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Performance Analysis of FSO-OFDM in Foggy weather condition

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ABSTRACT: Free space optical communication (FSO) is a technique based on data transmission by propagating the light in free Space. FSO is a flexible technique, providing enormous data rate, high Capacity, high security, and use the license free frequency spectrum. FSO is an effective technique to transmit the data at high rate over short distance. The various challenges like bad weather conditions, atmospheric turbulence and multipath fading are the major challenge faced by FSO. Different techniques are developed for increasing the Performance of FSO in terms of BER, SNR. Recently OFDM is a promising technique. This paper integrates OFDM with FSO and performance analysis is done over noisy channel.

KEYWORDS: FSO, QAM, OFDM

I. INTRODUCTION

Free-space optical communication (FSO) is an optical communication technology that uses light propagating in free space to wirelessly transmit data for telecommunications or computer networking. The theory of FSO is essentially the same as that for fiber optic transmission [1]. The concept is that the energy beam is collimated and transmitted through space from the source to the destination, instead of guided through an optical fiber. FSO systems can function over long distances. In case of a clear line of sight between the source and the destination, theoretical communication is possible. Technically positioned mirrors can be used to reflect the energy in case of no line of sight condition. FSO has several advantages such as it has high speed than broadband, easy installation process, high data rate, low power usage etc. Although FSO systems used for some broadband networking needs, there are some limitations. The obstacles such as rain, dust, snow, fog, or smog can block the transmission path due to which the receiver get distorted signal [2]. OFDM is a unique form of multi-carrier transmission where all the subcarriers are orthogonal to each other. OFDM has a high user data rate transmission capability at greater accuracy. At high data rates, the channel distortion to the data is very significant, and it is very difficult to recover the transmitted data with a simple receiver.

Hence the use of expensive equalizer and channel estimation algorithms are needed to correctly estimate the channel which makes the receiver structure to be very complex. OFDM can easily simplify the equalization problem by changing the frequency-selective channel into a flat channel. For channel estimation and data recovery a simple one-tap equalizer is needed. OFDM makes the use of the available spectrum very efficiently which is needful for multimedia communications. For the above advantages OFDM has already been chosen by number of the future generation systems [3-4]. This paper analyses the performance of OFDM technique in free space and this paper is organized in the following sections as: Section II describes the Model, Section III analyses the BER performance, Section IV simulates the result and the Section V concludes the paper.

II. MODEL DESCRIPTION

The proposed OFDM-FSO system is designed using OptiSystem TM from Optiwave Corporation. 10 Gbps data is generated through 4-level QAM sequence generator. By using 512 subcarriers, 1024 FFT, 32 cyclic prefix the QAM generated data is modulated by OFDM modulator as shown in Figure 01. Free space is used as means of transmission of

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the QAM signal. Semiconductor Optical Amplifier (SOA) is used for pre amplification at transmitter side and post amplification at receiver side. PIN photo detector is used at the receiver side for detection of the signal. The signal is detected after being faded to QAM demodulator and OFDM demodulator [5].

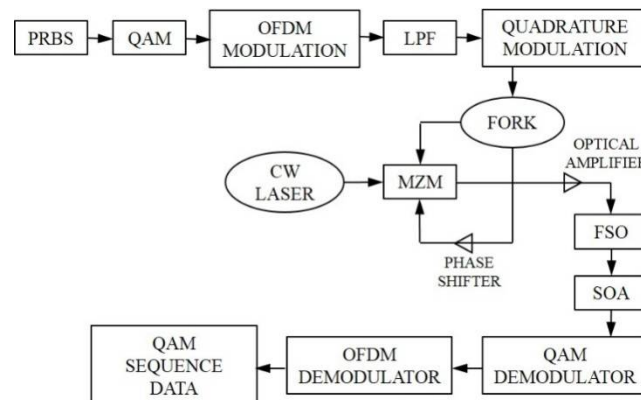


Figure-01 : Proposed model for OFDM-FSO using SOA

III. BER ANALYSIS

The received optical power in the presence of atmospheric hazards can be expressed as [6-7]

$$P_r(t) = P_{ls}(t) + L_{loss1}L_{loss2}F + N_{awgn}(t)$$

Where $P_{ls}(t)$ is output power from laser.

L_{loss1} is loss due to rain and attenuation.

L_{loss2} is Atmospheric turbulence loss.

F is the signal fading due to atmospheric hazards.

The BER can be calculated as $BER = 1/2 \int_0^\infty P_r(t) \operatorname{erfc}((\sqrt{\operatorname{cnr}} \cdot s) / P_R(r)) dr$

Where s is the random signal and 'cnr' is the S/N ratio.

IV. RESULTS AND DISCUSSION

By taking different weather conditions the SNR is calculated with respect to the measured distance and the simulation result shows that at 2.1 km distance the calculated SNR is 35dB for heavy fog weather conditions whereas SNR of 47dB is resulted for thin fog weather condition. By taking the haze condition the SNR is found to be 44 dB for 2.1km range. The attenuation values are taken as 4 dB for Haze, 9dB/km for thin fog and 22dB/km for heavy fog [8-9].

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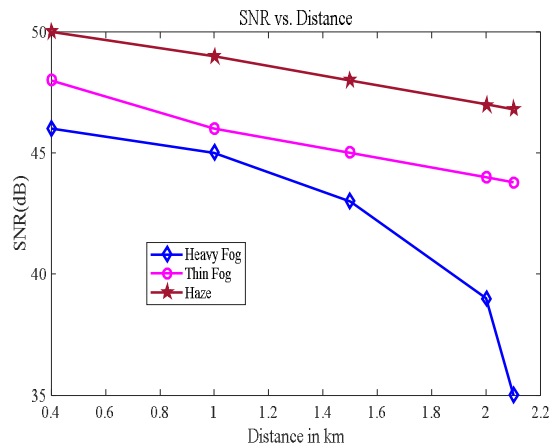


Figure-02 : SNR Vs Distance for OFDM-FSO with SOA

V. CONCLUSION

In this work OFDM-FSO is investigated by taking semiconductor optical amplifier for different weather conditions. The SNR is calculated for Haze, light fog and heavy fog weather conditions. The maximum distance is found to be 2.1km in heavy fog weather condition with SNR of 35dB.

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