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A 4×50 Gbps WDM Free - Space Optical Communication System

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***Abstract*— This paper is based on free space optical communication system which consists of four users each of which has 50 Gbps bit rate. Most popular WDM method is incorporated for data transmission. Results have been achieved by the simulation which includes error free SNR and Q factor upto 1.2 km**

***Keywords*—Free space optical communication, Signal to noise ratio, wavelength division multiplexing.**

I. INTRODUCTION

Free space optical communication is a wireless optical communication technology. Communication means to transfer or sending some data from one point to another point. Data can be transmitted through wire medium and through wireless medium. In wire medium in optical communication optical fiber may be used. But due to huge demand of communication, installation of fiber at large scale can be bulky and cost effective. To avoid such issues wireless medium can be preferred over wired medium now days. Free space means air or outer space, inside atmosphere. FSO operates on the Line-of-Sight technique which consists of a LASER at source and Detector at the destination to provide optical communication link between two users without fiber. Line-of-Sight is a Propagation technique of electromagnetic radiation which includes light emission travelling in a straight line. It provides high bandwidth for a number of applications such as satellite to satellite cross link, up and down links between space platforms and aircraft and other ground platform to solve the last mile problem through atmosphere.FSO communication links is becoming a great alternative of conventional radio frequency and microwave links.FSO links also solved the broadband and computer networking problem.

Free space optics can also be referred to as Free Space Photonics (FSP) which means transmission of modulated visible or infrared light through air to establish broadband connections. It is fiber less LASER technology in which no frequency allocation is required like conventional radio frequency communication.FSO operates on the wavelength range of 780-900 nm & 1550-1600 nm. FSO provides full duplex connectivity. Through FSO data may be transmitted in atmosphere it does not require any cable like fiber optics hence it is easy to install.

FSO is the next borderline for net-centric connectivity such as bandwidth, spectrum, high BER, low SNR, low cost issues. Due to such issues this technique becomes a great alternative over radio frequency communication.

In this paper 4×50 Gbps WDM FSO system has been designed which has transmitter and receiver section both are separated by FSO channel.At the receiver Signal Power ,Noise Power,SNR,Q factor is calculated here for the 1551 nm to 1554 nm wavelength. By using FSO System distance of several kilometres can be achieved.

II. SYSTEM DESIGN

A 4×50 Gbps WDM FSO system consists of four users [1]. At the transmitter side there is bit sequence generator, which generates the data bit sequence of 50 GBPS bit rate. This bit sequence is followed by NRZ pulse generator which converts bit sequence into pulses.LED or LASER source may be used to generate the beam light which have wavelength of 1551nm, 1552nm, 1553nm and 1554nm respectively and have a 15mw power [2]. Output of NRZ pulse generator and LASER is followed by Modulator. To transmit all these four wavelengths, 4×1 WDM multiplexer is used to generate many to one combination. To increase the signal strength amplifier is used after multiplexer. Then signal is ready to travel through FSO. It is assumed that all the turbulence effect such as scintillation, absorption, scattering, rain, fog, by which FSO system may be affected, is around 25dB/Km. So the total attenuation of FSO channel fixed at around 25dB/km.FSO is followed by another amplifier to amplify the signal strength again before reaching to the receiver.

At the receiver side signal is demultiplexed by 1×4 WDM demultiplexer in order to generate one to many combinations. All separate four signals are detect by photodetector.PIN Photo detector is used to demodulate the signal. To calculate the Signal and Noise Power, Electrical Power Meter is used at the receiving end.

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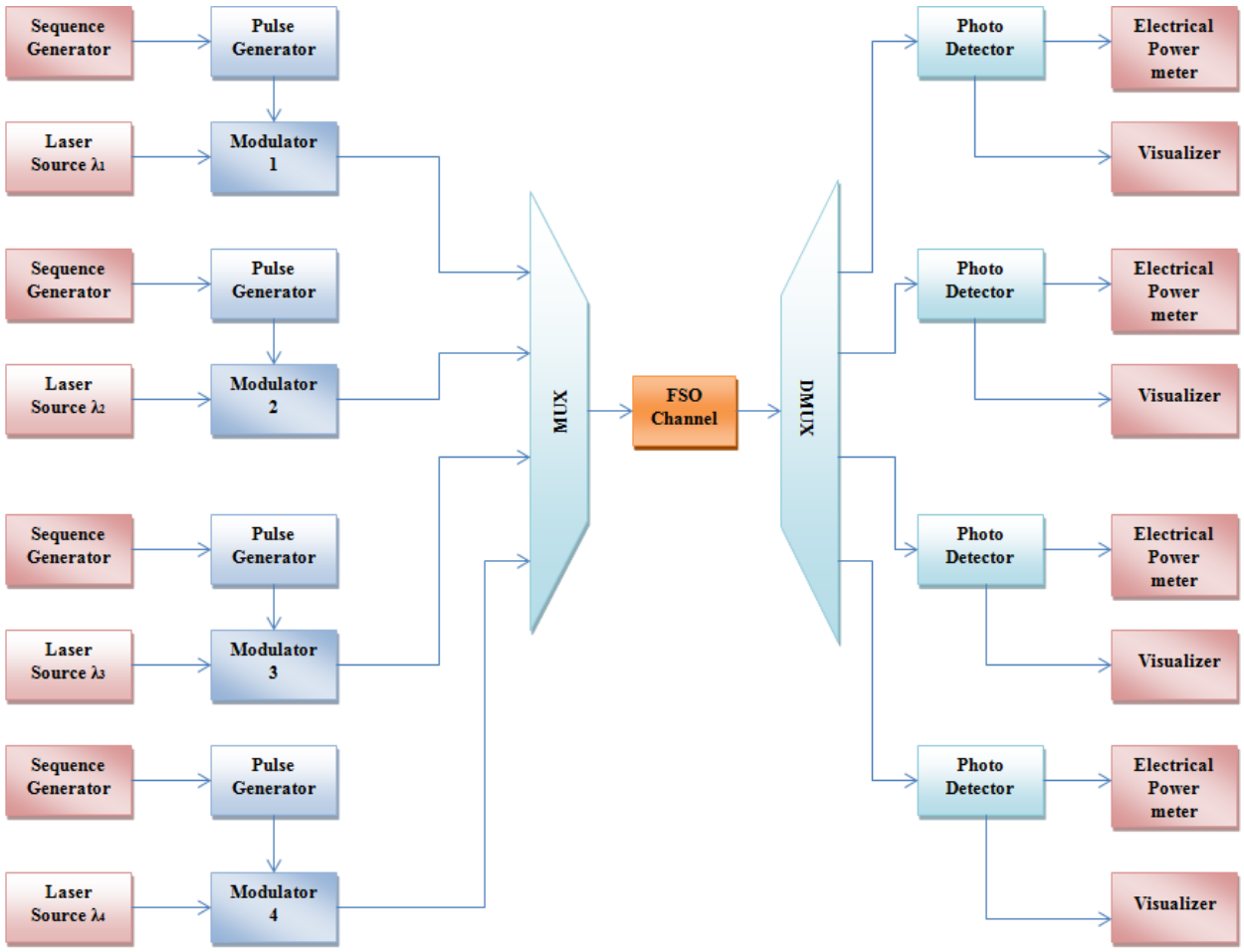

Figure 1: Free Space Communication system

In this study signal power and noise power is calculated for 100 m to 2000m range of FSO for each user.

To boost the ability of optical systems, bit rate may be increased and other is to use the WDM technique. It is found that at higher bit rates, the modulation format, and channel power are become main consideration for system design. From the above study it has been observed that the conventional non return-to-zero (NRZ) modulation scheme is better as compared to the return-to-zero (RZ) modulation scheme when trade with large WDM systems. By using RZ modulation signal and noise power has continually decreased as with NRZ modulation signal and noise power increased. So NRZ modulation scheme is used here. A non-return-to-zero (NRZ) is a line binary code technique in which 1s and 0s are represented by one significant condition such as positive and negative voltage respectively with no other break condition.

TABLE I. FSO CHANNEL PROPERTY

Parameters	Values	Unit
Range	100 -2000	m
Attenuation	25	dB/Km
Transmitter diameter aperture	5	cm
Receiver diameter aperture	20	cm
Beam divergence	2	mrad

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III. RESULTS

From this study with 50gbps bit rate two results have been obtained first one is length versus SNR graph and second one is length versus Q factor which are as follows:

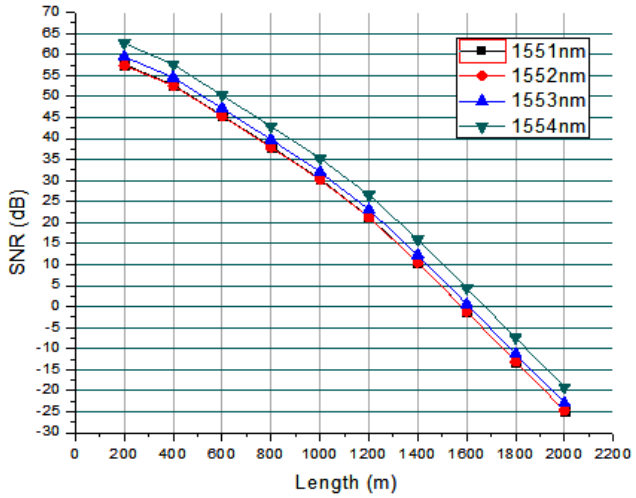

Figure 2: Length versus SNR (dB) graph

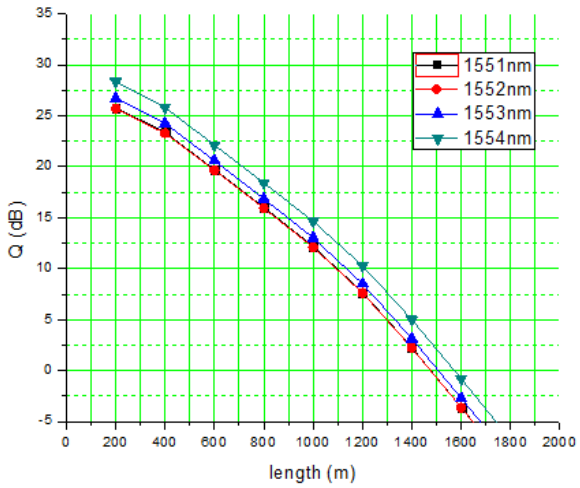

Figure 3: Length versus Q (dB) graph

IV. CONCLUSION

In this study a 4×50 Gbps WDM system has been observed . In previous work 4×12.5 Gbps system is designed using experimental setup here this work is carried out by the simulation. From the study it has been observed that upto 1200 m the SNR is 26dB and Q factor is approx 6 dB. As long as the length is increased beyond 1200 m SNR and Q factor may be decreased.

REFERENCES

[1] Ke Wang*,**, Ampalavanapillai Nirmalathas*, **,Christina Lim, *"Indoor WDM Optical Wireless Communication System with Single Channel Imaging Receiver"*,2012 17th Opto-Electronics And Communications Conference (OECC 2012) Technical Digest July 2012, Busan, Korea.

[2] Bijayananda Patnaik, P. K. Sahu ,*"Novel QPS Modulation for DWDM Free Space Optical Communication System"*, 2012 Wireless Advanced (WiAd)(2012).

[3] K.Wang et al.,*"Impact of background light induced shot noise in High-speed full-duplex indoor optical wireless communication systems"*, Opt. Exp. 19, 21321- 21332 (2011).

[4] K. Wang et al., Proc. of ECOC, Tu.3.C.6 (2011).

[5] K. Wang et al., *"High-Speed Reconfigurable Free- Space Card-to-Card Optical Interconnects"*,Opt. Exp. 18, 25199- 25216 (2010).

[6] AS/NZS 2211.1:2004, *"Safety of laser products"*,(Standards Australia International Ltd and Standard N Zealand,2004).

[7] J.M.Kahn et al., *"Wireless infrared communications "*, Proc. IEEE, Vol. 85, 265-298, 1997. Proc. of IEEE 85, 265-298(1997).

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