A Survey on Hybrid Optical Amplifiers

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Abstract

The optical fiber communication gains wide attraction in present time. With this communication technique, information can be sent with high data rates and low cost equipment. As there are various advantages of optical amplifier communication but its performance reduces by light dispersion effects. At the receiver end we use various types of optical amplifiers which can amplify these signals. In this paper we review that the hybrid optical amplifiers are combination of one or more amplifiers to remove the drawbacks of individual amplifiers.

Keywords: EDFA Amplifier, Hybrid Amplifiers, RAMAN Amplifier, SOA Amplifier

1. Introduction

In communication system the amplifier optical fiber communication is widely used now days because of its properties to provide higher data rates, its low cost etc. In optical fiber communication the light is used as carries and it transmit through thin fiber like structures made from glass (silica)\(^1\). The light is provided by various sources like: Light Emitting Diodes (LED) and laser. If the optical moves with the Standard Signal Mode Fiber (SSMF) it gets dissipate with the fiber and speed of data is high enough (> 15 Gb/s), it get change due to diffraction dispersions. To stop these dissipation we use Optical Fiber Amplifiers (OFA) are used. After the OFA the system has problems like amplified sudden emission. As the signal goes increases the ASE noise will gather the OFA. The bandwidth of the optical fiber is great if the S-band, C-band and L-band are utilized properly. so that optical amplifiers are designed to amplify the signal with the fiber, there must be more gain, more distance from end to end amplifier as long as signal not deform due to high optical power. To make use of the bandwidth we use the Dense Wavelength Division Multiplexing DWDM and each of the amplifiers must have different bandwidth (Figure 1).

Basically, there are three main elements in fiber optic communication system\(^2\). They are Compact light source, Low less Optical fiber and Photo detector. Depending on the application like local area network these light source are required. In this they include power, speed, noise, etc. light emitting diode and laser diode are the main components used in the light sources

Optical fiber well known as the cylindrical dielectric waveguide which is made up of low loss material. It is made up of high quality extruded glass and it is flexible the diameter of this cable in 0.25 to 0.5mm

The main principle of photo detector is to convert light signal to electrical signal. Depending on the user wavelength PN photo diode and avalanche photo diode is used

2. Hybrid Amplifiers

An optical amplifier is a device which amplifies the signal directly without converting into the electrical signals.

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This works on the principle of stimulated emission. Stimulated emission is a process where an incoming photon of a specific frequency can interact with the atomic electron causing to drop a lower energy level. Some of the Amplifiers are discussed below

2.1 EDFA

Erbium doped fiber amplifier consists of three basic components: length of EDF, wavelength selective coupler and pump laser. The fibre length used depends upon the pump potential, input significance and pumping wavelength. These EDFA can be used large in size in optical fibre communication system as the compatibility with the optical fibre. EDFA is capable of amplifying all the wavelength ranging from 1500 to 1600nm. there are only C-band and L- band windows for wavelength they allow data signal to simulate the atoms to replace photon. More EDFA are pumped by lasers with a wavelength of either 980nm or 1450nm (Figure 2).

Demerit of EDFA is different gain for different wavelength due to doping concentrate and EYCDF suppresses concentric quenching affect results in higher gain with flatness under pump power. Different applications for the EDFA amplifier are shown in Figure 3.

2.2 Raman Amplification

Raman amplifier based upon the gain which results from the effect of stimulated Raman scattering. Raman amplifier is little high power pump laser when compared to other amplifiers and wavelength division multiplexing WDM. Here the amplification occur itself in the fibre and it is distributed in the path it has a wide bandwidth of 10nm. It can amplify up to 10db in optical fiber. Raman amplifier is combined with EDFA to expand gain flattened bandwidth. Raman gain in optical fibre occur from the transfer of power from one optical beam to another through the energy of photon. If we insert an optical beam in the optical fibre then the Raman scattering occur in an silica glass then the signal passes through the fibre and the frequency around it shift through pump. Raman amplifier based on two cases Raman amplifier distributed and discrete. Here the amplification occurs according to the fibre between two stations and it is near the transmitter then it is forwarded pump or if it is near to the receiver it is reverse pump (Figure 4).

2.3 Semiconductor Optical Amplifier

Semiconductor optical amplifiers are typically used as a power booster for the optical amplifier and it provide amplification for long distance communication. Semiconductor optical amplifier is a modified semiconductor laser which has different reflectivity and different wavelength. When weak signals are transmitter to the active region of which is stimulate emission result in strong signal emitted from semiconductor (Figure 5).

Drawbacks of semiconductor optical amplifier high coupling loss polarization dependence a higher noise they
are typically used for construction of the small package and they work or 1310 and 1550 nm system.

3. Literature Review on Hybrid Amplifiers

Using the Er-Yb co-doped amplifier we have proposed the flat gain optical gain hybrid amplifier. The contribution for this paper is to implement the flat gain hybrid amplifier based upon the cheapest standard optical amplifiers. After the investigation of the various hybrid amplifiers of dense wavelength and division multiplexing, observed EDFA-Raman amplifier is the best combination for the better results. It is observed that the Raman amplifier is used as a booster for the hybrid distributed Raman amplifier and erbium doped filters. Due to the dynamics gain in the hybrid amplifier this distortion of the pulse shape and cross talk between the symbols presents. The results in terms of the gain flatness, cost brings the good performance and will be suitable for the next generation for the DWDM network.

In this paper we are going to investigate the gain spectrum of a gain clamped amplifier under the various operating conditions and wavelength must be stabilized. Mach-zehnder is used to equal the gain clamped and immune the signal to the input where the power in the range of WDM technologies. Due to the high optical gain and value the realization of ideal gain flattered spectrum with fixed gain independent to operating industries clamping and gain flattered operates within in the range of 70nm spectral to 1555nm using these mach-zehnder equalizer.

Four-Node metro division wavelength and dense multiplexing ring network where the lambda are source at network node and lambda is considered as the virtual ring. Here the downstream and the upstream for bit error rate is find out using the linbo3neal. Here we are demonstrating four node metro WDM ring network in which all the wavelength are sourced to one node and each wavelength can be sorted at a distinct virtual ring network modulated upstream signal exhibit negligible power penalty both the axis node and the end station are configured to benefit from the component integration.

Flat gain L-band propose hybrid optical amplifier for the dense wavelength division DWM Multiplexing using the two stages of DRA EDFA hybrid amplifiers we have proposed the flat gain corrections. It is observed that if we increase the input power the gain variations over the bandwidth also increases and it is observed from the investigation of DWM system with the 25Ghz channels and it is observed that all the smooth output spectrum is obtained when all the input power is at 3 mw and it is determined without using any flattering techniques.

4. Future Scope on Hybrid Amplifiers

In this paper, we have explained about different types of hybrid amplifiers which are combination of Raman amplifier and EDFA and for others amplifiers it can be extended with gain media. In future there is also a scope for increasing the performance of hybrid amplifiers for the combination of two or more amplifiers.

5. Conclusion

According to this study, we have presented a technique which will increase the gain of the amplifier by reducing the attenuation and loss of the signal strength. By adopting various types of hybrid optical amplifiers like EDFA, Raman amplifier and SOA best performance can be achieved when compared to the existing techniques. Hybrid amplifiers have proven effective in DWDM systems to increase long distance having efficient band width with nonlinear effects.

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