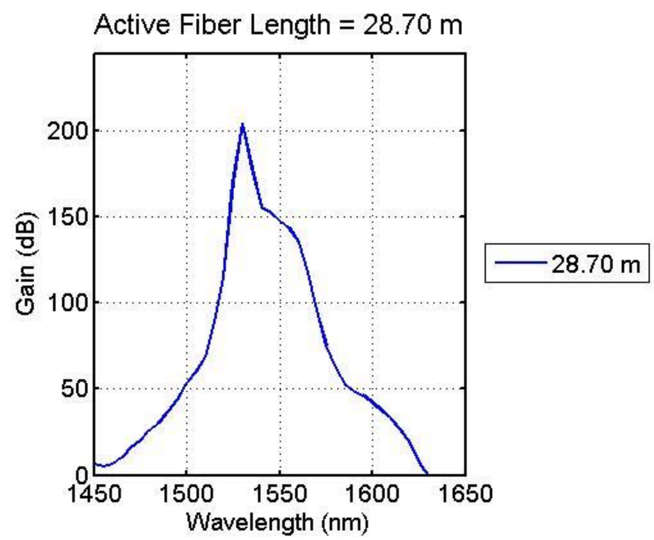

Figure 13:Graph between the Gain and wavelength using the switches at L band configuration

Figure12and 13 shows the gain spectra for various input signal powers. The spectra were measured by scanning the gain bandwidth with a low-power probe signal while inputting four WDM channels located at 1400nm -1700nm. The probe power is 50mW to 120mW, the power of each WDM channel is different. Figure 10 shows simulation consisted of active fiber length is 12.50m and gain versus wavelength of the range 1450-1650nm. Figure 11 shows, that the Gain and the wavelength at the different pump powers. At the gain is increase at the 50-60 dB and the wavelength 1400-1700 nm.

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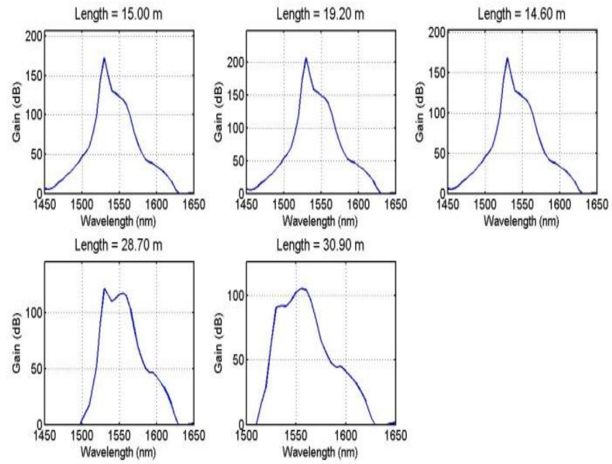

Figure 14:Graph between theGain and Wavelength by using more amplifiers by using switches at L band configuration

In Figure 14 shows Graph between the Gain and the wavelength at the different pump powers. At the gain is increase at the 50-60 dB and the wavelength 1450-1650 nm. There are length of the fiber is 15 m, 19.20 m, 14.60 m,28.70m and 30.90 m. When increase the length then the gain of the fiber is also increase. This is graph is by the using 5 EDF amplifiers i.e. more number of amplifiers.

In this paper, increase the gain and reduce the noise figure of the system. The EDFA is a key of WDM optical transmission systems. Since each period in a transmission system has a different attenuation, the EDFA gain must change according to the optical power level input into the amplifier. In such an EDFA, the population inversion level averaged along the EDF is kept constant to maintain a flat gain. Therefore, a typical variable gain amplifier consists of two and four amplifier stages with a VOA inserted between them .The total average inversion level of the two amplifier stages is kept constant and variable gain is achieved by changing the VOA attenuation. An amplifier with such a two stage amplifier configuration suffers from an increased NF in the low gain region, which is caused by the additional attenuation of the VOA. The NF degradation limits the gain range and results in the need for a large number of amplifier inventories with different gain ranges, EDFA is used for to reduce the NF and increased the Gain of the system because it is operate in the L band configuration.

VIII. CONCLUSION

In this Paper,proposed anddemonstratedthe successful information of commercial WDM system and a brief introduction to the EDFA that is the most important components in WDM communications, enabled by practical EDFAs, has it turn fuelled the developed of high power, wide bandwidth, low noise, gain flattened optical amplifiers. The important issues related to the amplifier performance, namely the optical noise figure and bandwidth to increase the Gain. Optical system can achieve much higher data rates than electronic system. The most important factors increased the transmission distance of fiber optical communication systems length and wide network area also, the optical power loss caused by scattering and absorption mechanisms in opticalfiber is occur that is reduced by the mechanism of the WDM and EDFA.

The concept and advantage of the SW-EDFA in terms of NF and pump power qualitatively and analyzed the NF and the pump power characteristics using the gain 85dB and the NF is 4.5dB. The numerical calculation shows that an SW-EDFA with five EDFs whose combination can be changed by using SWs exhibits less NF change and requires less pump power than the conventional two and four stage EDFAs for a variable gain range of 105 dB. We confirmed that we realized better characteristics as regards NF variation and the required pump power of the SW-EDFA than those obtained with the conventional two and four stage EDFAs. The SW-EDFA exhibited a smaller NF variation of 3.7 dB for a variable gain is more than 55 dB.

The EDFA gain must change according to the optical power level input into the amplifiers. To avoid excess NF degradation, a variable gain EDFA has been proposed that modifies the EDF length by using an optical switch method. However, the variable gain EDFA in assumes the use of a single 2× 2 bulk switch, 1× 2 and 3× 2 bulk switches also, to modify the EDF length since the use of many optical bulk switches is impractical.

This paper presents a comparative study on variable gain fiber of EDFA amplifier with the switching WDM method. The EDFA is change the total fiber network length by selecting 14 combinations of the noise figure and pump power. The relation between pump power and amplifier gain at the different wavelength & at the different doping concentration. The purpose is to increase the gain and reduce the noise figure of the fiber by using the L band.

REFERENCES

[1] TakaakiMukai, Yoshihisa Yamamoto, Tatsuya Kimura,"S/N and Error Performance in AlGaAs Semiconductor Laser Preamplifier and Linear Repeater Systems", IEEE Transaction on Microwave Theory and TechniQues,vol. 30, no. 10, 1982, pp. 1548-1556.

[2] M.C. Farries, P.R. Morkel, R.I. Laming, T.A. Birks, D.N. Payne and E.J. Tarbox, " operation of Erbium Doped Fiber Amplifier and lasers pumped with Frequency- Doubled Nd: YAG Lasers", Journal of Lightwave Technology, vol. 7, no. 10,, 1989, pp. 1473-1477.

[3] E. Desurvire and J.R. Simpson, "Amplification of Spontaneous Emission in Erbium-Doped Single-Mode Fibers", *J. Lightwave Tech.*, Vol.7,1989, No.5, 835.

[4] A. A. M. Saleh, Fellow, R.M. Jopson, J.D. Evankow and J.Aspell, " Modeling of Gain in Erbium- doped Fiber Amplifiers", IEEE Photonics Technology letters, vol. 2, 1990, no. 10, pp.714-71.

[5] R. J. Mears, S. R. Baker,"Erbium Fiber Amplifiers and Lasers", *Optical and Quantum Electronics*, Vol.24,1992,PP. 517.

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[6] A.K. Srivastava, Y. Sun, J.L. Zyskind, J.W. Sulhoff, , " EDFA Transient Response to Channel Loss in WDM Transmission System", IEEE Photonics Technology letters, vol. 9, no. 3,1997, pp. 386-388.

[7] P. C. Becker, N. A. Olsson, and J. R. Simpson, "Erbium-doped fiber amplifiers: fundamentals and technology", Academic Press, vol.3,1997, no. 15, pp 1-5.

[8] L. Tan Cevski, L. A. Rusch, and A. Bononi, "Gain Control in EDFA's by Pump Compensation", IEEE Photonics Technology Letters, vol. 10, no. 9, 1998, pp. 1550.

[9] Yan Sun, Senior, J.L. zyskind, A.K.Srivastava, "Average Inversion level, Modeling and Physics of Erbium Doped Fiber Amplifiers", IEEE Jouranal of Lightwave Technology, vol.3, no. 4, 1999, pp. 991-1007.

[10] P.C. Becker, N.A. Olsson, and J.R. Simpson, "Erbium-Doped Fiber Amplifiers", Academic Press,1999.

[11] W. Johnstone, B. Culshaw, D. Walsh, D. Moodie, and I. Mauchline,"Student Laboratory Experiments on Erbium Doped Fiber Amplifiers and Lasers", *SPIE Proceedings*, 6th International Conference on Education on Training of Optics and Photonics, 2000, Vol. 3, pp. 831- 259.

[12] Gyeong – ilKweon , " Noise Figure of Optical amplifiers", Journal of the Korean Physical society,2002, Vol. 5, pp. 617-628.

[13] Stephanie Novak and Richard Gieske, " Simulink Model for EDFA Dynamics applied to Gain Modulation", Journal of Lightwave Technology, vol. 20, no. 6, 2002, pp. 986-992.

[14] M. Melo, O. Frazao, A.L.J. Teixeira, L.A. Gomes, J.R. Ferreira D. Rocha, H.M. Salgado, "Tunable L-band erbium-doped fiber ring laser by means of induced cavity loss using a fiber taper", Applied Physics B, 2003, Vol.77, 139.

[15] M.A. Othman, M.M. Ismail, M.H. Misran, M.A.M. Said and H.A. Sulaiman , " Erbium Doped Fiber Amplifier (EDFA) for C- Band optical Communication System", International Journal of Engineering & Technology IJET- IJENS, vol. 12, no. 04, 2012, pp. 48-50.

[16] Hirotaka Ono, Member,Toshio Watanabe,Tetsuo Takahashi, and Tadashi Sakamoto, Kenya Suzuki,Atsushi Mori,"Wide-Range Variable Gain Fiber Amplifier With Erbium-Doped Fiber Switching",Journalof LightwaveTechnology,Vol. 31, No. 12,June 15 2013, PP. 1965-1972.

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