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# Performance Evaluation of Free Space

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**Abstract:** In this research, a designating and simulating of free-space-optical-communication is done using MATLAB simulating program, the simulation covers the QoS of the system while using different design and configurations by increasing or decreasing the distance.

**Key words:** Free-space-communication, LiFi, QoS, outdoor communication, last miles communications, configurations

## INTRODUCTION

"FSO" can be defended as a communication technology based optical which propagating through lights. The travel in multipath using lights over free-space to send data through the transmitter wirelessly serving wireless telecommunications services or a networked computers.

**Objectives:** To design and simulate free-space-optical communication system and evaluate the performance of the network using OptiSystem Software and MATLAB.

**Literature review:** In this study, an analysis to the dispersion compensation using fiber Bragg grating at different fiber lengths and at different FBG. The simulated transmission system has been analyzed on the basic of different parameters. The optical transmission system has been modelled by using OptiSystem 7.0 simulator in order to investigate different parameters of the system. From the simulation result, it can conclude that the fiber Bragg grating length and the input power are directly proportional to the signal power. When input power (dBm) is increased then its output power (dBm) is increased but Q-Factor (dB) is decreased. FBG length (dB) is increased then output power (dBm) and Q factor (dB) are increased (Carson, 2007; Bissplinghoff *et al*., 2016; Idachaba *et al*., 2014).

## MATERIALS AND METHODS

The methodology of this project starts by collecting data about the free-space-optical-communication from scientific papers and related works from internet and the way it can be simulated into the MATLAB, then, extract the required equations and mathematical considerations and the optimal components that will be used in the simulation. Moreover, the simulation results will cover the evaluation of the performance such as delay time, throughput and data rate and SNR/BER (Anonymous, 2012, 2015; Bell, 1880; Berenguer *et al*., 2016).

## RESULTS AND DISCUSSION

The following figures illustrate the performance of the free space communication in term of three QoS parameters delay time, throughput and SNR/BER (Fig. 1) (Khanna *et al*., 2006; Rigby, 2014).

### Simulation scenario

**Delay comparison:** While the simulation time increase in seconds the delay time in ms decreases according to the traffic intensity and it was found that the light traffic has a delay time less while the medium and heavy traffic have a high delay time. From 5-10 sec the system decrease the delay time to the minimum value.

Figure 2 while set the network traffic to low it was found that the delay time of the network has a minimum delay compared to the medium and heavy traffics. Moreover, the heavy traffic has a max of delay time compared with the medium and lite traffic.

**Throughput comparison:** While the simulation time increase in seconds the delay time in ms decreases according to the traffic intensity and it was found that the light traffic has a throughput identical to the traffic intensity. From 5-10 sec the system the throughput gone to maximum increasing the efficiency and stability.

Figure 3 while set the network traffic to low it was found that the throughput of the network has a maximum goodput compared to the medium and heavy traffics. Moreover, the heavy traffic has a min of maximum goodput compared with the medium and lite traffic.

**Bit error rate vs. signal to noise ratio:** While the simulation runs, it was found that the lite traffic to the heavy traffic, it was found increased data rate and requires high power.

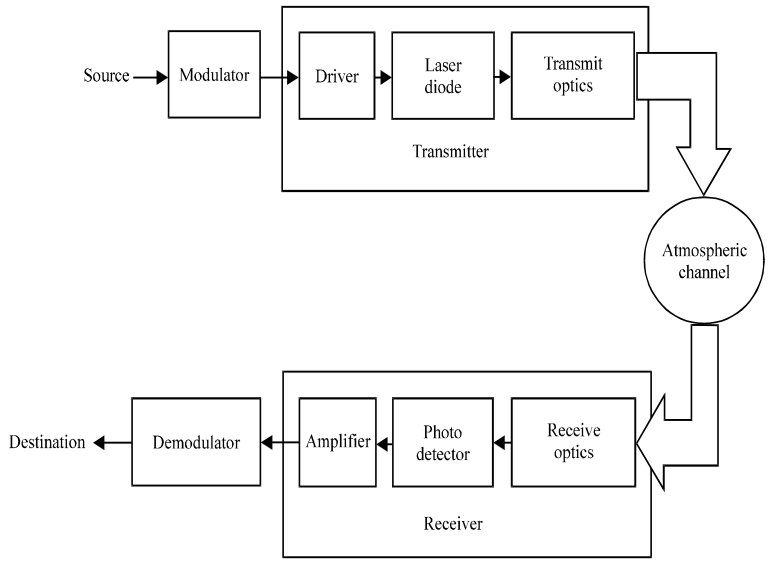


Fig. 1: Simulation scenario

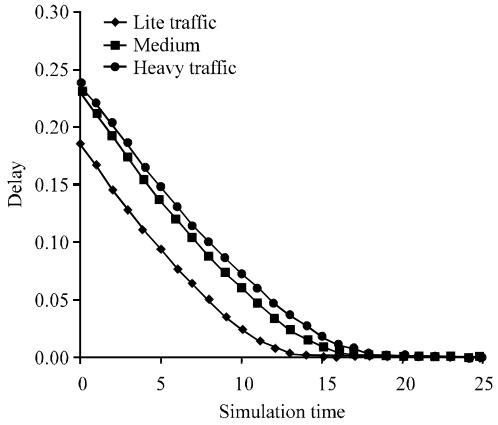


Fig. 2: Simulation time vs. delay; Free space optical (Delay time comparison)

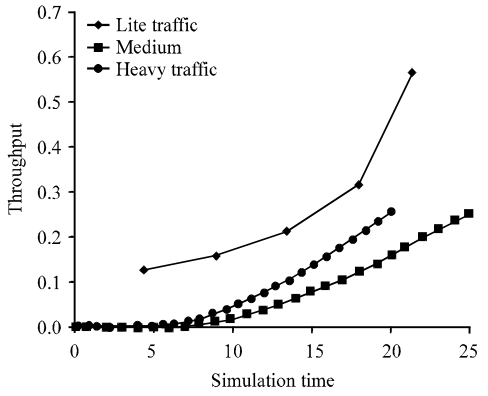


Fig. 3: Simulation time vs. throughput; Free space optical (Simulation time vs. throughput)

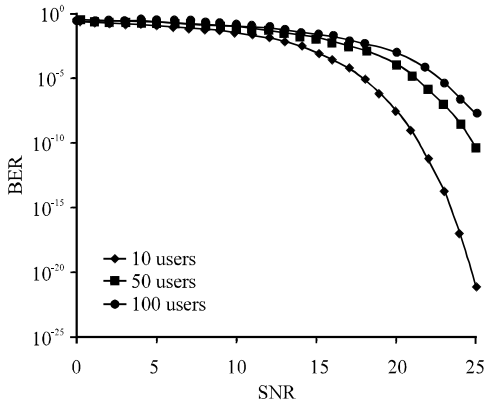


Fig. 4: Signal to noise ratio vs. bit error rate

The signal to noise ratio was set between the 0 and 25 dB and it was found that increasing the power decreases the bit error rate and increasing the power required while increasing the data rate. Figure 4 while set the network traffic to low it was found that the signal to noise ratio of the network has a minimum required power compared to the medium and heavy traffics. Moreover, the heavy traffic has a maximum power required compared with the medium and lite traffic.

## CONCLUSION

Free-space-optical-communication can be used as last mile connection for computer networks, any other telecommunication service. It is especially advantageous for long-distance communications because light

propagates through the free space with little attenuation compared to electrical cables or wireless medium that depends on the electromagnetic filed such as RF communication. This allows long distances to be spanned with few repeaters.

It was found that increasing the number of users increase the load on the network which leads to an increasing level in the delay time and the required power used.

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