Erbium-Doped Fiber Amplifier (EDFA)

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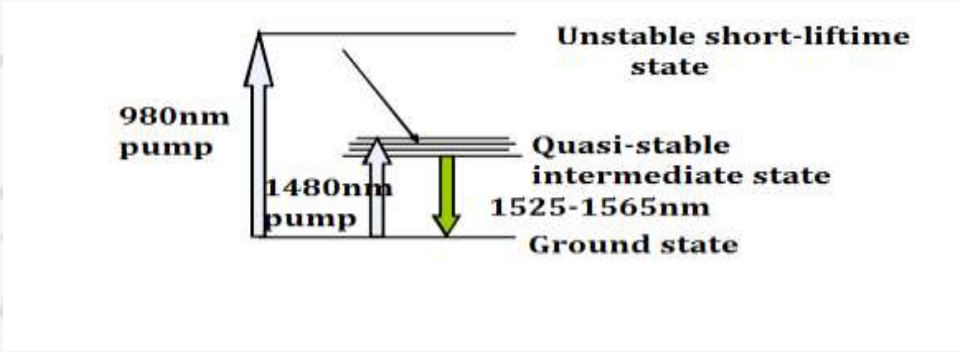
Erbium-Doped Fiber Amplifier (EDFA) Erbium-Doped Fiber Amplifier (EDFA) is an optical amplifier used in the C-band and L- band, where the loss of telecom optical fibers becomes lowest in the entire optical telecommunication wavelength bands. Invented in 1987, an EDFA is now most commonly used to compensate the loss of an optical fiber in long-distance optical communication.

Origin of EDFA (Who, When and Where)

- Prof. David Payne and team
- Published the research paper in the year 1987
- At the University of Southampton,UK

EDFA Working Principle

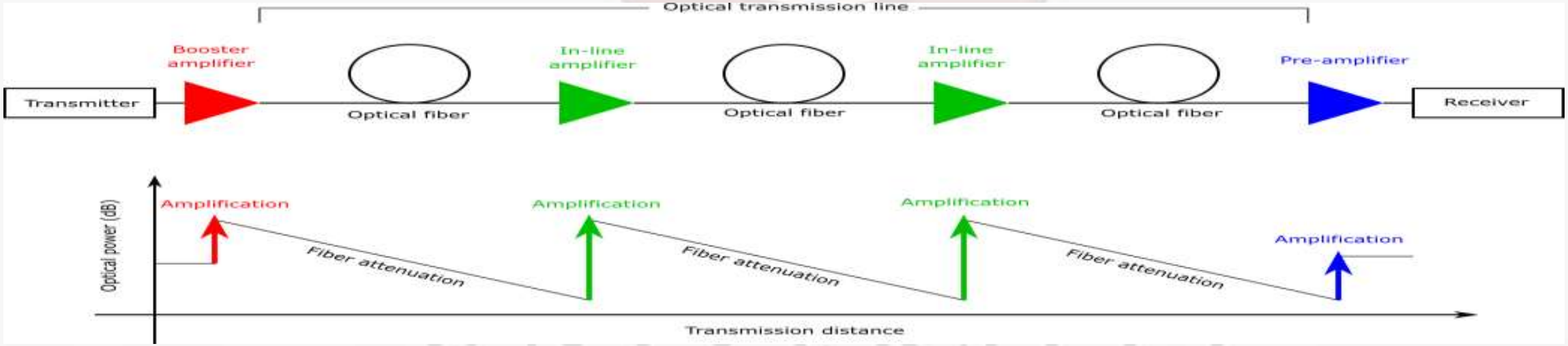
The erbium-doped fiber (EDF) is at the core of EDFA technology, which is a conventional silica fiber doped with Erbium. When the Erbium is illuminated with light energy at a suitable wavelength (either 980 nm or 1480 nm), it is motivated to a long-lifetime intermediate state, then it decays back to the ground state by emitting light within the 1525-1565 nm band. The Erbium can be either pumped by 980 nm light, in which case it passes through an unstable short lifetime state before rapidly decaying to a quasi-stable state, or by 1480 nm light in which case it is directly excited to the quasi-stable state.



Baisc configuration of EDFA

EDFA configuration is mainly composed of an EDF, a pump laser, and a component (often referred to as a WDM) for combining the signal and pump wavelength so that they can propagate simultaneously through the EDF. In principle, EDFAs can be designed such that pump energy propagates in the same direction as the signal (forward pumping), the opposite direction to the signal (backward pumping), or both direction together.

EDFAs are used as a booster, inline, and pre-amplifier in an optical transmission line. The booster amplifier is placed just after the transmitter to increase the optical power launched to the transmission line. The inline amplifiers are placed in the transmission line, compensating the attenuation induced by the optical fiber. The pre-amplifier is placed just before the receiver, such that sufficient optical power is launched to the receiver. A typical distance between each of the EDFAs is several tens of kilometers.



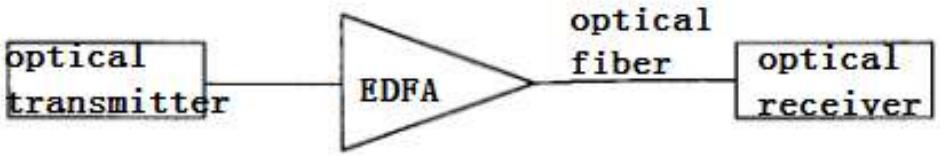
Application of EDFA

After learning what is EDFA, and EDFA working principle. Next, application forms and application fields of EDFA.

Forms of application-

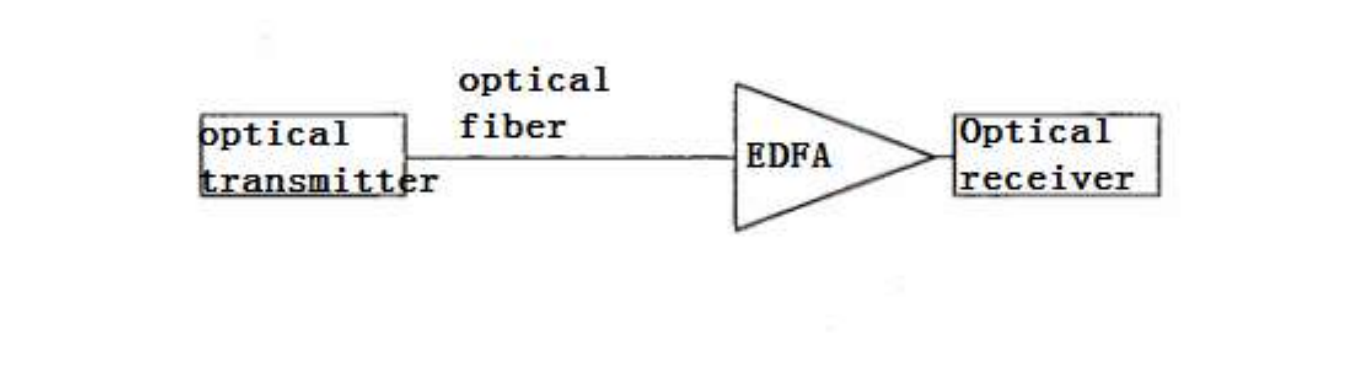
Booster Amplifier

When used as the booster amplifier, EDFA is deployed in the output of an optical transmitter to improve the output power of the multi-wavelength signal having been multiplexed.



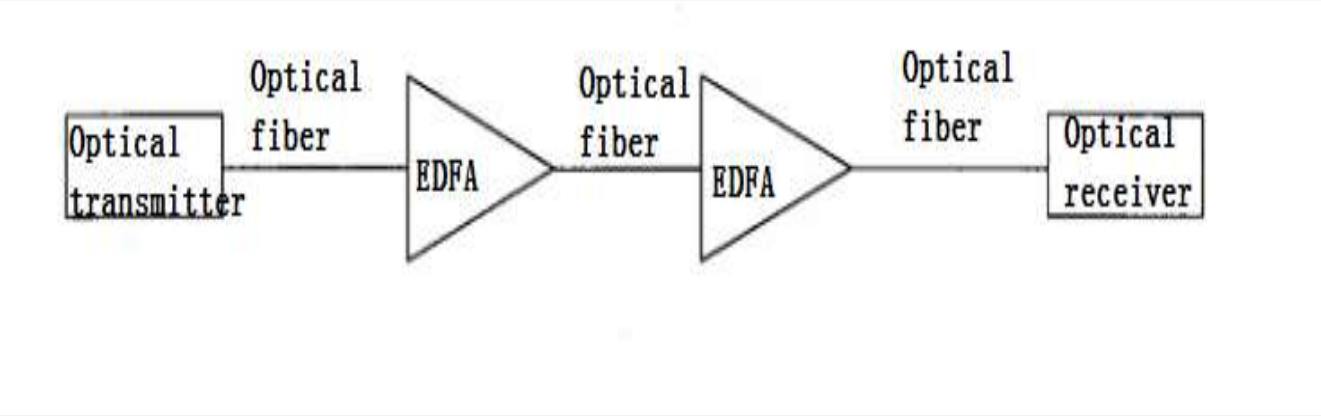
Preamplifier

When used as the preamplifier, EDFA needs the features of low noise and high gain. Being equipped with these features, EDFA can significantly improve the sensitivity of an optical receiver when deployed in the input of an optical receiver



Line Amplifier

When used as the line amplifier, EDFA is able to periodically compensate for the transmission loss of lines. As a substitute for OEO repeater, EDFA can directly amplify the optical signals transmitted in lines. In this way, we solve the bottleneck problems of photoelectric interchange to lay a foundation for all-optical network (AON)



Fields of application

EDFA has the following fields of application:

(1) EDFA can be employed in the high-capacity and high-speed optical communication system. The application of EDFA is very constructive to deal with the problems of low sensitivity of receivers and short transmission distances owing to a lack of OEO repeater.

(2) EDFA can be utilized in long-haul optical communication system. By utilizing EDFA, we can dramatically lower construction cost by increasing the repeater spacing to reduce the quantity of regenerative repeaters.

(3) EDFA can be used in the optical fiber subscriber access network system. If the transmission distances are too long, EDFA will function as the line amplifier to compensate for the transmission losses of lines, thus greatly increasing the number of subscribers.

Drawbacks

- Pump laser necessary
- Need to use a gain equalizer for multistage amplification
- Difficult to integrate with other components
- Dropping channels can give rise to errors in surviving channels

Conclusion

EDFA technology is by far the most advanced. Nowadays EDFA is extensively in the optical fiber communication networks. As communication technologies continue to be developed, EDFA will become the preferred choice for the future optical amplifiers. EDFA will play a more and more important role in optical communication system to better serve subscribers.

Thank you