A Review: An Evolution of Prior Different Transmission Techniques with EDFA and RAMAN Optical Amplifiers

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Abstract **-** Optical Raman Fibre Amplifiers have been widely studied because it can provide amplification with low noise figure over the entire fibre transmission bandwidth. The practical communication bandwidth on an optical fibre is so massive as a result of which, it is accomplished of letting the transmission of several signals over long distances. However, attenuation and distortion is the major constraint imposed by the communication medium for long-distance high-speed optical systems and networks. The hybrid optical amplifier have attracted much attention as they amplify the wide-ranging bandwidth. The crossbreed optical amplifier has wide gain spectrum ease of integration with other devices and little cost. This survey is mostly concerned with the hybrid optical amplifiers which are used in multichannel Time Division Multiplexing and wavelength division multiplexing (WDM) optical communication system and network. As the noise figure and ripples are one of the main constraints in WDM networks for hybrid amplifiers i.e. EDFA(Erbium Doped Fiber Amplifier) and RAMAN amplifier.

Keywords **-** Optical Network, Amplifier, Techniques of EDFA and WDM networks.

I. INTRODUCTION

The optical networks were developed with the main goal to supply the demand for high transmission rates, because the optical networks enable high signal capacity transmission, not prone to electromagnetic interferences [1], [2]. Nowadays with the popularization of the internet, the demand for high capacity communications is even higher, and the providers are under pressure to furnish higher rates at a lower cost.

In instruction to convey signals over extended distances (>100 km) it is necessary to recompense for attenuation fatalities inside the fiber. Initially this was accomplished with an optoelectronic module consisting of a visual receiver, renewal and equalization scheme, and an optical transmitter to send the data. Although functional this preparation is incomplete by the optical to electrical and electrical to visual alterations.

Several types of optical amplifiers have since been demonstrated to replace [5] the OE – electronic regeneration systems. These systems eliminate the essential for E-O and O-E alterations. This is one of the main reasons for the achievement of today's optical infrastructures schemes.

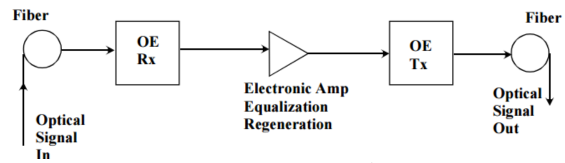

Fig.1: Optical Amplifier

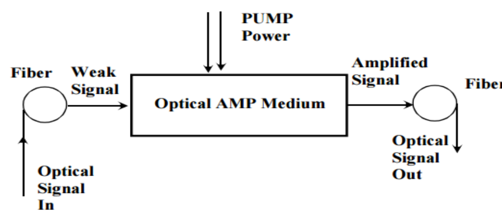

Fig.2: General Form of optical Amplifier

Carmelo J. A. Bastos-Filhoet.,al(2011)[1] robust and can produce Pareto Fronts which are useful to design real Raman amplifiers. From these results, they experimental that the designer can easily regulate the smallest number of pump lasers to build the amplifier appropriately. As an sample, they calculated an amplifier with ripple and normal on-off gain equal to 0.2 dB and 20 dB, individually, for the case where 40 signal frequencies are enlarged with total pump power equal to 1.5 W. FabrizioChiarello et., al(2011)[2]Polarization attraction in counter propagating, randomly brief regent, fiber Raman amplifiers is statistically investigated, counting the possessions of nonlinear polarization rotation, pump diminution and orthogonal Raman gain. The investigation determines the limitations of the drawing efficiency, and shows thatthe determined achievable mean degree of separation is a function of the mean gain.Montserrat Fernandez-Vallejo et.,al(2012)[3] network multiplexes low-cost concentration point devices based on fiber-optic tapers, which are able to quantity sensations in the 0.01 to 50 Hz incidence range. The instrument network with a double-bus is a low noise formation, which offers a higher ophthalmic signal to noise ratio and self-motivated range than a single-bus. Thus, the number of instruments to be multiplexed could growth or they could reach further detachments. The system also deploys distant distributed Raman amplification to extend the distinguishing range. Victor V. Kozlovet.,al(2011)[4] proposed a method for the destruction of relative intensity noise at the output of a Raman polarizer, a unusualtype of

Raman amplifier that transforms an input weak beam of polarized light into an highly separated amplified beam towards its output. We show that the RIN which is tempted by polarization- dependent gain was repressed whenever the Raman polarizer works in the exhausted pump regime. K.P. Maheshwari1 et .,al(2011)[5]Analytical and numerical investigation of plasma wave by a relativistic electron beam spreading along the axis of a metal wave guide in the attendance of strong external attractive field was carried out. Contingent on the parameters of the beam -plasma system, intensification of plasma waves is conceivable in different frequency ranges. If the connection coefficient is large, waves will be amplified over a broad frequency range. In the situation of small coupling constant the amplification takes place in a narrow range Juliana.

In the paper, we have discussed the types of optical amplifiers, an overview of optical amplifiers,optical gain flattening filters, techniques of EDFA ,the summary and finally the conclusion in the following paragraphs.

II. TYPES OF OPTICAL AMPLIFIER

1. Laser amplifiers.
2. Semiconductor optical amplifier
3. Raman amplifier.
4. Optical parametric amplifier.

a) Doped fiber amplifiers

Doped Fiber Amplifier are optical amplifiers that use a doped optical as a gain intermediate to amplify an optical signal [3]. They are associated to fiber lasers. The signal to be augmented and a drive laser are multiplexed into the fixed fibre, and the signal is improved through interaction with the doping ions. The most mutual instance is the Erbium Doped FiberAmplifier, where the core of a silica fibre is fixed with trivalent erbium ions and can be competentlypropelled with a laser at a wavelength of 980 nm or 1,480 nm, and exhibitions gain in the 1,550 nm regions.

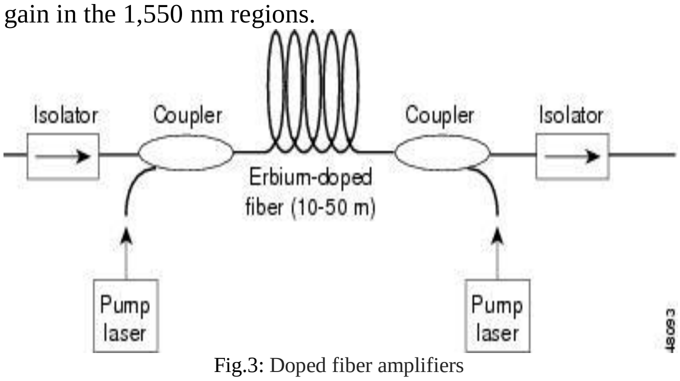

Fig.3: Doped fiber amplifiers

b) Semiconductor optical amplifier

The SOA(Semiconductor optical amplifier) operates under two principal [4] physical principles to produce a tunable weight and delay: slow and fast light and XGM. Slow and fast bright [8] refers to monitoring the group velocity of light in a propagating medium by generating a material dispersal. In semiconductors, slow and fast light is shaped via CPO, where the beating between two optical waves leads to alternations in the ground state populaceat the beat frequency. In microwave photonics, the two optical waves are expediently played by the optical carrier and its RF sidebands. CPO generates a resonance centered on the optical carrier frequency with a bandwidth incomplete by the semiconductor carrier lifetime. For an SOA operated in the gain regime, as it is here, the quality is a gain hole, which, through the Kramers- Kronig relations, results in fast light. From here on, we use the term time development rather than time delay to represent the time shift achieved by the SOA(semiconductor amplifier).

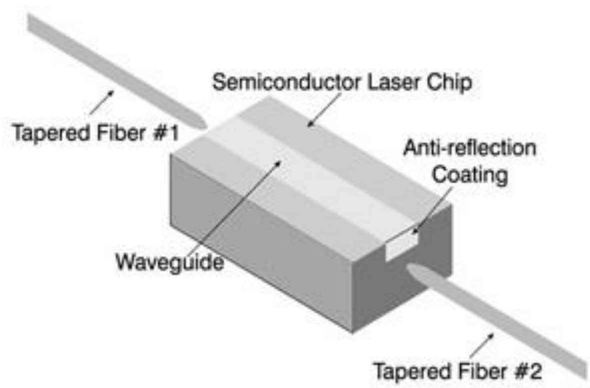

Fig.4: Semi-conductor Amplifier

c) Raman amplifier

In a Raman amplifier, the signal is exaggerated by Raman amplification. Unlike the EDFA and SOA the intensification effect is accomplished by a nonlinear collaboration between the signal and a pump laser within a photosensitive fibre. There are two types of Raman amplifier: disseminated and endured. A distributed Raman amplifier is one in which the transmission fibre is utilized as the gain intermediate by multiplexing a pump wavelength with indication wavelength, while a lumped Raman amplifier utilizes a committed, [5] smaller length of fibre to provide magnification. In the case of aendured Raman amplifier highly nonlinear fibre with a small core is operated to increase the communication between signals and pump wavelengths and thereby reduce the length of fibre compulsory. The pump light may be attached into the transmission fibre in the same course as the signal (co-directional pumping), in the opposite course (contra-directional pumping) or both. Contra reversingforcing is more common as the relocate of noise from the pump to the indication is reduced.

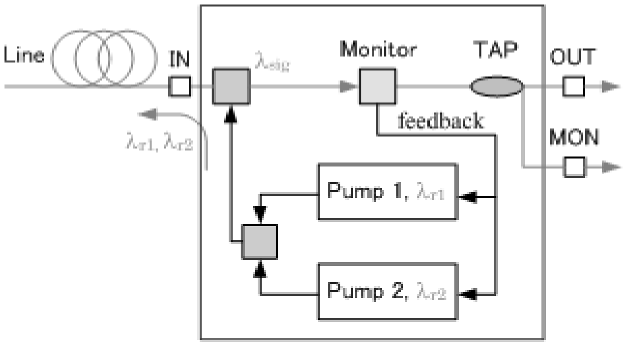

Fig.3: Raman Amplifier

III. OVERVIEW OF OPTICAL AMPLIFIER

The broadcast of signal in optical fiber is affected by two important limitations i.e. attenuation and dispersal [6]. Here dispersion is as a result of indicationmachineries at different wavelength travelling at different speeds privileged the optical fiber. Attenuation is as a consequence of the partial transparency of the glass suppliesestablishing the optical fiber which will result in measured reduction of amplitude of the signal broadcast and hence the gain. Both decrease and dispersion results in the reduction of precision associated with the signal broadcast through optical fiber. In the case of single mode fibers the effect of dispersal is deserted but the problem related with attenuation is a very serious issue. Spread of signal in optical fibers mostly takes place around 1310nm and 1550 nm. The typical [7]reduction of silica fiber is in the order of 0.2dB/km at 1550nm. Later after a distance of around 100km, the signal attenuation will be approximately 20dB which will result in significant loss of signal.

The optical amplifiers production a key role in preventive the reduction of optical communication system. Optical amplifiers compensate for circulation losses in long distance links and branch losses in access networks, at the similar time escaping [8] costly two-way adaptations between optical and electrical signals. By optical intensification the network presentation is increased and also optical amplification outcomes in lowering the number of repeaters and thereby shortening the network. An optical amplifier increases the signals and so increases the SNR of the signals and also it takes the BER rate below 10-9 which is the anticipated rate in optical communication.

IV. OPTICAL GAIN FLATTENING FILTERS

In general, the advance profile of an EDFA can be flattened by adjusting the material composition in the erbium-doped fiber or by using visual filters to compensate for the dissimilarities in the gain spectrum. A variety of kind of optical filters have been established for this application, including long-period fiber gratings, fiber Bragg gratings, fiber acoustic optic tunable filters [9,10], Mach–Zehnder filters, and a split-beam Fourier filter [11]. As the technique of flattening a gain range of EDFA, methods using optical gain-flattening filter with reverse loss spectrum against gain range are common. The principle of optical gain-flattening filter .It is shown that EDFA has gain requirement on wavelength before flattening. After destruction of gain by using the optical gain-flattening filter, it is shown that confidence of EDFA (Erbium Doped Fiber Amplifier) on wavelength is firmed and deviation of signal power is improved. In Figure 4 sample conformation of EDFA with optical gain-flattening filter is shown. Generally optical gainflattening filter is used in sequence with EDFA.

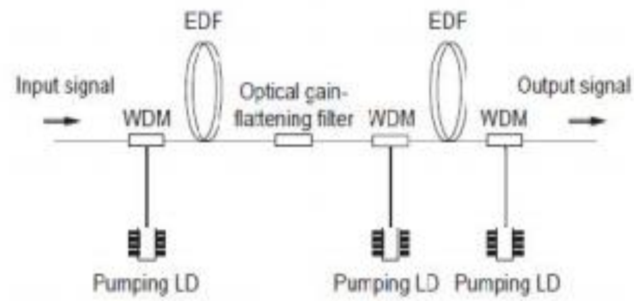

Fig.5: Gain flattening filter

V. TECHNIQUES OF EDFA

A. Chromatic Dispersion

The communication between an electromagnetic wave and certain electrons of a dielectric average is in general reliant [12] on the optical frequency, ω, of the signal. This property of optical spread through a dielectric medium establishes itself in optical fiber mainly due to the frequency requirement of the refractive index of the core. It is mentioned to as chromatic dispersion.

B. Fiber Non-Linear Characteristic

The concentration of the electromagnetic wave increases, the answer of the dielectric medium starts to exhibit non-linear behaviors. The origin of this nonlinearity is related to [13] the enharmonic signal of the bound electrons, when a high intensity filed is functional. The relation between the tempted polarization P and the electric field E is non-linear.

C. Bragg Grating

An optical Bragg grating is a translucent device with an intermittent variation of the refractive index, so that a large reflectivity may be reached in particular wavelength range (bandwidth) around a sure wavelength which fulfills the Bragg illness.

D. Geometric Description of Beam Propagation

The ray explanation of light propagation in fiber is based on the singularity of total internal reflection. The theory of TIR states that when a beam is occurrence at the boundary between two media where the occurrence medium is of a higher refractive index than the second intermediate and the angle of frequency exceeds a dangerous value θc, the light will be totally reflected. Outside this angle light is no longer transmitted into the second medium, in its place it is replicated into the original medium [14].

E. Dynamic Response Characteristic of EDFA

In dynamic systems an additional major cause of transients is related to the genuine add and drop incident of channels. Therefore, transient suppression should be able to deal with events on a microsecond time-scale, ensuring compatibility with future switching tools and applications. Furthermore, dynamic network [11] are usually calculated to cater for higher channel counts, up to 96 frequencies in the C-Band, meaning that changes in input power can be as high as 20 dB. The passing suppression time needs to be smaller, typically less 200 μs. This type of presentation was achieving using an original digital feed-back control loop.

F. Pumped EDFA(Erbium Doped Fiber Amplifier)

Cladding pumped EDFA [12] has been recognized as a solution for L-band amplification. , the noise presentation of these devices is studied for both co and counter circulating pump schemes.

VI. SUMMARY OF OPTICAL AMPLIFIER

Carmelo et al , 2011 [1]presented a method to intend Raman amplifiers using a multi-objective particle swarm optimizer. The goal is to define the number of force lasers and their wavelengths and power in order to maximize both the average on-off gain and the flatness of the gain. The multipurpose optimizer aim to generate non-dominated solutions considering the average on-off gain, the number of used force lasers and the increase ripple over the transmission bandwidth. Fabrizio Chiarello et al,2011[2] Polarization draw in counter propagate, randomly birefringent, fibre Raman amplifiers is numerically investigated, including the effects of non-linear polarization rotation, pump depletion and orthogonal Raman gain. The analysis determines the limitations of the pulling efficiency, and shows that the maximum achievable mean degree of polarization is a function of the mean gain. Montserrat Fernandez-Vallejo et al., 2011[3] proposed sensor network multiplexes low-cost intensity point sensors based on fibre-optic tapers, which were able to measure vibrations in the 0.01 to 50 Hz frequency range. The sensor network with a double-bus was a low noise configuration, which offers a higher optical signal to noise ratio and active range than a single-bus. Thus, the number of sensors to be multiplexed could increase or they could reach further distances. The systems also deploy remote dispersed Raman amplification to extend the sensing range.

VII. CONCLUSION

More than thirteen years have passed since the first investigationalprotest of a high-gain erbium doped fiber amplifier. Since then the aggregate bandwidth of optical fibers has enlarged dramatically with the deployment of WDM systems. Back in 1986 a bandwidth of 4THz appeared fantastic, yet recent lab protests in Japan have pushed the I EDFA bandwidth close to the limit. A novel dopant amplifiers offer anadditional order of extent in bandwidth, but further gains will only be possible with more efficient coding approaches and multiple deployment of fibers. The use of concatenated EDFAs in WDM systems raises issues of gain tilt and longer term stability. As aneffect, a number of examination groups, including that of the author, are examining dynamic spectral equalization techniques for WDM channelorganization. The paper will review the account and certain topics of current interest in EDFA investigation and look advancing to further expansions in the twenty-first century.

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