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PERFORMANCE ANALYSIS OF OPTICAL COMMUNICATION SYSYTEM USING DIFFERENT OPTICAL FILTERS

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ABSTRACT

An optical communication system uses a transmitter, channel and receiver. In optical communication system, optical filters are used to selectively transmit or reject a wavelength or range of wavelengths. Optical filter is a device which allows a light of particular range or wavelength and the remaining is blocked.

In this paper, the performance of optical communication channels with different optical filters were analyzed and compared with that of without filters. At first, performance analysis was done without optical filter. Later the performance analysis was done using different optical filters namely Bessel, Trapezoidal, Gaussian and Fabry Perot optical filters. The OptiSystem Simulation Software is used for analyzing the performance of the optical communication system. The results have shown the maximum quality factor in terms of both optical range and beam divergence when compared to without using filter. Among different optical filters the Gaussian filter achieved maximum quality factor in terms of optical range, transmitter and receiver aperture diameters.

In addition to performance analysis, simulation was also done by implementing multiplexer/demultiplexer for multi users using a single channel.

Keywords: Optical communication channel, Bessel optical filter, Trapezoidal optical filter, Gaussian optical filter, Fabry Perot optical filter.

1. INTRODUCTION

Fiber-optic communication is a method of transmitting information from one place to another by sending pulses of light through an optical fiber. Fiber is preferred over electrical cabling when high bandwidth, long distance, or immunity to electromagnetic interference are required.

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This type of communication can transmit voice, video, and telemetry through local area networks, computer networks, or across long distances. Optical fiber is used by many telecommunications companies to transmit telephone signals, Internet communication, and cable television signals.

The process of communicating using fiber-optics involves the following basic steps as shown in Fig.1.

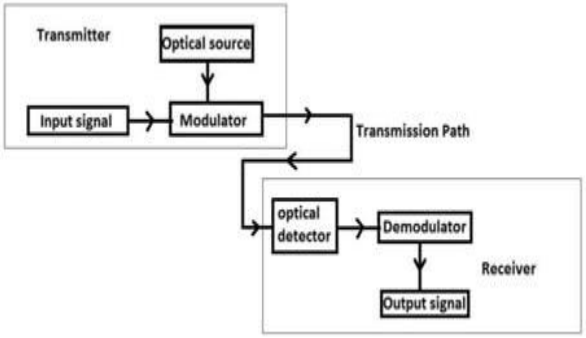

Fig. 1: Optical Communication System

Lasers, CW (Continuous Wave) Lasers and LED's (Light Emitting Diodes) are used as sources. The light forms an electromagnetic carrier wave that is amplifiedand modulated to carry information.The modulated signal is transmitted through the fiber optic cables ie., through channel and then at that receiving end optical detectors detects the received signals and demodulated to generate the signal.Optical Communication System with optical filters improves its efficiency.

2. EXISTING METHOD

The basic diagram of optical communication system without using optical filter was shown in Fig.2. Transmitter part includes the Continuous Wave (CW) laser for optical source, Mach-Zehnder modulator (MZM) for modulation, Pseudo Random Bit Sequence (PRBS) generator at a maximum data rate of 20 Gbps, and NRZ pulse generator for encoding technique. In a short range communication, we need an optical amplifier set at 20 dB. The amplified signal is then directly sent to the receiver through Optical fiber Link. The receiver section is to detect the optical signal using APD photo detector, where initially there is no application of the optical filter.

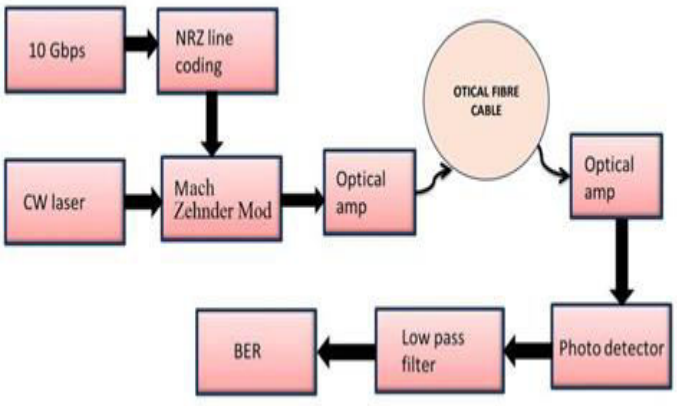

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Fig.2:General Optical Communication System

The layout of the general optical communication system without using filters was simulated

Using OptiSystem software, as shown in Fig.3.

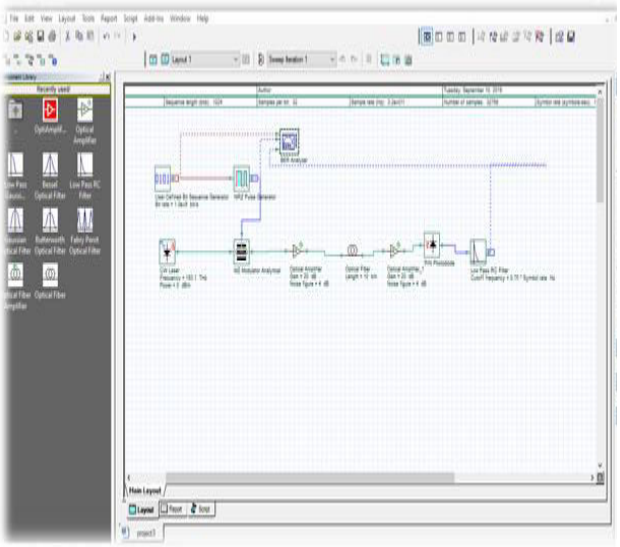

Fig.3: Layout of General Optical Communication System in OptiSystem software

OptiSystem is an innovative, powerful and rapidly evolving software design tool. It enables users to test, plan and simulate almost all type of optical link. In OptiSystem software**,** BER analyzer is used for finding the Quality factor of the system.

3. PROPOSED METHOD

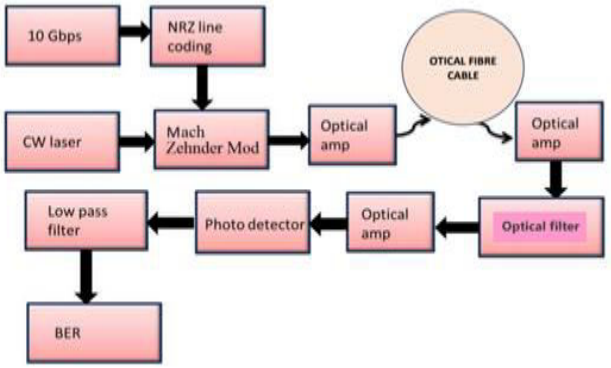

Fig. 4: Proposed System with Optical Filter and pre-post amplification

The modified system as shown in Fig.4has been designed with the optical filters. The performance is further enhanced by getting the amplified signal component at the pre and post section of optical filtering process. The received signal is amplified using the optical amplifier. The amplified signal is then filtered. The filtered signal is detected using the photo detector and filtered before giving to the Bit Error Rate (BER) analyzer. Bessel filter in Fig. 5 is replaced with the other three optical filters, namely Trapezoidal optical filter, Gaussian optical filter, and Fabry Perot optical filter. The same process was repeated and the quality factor was obtained for all other filters.

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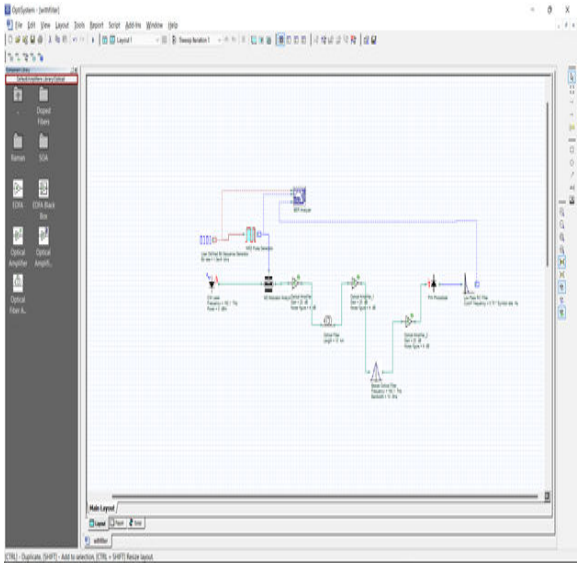

Fig.5:Layout of Proposed System with Optical Filter and pre-post amplification

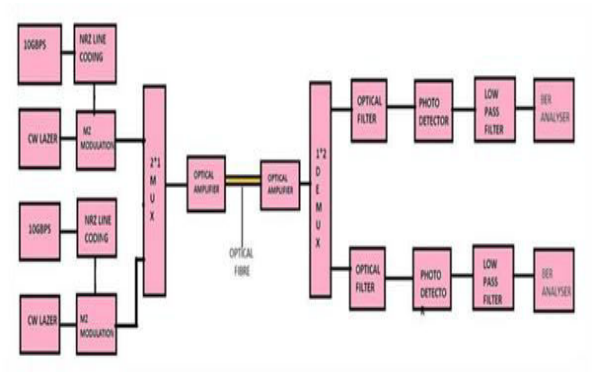

Fig 6: Optical Communication System with multiple transmitters and multiple receivers

The proposed system was extended for the multi users as shown in Fig.6. The multi users system contains multiple transmitters, multiple receivers, and a single channel. A multiplexer is used for combining multiple signals into single signal and a demultiplexer is used for splitting single transmitted signal into multiple signals, such that multiple input signals pass through a single channel and received by the corresponding receivers.

4. RESULTS AND DISCUSSION

Simulation was performed with the help of OptiSystem Software. Quality factor is used as performance metric. The Proposed method was implemented with different optical filters and also verified the quality for various distances. The graph for quality factor versus distance was plotted and shown in Fig. 7. The performance was analyzed among different filters.

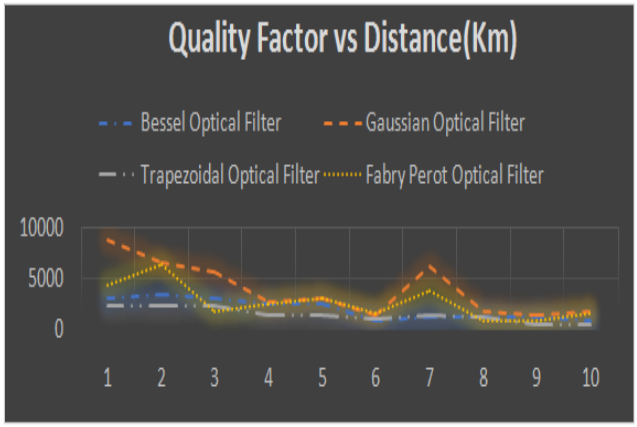

Fig 7 :Comparison of quality factors of different optical filters

5. CONCLUSION

The proposed opticalcommunication systemwas implemented using various filters. The BER analyzer is used to determine the quality factor. The quality

factor was determined for various distances and plotted. The pre-post amplification improved the signal quality which resulted in a better performance.Among all the filters, the proposed system exhibited maximum quality factor with Gaussian optical filter.

6. FUTURE SCOPE

The few important and common issues related to the service quality of communication systems are high capacity and reliable connectivity. Optical spectrum analyzers can be used to analyze the optical spectrum.

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