SOURCE FRAMEWORK FOR EFFICIENT OPTICAL NETWORK

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Abstract : The performance of Optical Fiber Communication system is mainly dependant on Transmitter and Receiver design. In most of the cases a Transceiver is used which means a module in which both transmitter and receiver are embedded. In this paper, we performed various parameters alterations on Optical Fiber Communication Transmitters. By analyzing various performance parameters, the performance of optical signal has been observed and various challenges have been dealt with. In the proposed optical source framework, gain improvement for various pump signal wavelength has been observed with linearly gain increasing when pump power (15mW) and when pump power is 2mW then gain is increased to 19db. Gain improvement for various active fiber length signal wavelength has been observed. It is observed that the proposed transmitter has better performance over the conventional designs.

***IndexTerms* – Quality Factor, Bit Error Rate, Transmitter, Receiver, OSNR.**

I. Introduction

As data transfer capacity requests innovative advances, fiber will keep on assuming a crucial job in the long haul achievement of media transmission [1]. Regular optical transmission wavelengths are 850 nm, 1310 nm, and 1550 nm. The two lasers and Light Emitting Diode (LEDs) are utilized to transmit light through optical fiber [2]. Three fundamental sorts of fiber optic link are utilized in correspondence frameworks like multimode, single mode and Graded. Step-list multimode fiber has a record of refraction profile that means from low to high to low as estimated from cladding to center to cladding. Moderately enormous center measurement and numerical gap describe this fiber [3]. Two fundamental light sources are utilized for fiber optics: laser diodes (LD) and light-producing diodes (Driven). LEDs are normally utilized at the 850-nm and 1310-nm transmission wavelengths, though lasers are principally utilized at 1310 nm and 1550 nm[4]. Two essential structures for LEDs are utilized in fiber optic frameworks: surface-producing and edge-emitting. LEDs are utilized in lower-information rate, shorter-separation multimode frameworks due to their innate transfer speed confinements and lower yield control [5]. Laser diodes (LD) are utilized in applications in which longer separations and higher information rates are required. Since a LD has an a lot higher yield control than a LED, it is equipped for transmitting data over longer separations [6]. LD can give high-data transmission correspondence over long separations. The trouble with LDs is that they are inalienably nonlinear, which makes simple transmission progressively troublesome. They are likewise extremely touchy to variances in temperature and drive current, which makes their yield wavelength float. In applications, for example, wavelength division multiplexing in which a few wavelengths are being transmitted down a similar fiber, the security of the source winds up basic. This typically requires complex hardware and input components to distinguish and address for floats in wavelength [7]. Index-guided laser diodes utilize refractive file steps to limit the lasing mode in both the transverse and vertical headings. Single-recurrence laser diodes are another intriguing individual from the laser diode family. These gadgets are presently accessible to meet the necessities for high-transmission capacity correspondence. Different points of interest of these structures are lower limit flows and lower control necessities. This yields yield wavelengths that are amazingly thin like a trademark required for Dense Wavelength Division Multiplexing (DWDM) frameworks in which numerous firmly dispersed wavelengths are transmitted through a similar fiber. The key prerequisite is that a source should turn on and off quick enough to meet the data transmission points of confinement of the framework. Linearity is significant trademark for certain applications. Linearity speaks to how much the optical yield is legitimately corresponding to the electrical flow input. Most light sources give practically no thoughtfulness regarding linearity, making them usable just for computerized applications Nonlinearity in LEDs causes consonant bending in the simple sign that is transmitted over a simple fiber optic connection.

II. Mathematical Model

The basic directing frameworks decide the real nature of transmission and the idea of Quality of administration depends on this framework parameters, can be characterized as the general assistance experience [1]. The system can be characterized as far as the Quality of Service (QoS) measurements or cost measurements, for example, Bit Error Rate (BER), Optical Signal to Noise Ratio (OSNR), information rate, Quality factor (Q-factor). The framework time reaction is the square base of the total of the squares of transmitter rise time, recipient rise time, laser diode rise time, photodiode rise time and the beat spreading brought about by fiber scattering. Transmitter and collector rise time and full occasions are recorded on information sheets, fiber reaction times must be determined from the fiber length, the trademark scattering per unit length, and the source otherworldly width. But the fiber scattering which is communicated in picosecond, rest of the ascent times is normally communicated in nanosecond. The Q-Factor and OSNR are indicators of the nature of transmission, which can be calculated from the following equations [4].

$$Q = \frac{2*OSNR*\sqrt{B_o/B_e}}{1+\sqrt{(1+4OSNR)}}$$

(1)

The clients prerequisite is generally characterized as Quality of Service and the light way steering must be done so that it guarantees the Q-Factor necessity of the customer and furthermore thinking about the accessibility of assets in the system. The most extreme estimation of Q-Factor is the ideal prerequisite for the association demand. The consolidated impact of administration execution which decides the level of fulfilment of client of the administration is called Quality of Service. QoS qualities, for example, transmission capacity, postponement, jitter and misfortune rate are utilized to help steering in optical system incorporate. QF is characterized regarding the data transfer capacity and postpone associated with the fiber in the way for each light way in the system. Transfer speed is essentially influenced by the length of the connection and scattering impact in the fiber interface. Additionally, delay relies upon the wavelength dispensed for the light way . The base achieved optical power expected to keep SNR at the predefined level is called collector affectability which is additionally identified with SNR. BER is characterized as the proportion of blunder bits to add up to number of transmitted bits at the decision point and is ordinarily utilized as a figure of legitimacy in computerized optical correspondences .

$$BER \approx \frac{exp^{\frac{-Q^2}{2}}}{Q*\sqrt{2*\pi}}$$

(2)

Electrical transmission capacity (Be) is characterized as the recurrence at which the proportion flow out/flow in (Iout/Iin) gets diminished to 0.707. (Ordinarily, electrical transmission capacity is utilized to determine the simple frameworks). Optical transmission capacity (Bo) is the recurrence at which the proportion power out/control in (Pout/Pin) gets diminished to 0.5. Since Pin and Pout are legitimately relative to Iin and Iout, the half-control point is equal to the half-current point. This outcomes in a Bo that is bigger than the Be.

$$BWe = 0.707 * BWo$$

(3)

The transmission information pace of an advanced fiber optic correspondence framework is constrained by the ascent time of the various constituents, for the most part by the intensifiers and LEDs, and furthermore by the scattering of the fiber. The joined impact of the considerable number of parts may impact the transfer speed of the framework. The ascent time (ts) and framework data transfer capacity (BWs) are relates as:

$$BW_s = 0.35/t_s$$

(4)

III. SIMULATION RESULTS

Simulation and result analysis is done on the basis of all the layout, LED and Laser parameters using MATLAB 2015a. Various LASER parameters characteristics such as Power Amplified Spontaneous Emission, P_{ASE}, Pumped Signal, P_s, Pumped Power, P_p have been modulated. BVP of 0.0235 with (L=1000cm, Pp=100mW, Ps=30uW)(#points=100,dz=10.0cm) has been performed after 15.48 seconds and 249 iterations. Optical source parameters such as Pump signal power, Fiber length (input), Output power, Active power length, Gain have been analyzed.

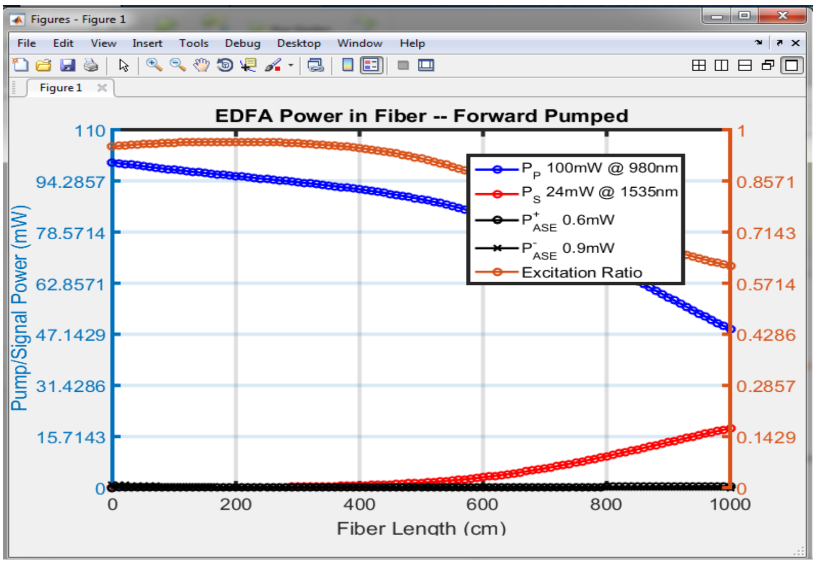

Fig 1: LASER Power in watt in optical fiber communication.

Fig. 1 shows Fiber length with respect to Pump signal power curve these are identifiy increasing fiber lengh to reducing Pump power(100mw) And excitation length increasing suddenly with respect to fiber length. Solving BVP for (L=100cm,Pp=250mW,Ps=22586uW)(#points=75,dz=1.3cm) .Done after 4.11 seconds and 181 iterations. Output signal power is 45.08 mW; 45.08 mW reflected back into the cavity and Maximum change is 0.002 dB. Solving BVP for (L=100cm,Pp=250mW,Ps=22586uW)(#points=75,dz=1.3cm) . Analysed after 4.20 seconds and 181 iterations.

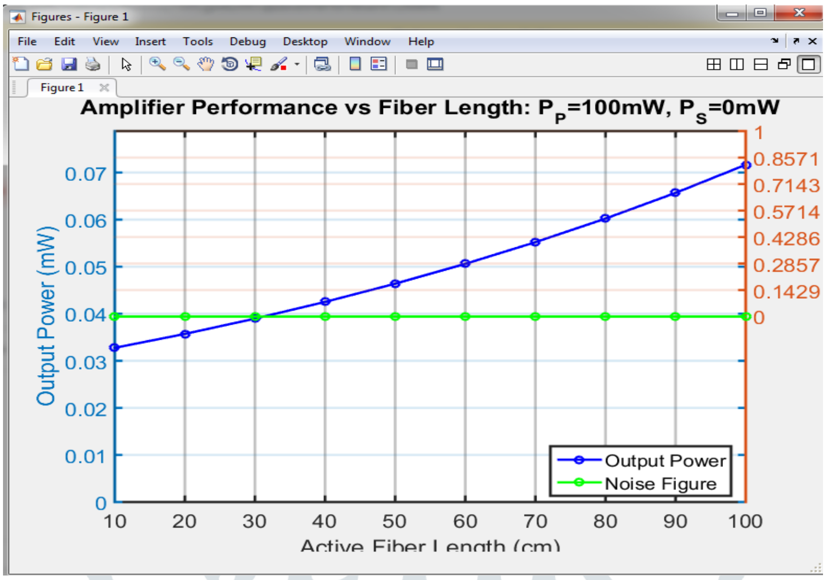

Fig 2: LASER fiber length with respect to power curve.

Fig.2 shows active fiber length with respect output power curve these are representing our proposed optical source denoted noise figure constant 0.04 and increasing value of output power 0.03 to 0.8571(mw). Hence our proposed work are reducing noise and improving main signal strength.

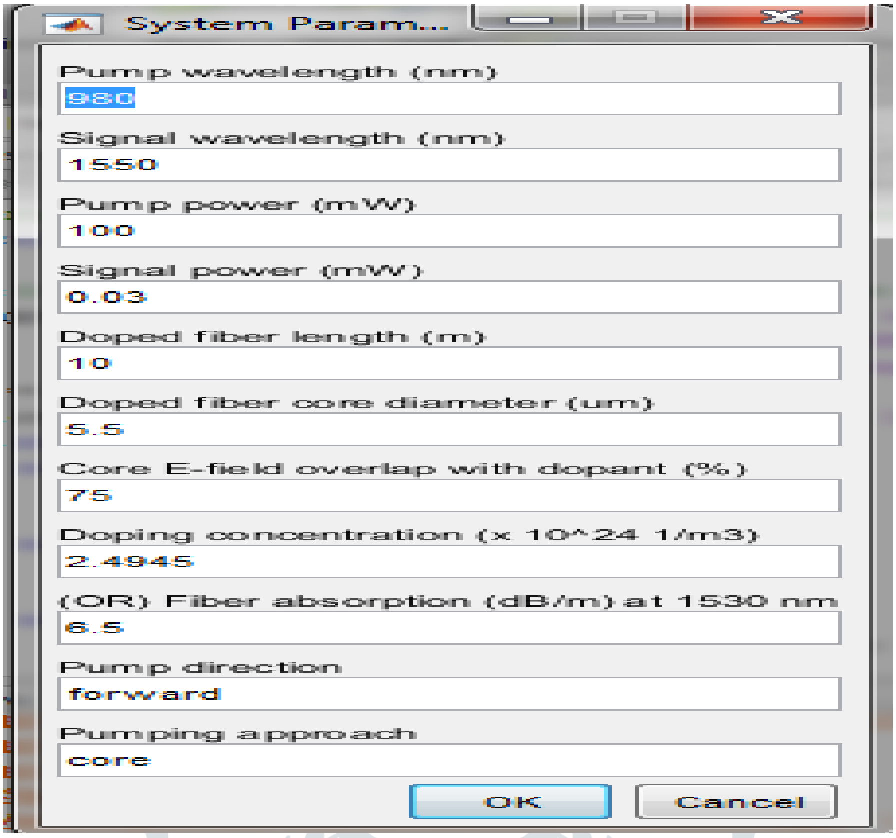

Fig 3: Laser source parameters

Fig. 3 shows input parameter GUI window to input of various parameters like as pump wavelength, signal wavelength, pump power etc. Fig.4 illustrates MATLAB 2015 function based output curve to selection of output curve.

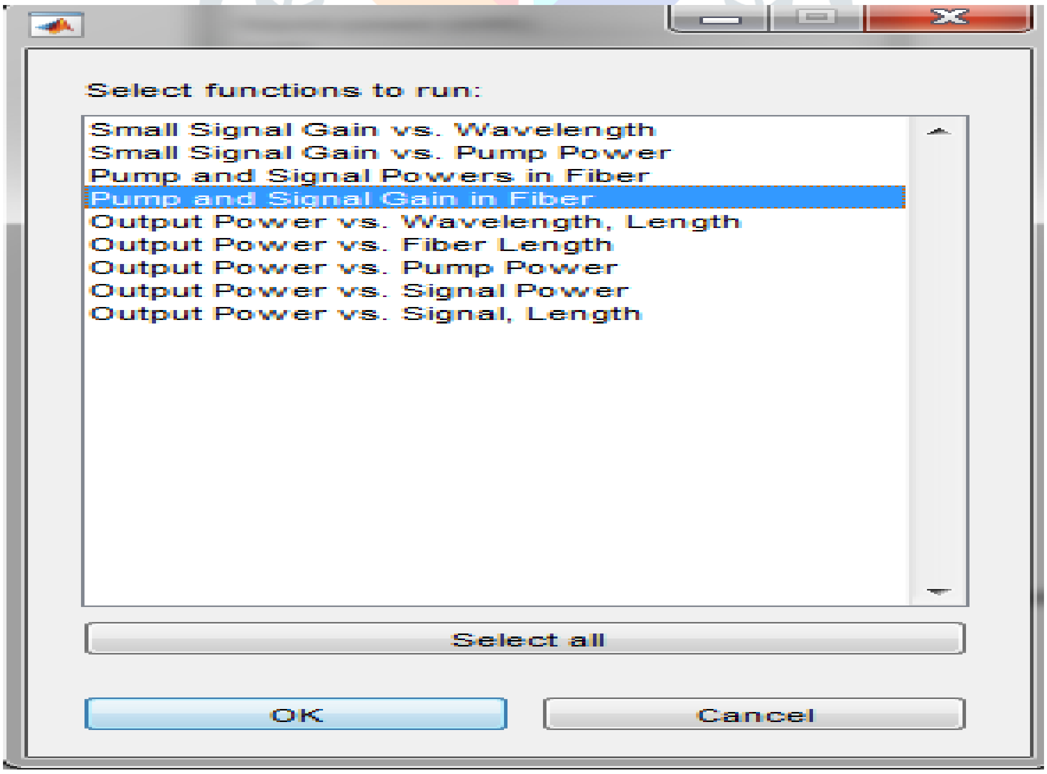

Fig 4: Selection graph window

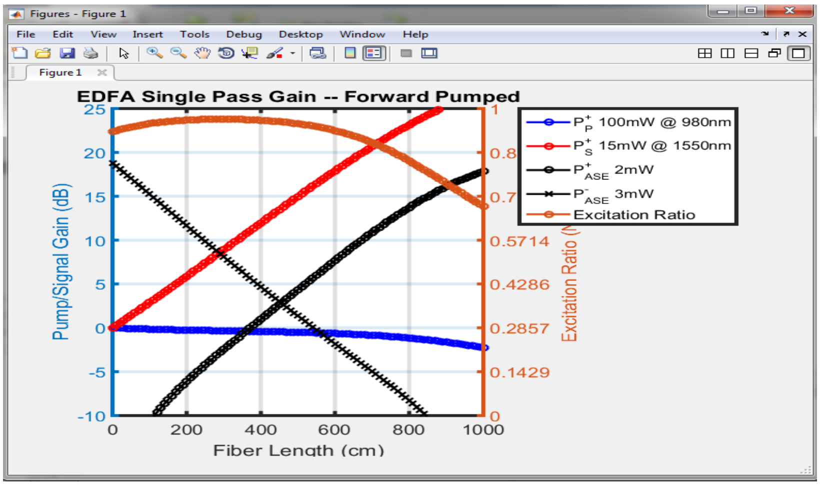

Fig 5: Laser power gain improvement

Fig. 5 show gain improvement for various pump signal wavelength. Now we identifying linearly gain increasing when pump power(15mW) and when pump power (2mW) then gain is increased to 19db.

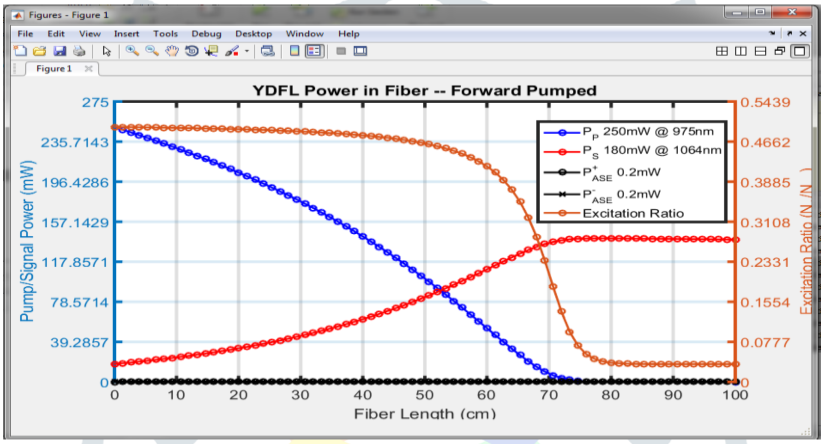

Fig 6: Laser Pump power.

Fig. 6 shows active fiber length with respect output power curve these are representing our proposed optical source 39.287mW and increasing value of output power 0.03 to 0.8571(mw). Hence our proposed work are reducing fiber length and improving main signal strength. Fig. 7 illustrates gain improvement for various active fiber length signal wavelength.

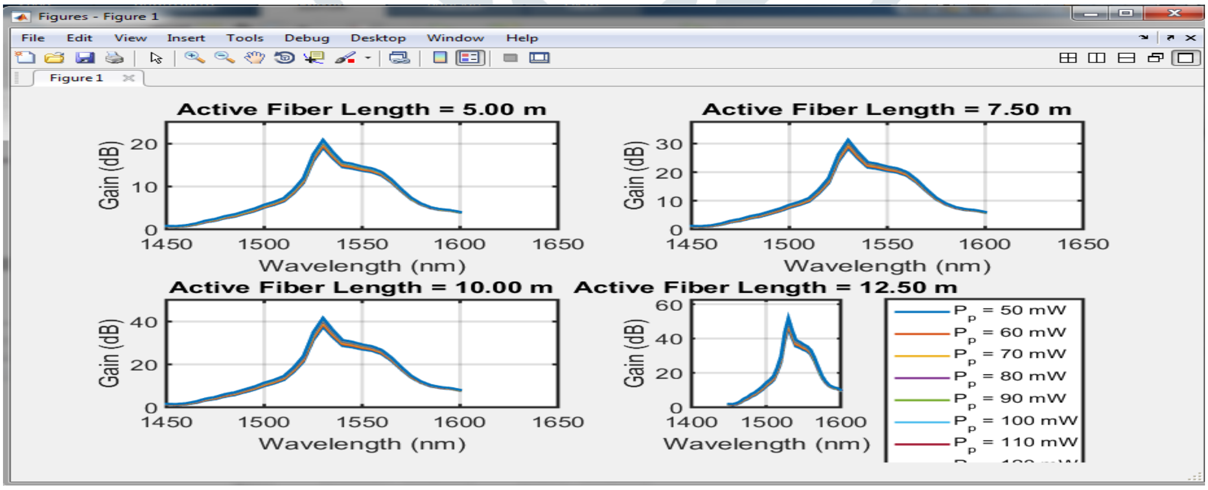

Fig 7: Laser Gain.

IV. CONCLUSION

We have calculated gain, BER for the given topology using the analytical model for gain and considering the effect of rise time. Here by transmission data rate, we are indirectly referring to the optical bandwidth of the system. With increase in the length of the cable, the magnitude of the dispersion problem increases and hence the transmission data rate decreases with fiber length. We need more transmitted power to get the same BER in the system, if the fiber length increases. Also, if the power is held constant, the BER increases as data rate increases. So in order to get the lower BER and good performance in communication system, the overall rise time must decrease on the higher data rate. The effect of system rise time on Q-factor indicates how transmitter and receiver properties affect the quality of transmission in optical communication. We need to choose the transmitter and receiver rise times and other rise times to such a minimum value so that we can get the best and optimization in fiber optic channel design. Except the fiber dispersion which is expressed in picosecond, rest of the rise times is usually expressed in nanosecond. The proposed optical source denoted noise figure constant 0.04 and increasing value of output power from conventional value of 0.03 to 0.8571(mw). Hence signal strength has been improved. Gain improvement for various pump signal wavelength has been observed with linearly gain increasing when pump power(15mW) and when pump power(2mW) then gain is increased to 19db. Gain improvement for various active fiber length signal wavelength has been observed.

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