Design and Analysis of BER of 200 GBPS Free Space Optical Communication System with Varying Receiver Aperture

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ABSTRACT
Optical communication is one of the most widely used technologies in field of telecommunication now days. As it gives higher speed as compare to conventional technique. Earlier coaxial cable and twisted pair cable is used as a media between transmitter and receiver. But with the advent of fiber optics these conventional links becomes less applicable. Optical communication not only provides fiber communication it also provides fiber less communication that what it is called optical wireless communication or free space communication. In this work we investigate the behavior of optical wireless communication system with respect to BE while keeping aperture of FSO channel is varying at distinct values. It is observed from this study that distance of FSO system may be improved with change in aperture.

Keywords
Free Space Optical Communication, Bit Error Rate, Wavelength division multiplexing.

1. INTRODUCTION
Free-Space or optical wireless communication means transmission of modulated light beam through the atmosphere .For optical source, LASER is used which produces light beam at the transmitting end[1].Whenever free space is opted for communication then it means that the transmission media is air ,not an optical fiber or other conventional cable like co-axial cable, twisted pair cable. Due to which frequency allocation is not required in free space communication. This is the advantage of FSO technique over radio communication, where frequency registration is require [2].Optical wireless communication system gives availability of high speed performance in many area of communication such as broadband communication [3].Optical wireless communication is also preferred in the area where high bandwidth is crucial, which helps in the high internet access, video on demand, and high definition television [4]. Free space also refers to the Free space Photonics [1]. FSO operates on the Line-of-Sight phenomenon, consisting of a LASER at source and detector at the destination which provides optical wireless communication between them. Line-of-Sight provides Propagation of electromagnetic wave by which light is emitted and travelled in a straight line[2].This type of fiber free optical communication technology uses highly directed narrow beam to transmit data between source and destination. Conventional optical fiber communication faces some challenges such as 1)High cost of digging roads 2)Unfeasible physical links between transmitter and receiver.FSO not only overcome to all mentioned problem & provides smooth communication as well. It proves itself a great objective of optical wire communication, that covers long distance up to few kilometers [2].Optical wireless communication becomes advantageous when high BER, high bandwidth, low SNR, low cost issue has been considered. As already stated that FSO systems can function over distances of several kilometers if there is a clear line of sight between the source and the destination, which make communication possible. Even if there is no direct line of sight, then positioned mirrors can be used to reflect the energy. The beams can pass through glass windows with little or no attenuation.
Although FSO systems can be a good solution for some broadband networking. But in case of outdoor wireless communication system atmospheric effects such as rain, dust, snow, fog, or smog can block the transmission path and shut down the network. As these are the indoor optical wireless communication system so the total attenuation is considered here to be 25 dB /km. As already discuss that free space is a great alternative of radio frequency wireless communication but FSO has some advantages over RF communication. Optical components are cheaper and consume less electrical power than high speed RF components. OW links do not suffer from multipath fading and have much less potential for interference with RF-sensitive electronic systems. These advantages involve that OW is a universal replacement for RF communications.

2. PROPOSED WORK
In this proposed work four users WDM Free Space optical communication system is designed. Bit rate of all users is set to be 50 Gbps. In our previous work BER is calculated while keeping aperture constant but in this work we keep the variable aperture of FSO at 5, 10, 15,20,25,30 cm. Main aim of this work is to compare the BER in two case when aperture is fix and when it is varying.

3. SYSTEM DESGIN
This system is divided into three part as same as the communication system: Transmitter, Channel, Receiver.

3.1 Transmitter section
A 200 (4×50) Gbps WDM FSO system consists of four user [1], each having wavelength of 1551nm, 1552nm, 1553nm, 1554nm respectively. Each user incorporated with LASER which can be used to generate light beam at transmitting end. Here Mach –zehnder modulator is used to modulate upcoming light beam from LASER. Whenever optical communication is used for transmission then WDM is the best solution to make many user to one transmission, so 4×1 WDM is used. To increase the signal strength amplifier is used after multiplexer [1].Then signal is ready to travel through FSO. FSO system is affected by the turbulence effect such as scintillation,

absorption, scattering, rain, fog. To compensate all turbulence effect, 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.

3.2 Channel

This work is based on free space so the media or channel is also free space or unguided media as already stated that through propagation theory modulated light is travel through air from one end to another end.

3.3 Receiver section

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 Photodetector is used to demodulate the signal. To calculate the Signal and Noise Power, Electrical Power Meter is used at the receiving end, from which BER is also calculated for different aperture of FSO channel.

Table 1. BER with fix aperture

Length	BER(dB)			
	User 1	User 2	User 3	User 4
1200 meter	-8.57	-8.37	-12.25	-25.99
1400 meter	-1.32	-1.31	-1.69	-3.090

It is shown from the table that when aperture is fixed say 20 cm then upto 1200 meter communication is achieved with BER≤ 10^-6.At 1400 meter the BER is not so good to achieved proper communication. In this work we investigate that how good BER is obtained and distance is improved.

4. DIAGRAMATIC SETUP

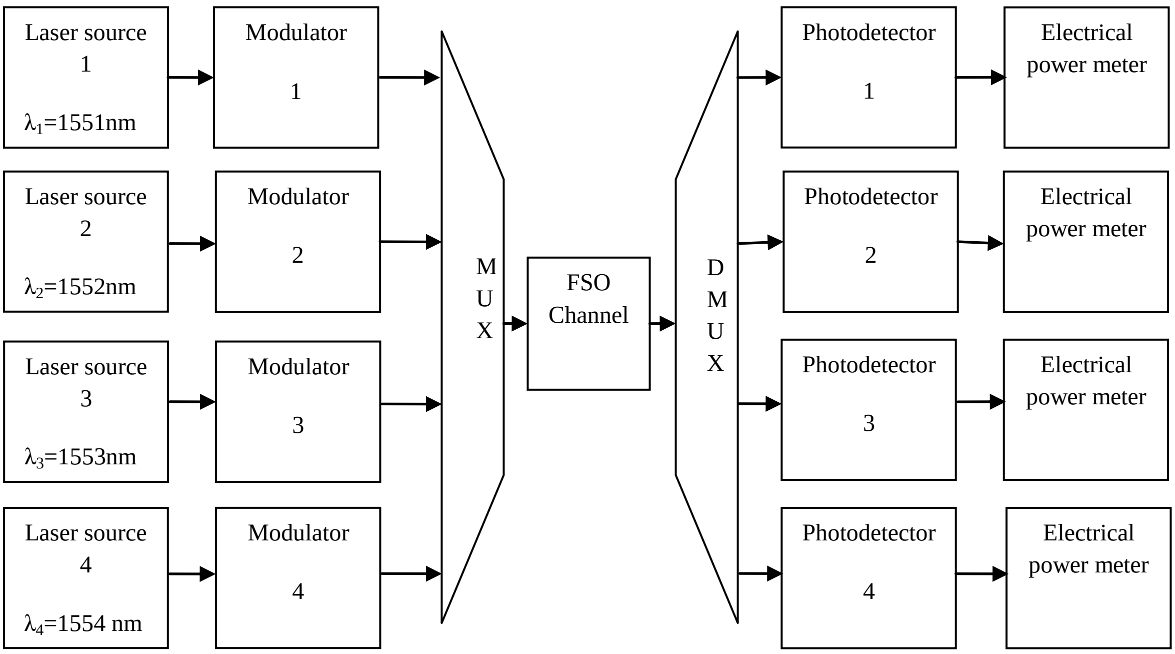

Fig 1: Free Space Optical Communication System

5. RESULT AND DISCUSSION

In FSO system a smaller diameter of transmitter and a larger diameter of receiver aperture are required to establish high data rate communication links. The diameter aperture of the transmitter and receiver must be adequate for the weather conditions. A large size of diameter aperture of receiver is able to reduce turbulence effect on FSO. Hence From the simulation study two results are obtained regarding to improved BER which are as follows:

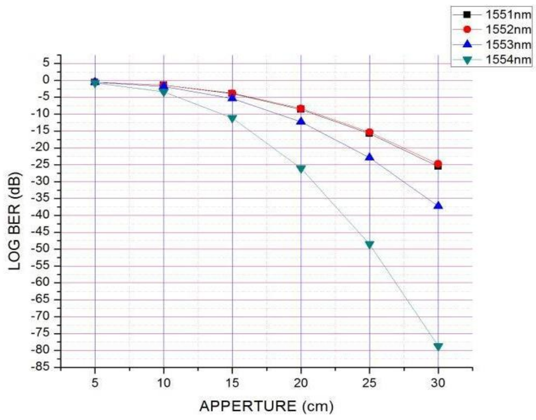

Fig 2: Aperture versus BER Graph for 1200 m

It is shown from the above graph that at different Aperture, BER is different. Aperture is measured in cm while BER is measured in dB.As from the graph it is shown that when the value of aperture is 5 cm then BER is measured -0.5 dB. As the aperture is further increased BER is decreased.

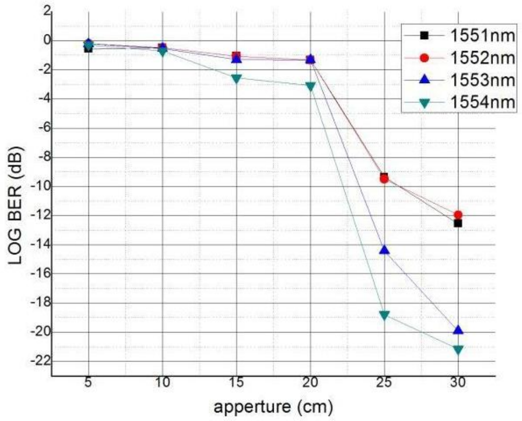

Fig 3: Aperture versus BER Graph for 1400 m

From the above graph it is shown that while varying the aperture distance is improved from 1200 to 1400 meter. At aperture of 20 cm BER is approximately 10^-3As the aperture is further increased (25cm) BER is also improved.

6. CONCLUSION

In this work 4×50 (200Gbps) Gbps has been designed with varying aperture of FSO channel. In previous work same FSO system is designed but in that work aperture is constant. When we compare these two system we found that as the aperture is vary the distance of FSO system is also improved with improved BER as in previous work it is only upto 1200 meter. In this work we can achieved communication up to 1400 meter.

7. FUTURE SCOPE

In this study we have discuss about the free space technology. Today FSO becomes a immerging technology when wireless communication is considered. As this is absolutely license allocation free technique so it will be employed not only today but in future also.

FSO has a great future scope in many communication company like light point. Other companies have found the implementation of FSO in recent market to fulfill the demands of users by providing high wireless connectivity.

8. REFERENCES

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