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ANALYSIS OF PERFORMANCE AND COMPARISON OF MODULATION FORMATE FOR OPTICAL FIBER COMMUNICATION SYSTEM

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ABSTRACT- **The invention of optical fiber is a major revolution in the world of communication. Optical fiber has not only helped communication to make it better but also reduces the cost of installing large cables and wires. In most cases it was found that as a signal is transmitted over distance its power gets reduced. The quality of the signal also gets quite detoriated when it reaches the other end. The output gets distorted and all this ultimately affects the performance of a system. There exist various important factors and technological issues such as, attenuation, fiber nonlinearity and dispersion which are responsible for degrading the performance of a system.**

There must be some way out to transmit an error-free signal over a certain distance. With growing time, advance modulation format has replace the older ones with their distinguish properties. This has inspired to study and analyze all the aspects of advance modulation formats in Optical Wavelength Division Multiplexing/Dense Wavelength Division Multiplexing (OWDM/DWDM).

Here it has been analytically evaluated the effect of higher order dispersion and phase modulation on advance modulation formats like Chirped Return-to-Zero (CRZ), Alternate Chirped Non Return-to-Zero (alCNRZ) and Novel Chirped Return-to-Zero (nCRZ) modulation format. The mathematical modeling of the CRZ, alCNRZ and nCRZ modulation format are also presented in the following chapters. The output electric field in the presence of higher order dispersion and phase modulation index for each modulation format as explained above are mathematically and graphically evaluated.

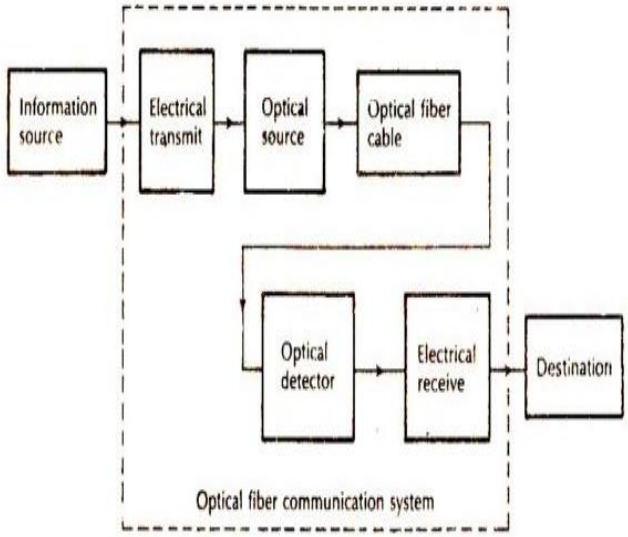
Keywords- Optical Fiber Cable, OWDM, DWDM, LASER

INTRODUCTION

The word telecommunications mainly consist of two parts: "tele" and "communications". The word "tele" is a Greek word which means "over a distance" and the word "communications" means "exchange of information". Combining the two it can be said that "telecommunications is the exchange of information over a certain distance using some type of equipment". Basically three types of information are there to be exchanged: voice, video, and data. Telephone, radio, television.

Optical Fiber Communication System

The schematic block diagram of the process is given below in figure.Each block in the system works according to its function and the target of the system is to convey the signal from the source of information to the source of destination

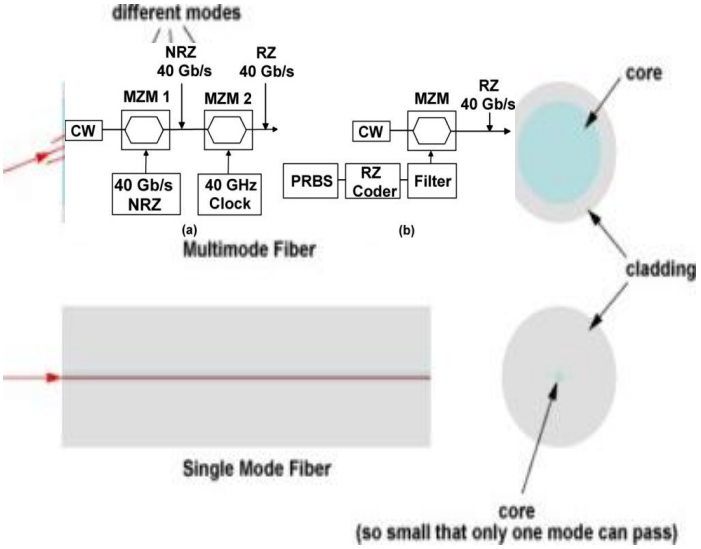


General block diagram of optical fiber communication system

Modes of Optical Fiber

Modes can be defined as those distinct patterns through which an optical fiber guides the light wave to pass through it. It also describes the distribution of light energy across the fiber. When rays of light enter the fiber they strike the internal

surface at different range of angles and these rays travel down the length of the fiber as long as they hit the core-cladding interface at an angle larger than the critical angle



Attenuation in Optical Fiber

In fiber-optic communication technology, attenuation may be defined as the decrease in light power during propagation of light along an optical fiber**.** In fiber-optic communication technology, attenuation may be defined as the decrease in light power during propagation of light along an optical fiber

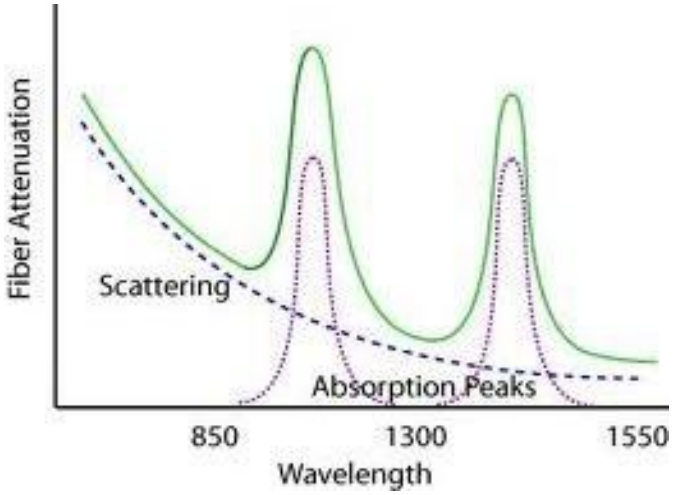
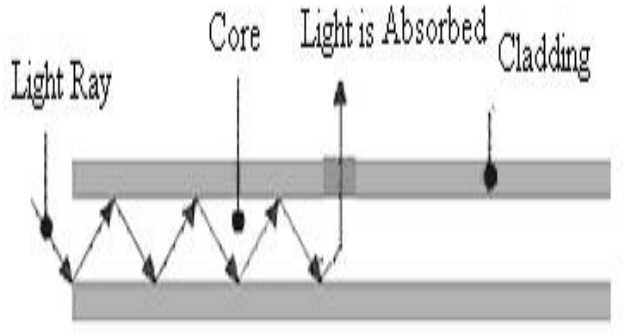


Diagram showing how Attenuation occurs

Absorption in Optical Fiber

The loss mechanism that is related to the material composition and the fabrication process for the fiber is known as Material Absorption



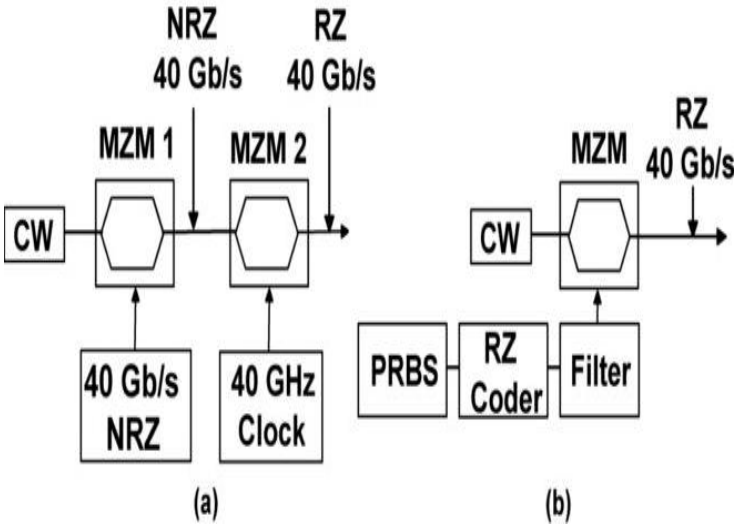
Absorption of light in optical fiber

RZ-based modulation formats

A line code used in telecommunication signals in which the signal drops to zero between each pulse in defined as Return-to-Zero (RZ) modulation format. The signal is selfclocking. The following section briefly describes the signal generation of RZ and Chirped RZ modulation formats. The collective characteristics features of these formats are a duty ratio lesser that 1 and a broad signal spectrum Wree

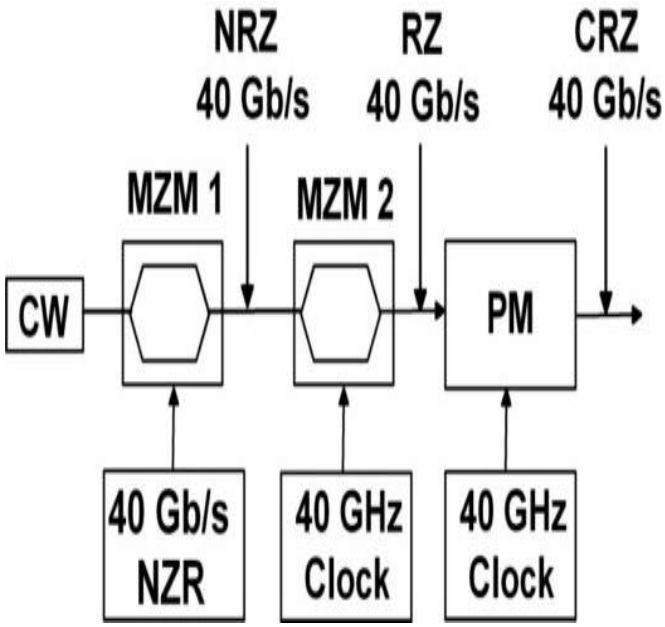
Return-to-zero (RZ) modulation

The duty cycle value is smaller than 1 due to the RZ pulses occupying just a part of the bit slot. The complexity and costs of RZ are varying because from the origin with an electrical or optical time division multiplexing (ETMD/OTMD) of several lower data rate channels, over an activity mode-locked laser in augmentation to a NRZ data modulator and a generation with two modulation stages, up to the generation with a phase modulator and delay line interferometer Miyamoto

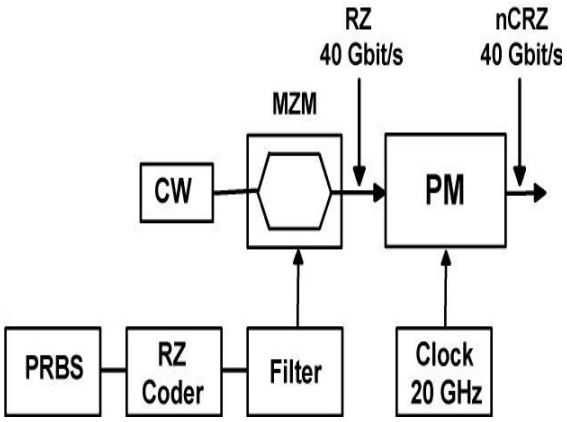


Chirped RZ (CRZ) modulation

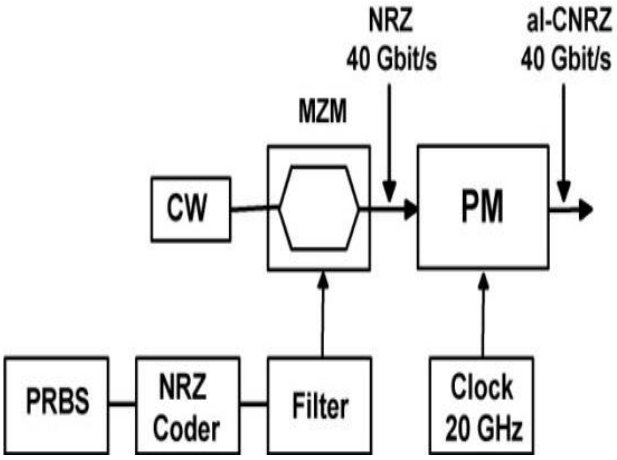
In RZ modulation, the Chirped RZ (CRZ) modulation is a special case realized by the implementation of the pre-chirp on the conventional RZ pulses at the transmitter side. Mainly in long-haul under sea transmission systems at the channel data rates up to 10 Gb/s the CRZ modulation is used Banchi



Alternate Chirped NRZ (alCNRZ) modulation



Novel Chirped RZ (nCRZ) modulation

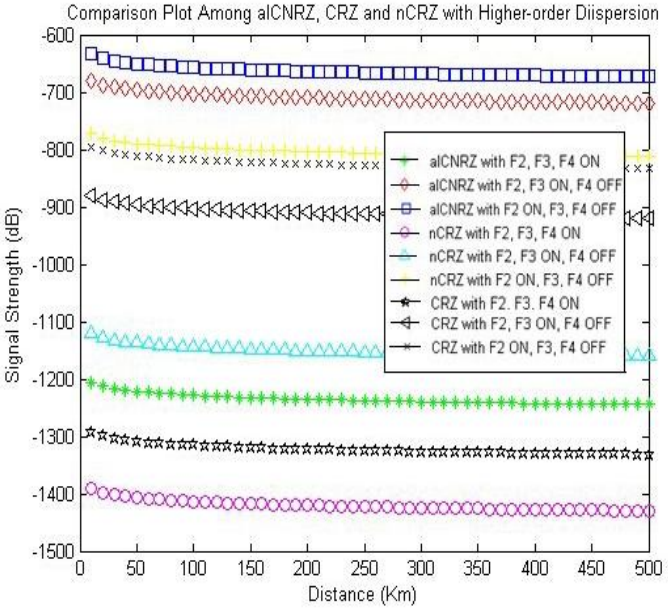


RESULTS AND DISCUSSION

Performance Comparison of CRZ, alCNRZ and nCRZ modulation format

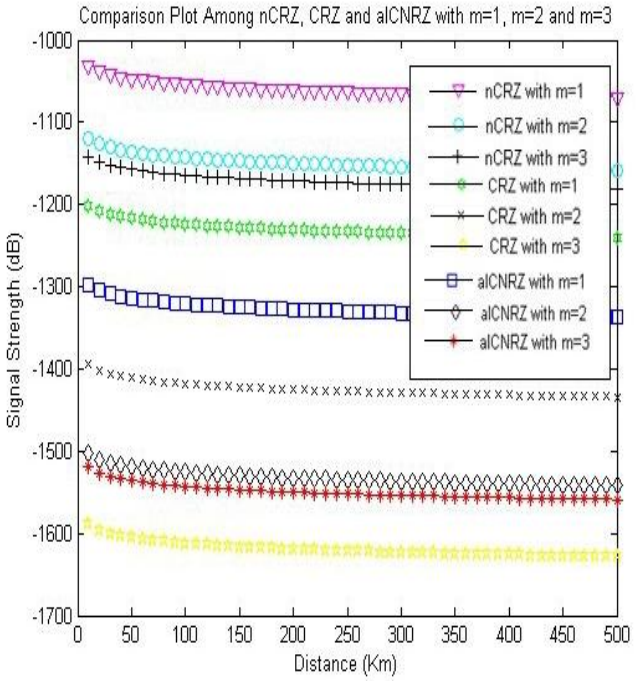
After providing the detail graphical analysis of each modulation format as mentioned above, a comparison is made among them on the basis of higher-order dispersion compensation and on varying values of phase modulation in order to find out which modulation format gives the best performance regarding signal strength. The detail illustration is as follows:

On the basis of higher-order dispersion terms



Comparison of CRZ, alCNRZ and nCRZ modulation format in presence of higher-order dispersion compensation

On the basis of phase modulation



Comparison of CRZ, alCNRZ and nCRZ modulation format in presence of phase modulation.

Conclusion

The modified relationship to determine the signal strength includes the effect of higher-order dispersion terms and varying values of phase modulation for optical based CRZ, alCNRZ and nCRZ modulation format. The system equation of each format has been presented in equation (3.40), (3.54) and (3.68) respectively. The effect of higher-order dispersion compensation has been evaluated at the operating wavelength of 1.55 m . The value of phase modulation has been evaluated by using varying values of phase modulation index m as 1, 2 and 3. In all these calculations it has been found that signal strength due to higher-order dispersion effects is significant at the smaller distances for all the modulation formats. Furthermore, it has been conclusively proved that the signal strength is improved after employing higher-order dispersion compensation and phase modulation techniques. This will lead to increase in transmission distance thereby reducing the cost in an optical fiber link. A detailed comparison is made among CRZ, alCNRZ and nCRZ modulation formats. It has been found that alCNRZ provides best performance among the other two when higher-order dispersion compensation is considered. While nCRZ gives the best performance when phase modulation is taken into account. So it can therefore be inferred that signal strength can be improved if both higher-order dispersion compensation and phase modulation is considered for modulation formats in optical WDM systems.

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