Effects of Noise or Without Noise on Inter-Satellite Optical Wireless Communication System

Sonali Sangral[1*], Dr. Rakesh Goyal[2], Dr. Amit Gupta[3], Dr. Monika Rani[4]
[1]M. Tech Student I.K.G. Punjab Technical University Kapurthala
[2,3]Assistant Professor, I.K.G. Punjab Technical University Kapurthala
[4]Assistant Professor, Kanya Maha Vidyalaya, Jalandhar
Email: [1]shellysonali1@gmail.com, [2]drrakeshgoyal15@gmail.com, [3]amitguptacgc@gmail.com and [4]gargnitk24@gmail.com

***Abstract*—In this paper, discusses the effect of noise on IsOWC system using EDFA. The wavelength in this model is 850 nm and 950 nm with same range 300 km for both wavelengths. We observed the BER and Q factor in IsOWC by adding or removing noise in this system. The simulated results shows the all BER graphs by noise addition or remove on different wavelengths.**

Keywords: Inter-Satellite Optical Wireless Communication System (IsOWC), EDFA, Optical Wireless Communication (OWC), BER.

I. Introduction

In day by day the imperious goal is communication from one place to another part on the earth. In the last few years has observed huge growth in communications with Light wave technology in the field of communication. In this communication data transferred in over large distance has become achievable. Optical communication has advanced from long strands to wireless technology .This has resulted to use the optical wireless communication in space. Because of high band width, light weight, small size, low power and low cost of inter satellite optical wireless communication. LASER communication is matured enough to transmit data in space to communication between satellites [1] .Inter-satellite optical wireless communication (IsOWC) is developed by modifying OWC technology into space technology [2]. The transmission of data on long range distance is only possible through optical wireless communication. In IsOWC system, the optical wireless communication between two satellites. The satellite laser links covers a large area of the earth surface. FSO is a medium between two satellites and laser beam provide wireless connectivity between transmitter and receiver [3]. In figure 1. Shows the IsOWC system divided into three parts, the transmitter, OWC channel, the receiver part, the transmitter part is satellite one and the receiver part is satellite second. The transmitter part consists of laser and it is used for generating light, tracking and communication system, satellite telemetry and an optical modulator. This information generally comes from the satellite's telemetry, tracking and communication (TT & C) system [4]. The most important component in the system is light source as communication is done by transmitting light. Two types of optical light source used in optical communication i.e LED (Light Emitting Diode) and IDL (Injected Laser Diode). Optical wireless channel is a transmission medium between two satellites. OWC channel is formed to be free space and it is free from atmospheric attenuation factor[5]. The receiver side it consists of photodiode and a low pass filter. Here avalanche photodiode (APD) is used to convert optical signal to electrical signal, is has high sensitivity compare to PIN [6]. It carry positive and negative charged semiconductor connections, in reverse bias connection like an optical light source [7]. Then, when photons strike the junction, electrical signal is created. Due to the huge amplification of low or weak light signals, APD is employed in freer optical data transfer. [8]. The APD is increased when charged electrons are injected and collide with neutral semiconductor atoms in these high electrical fields which therefore create enormous amounts of additional carriers [9-20].

II. System Simulation Model

The system performance may be verified by examining the BER and Q-factor in numerous ways. The proportion of bit errors identified in the receiver and the amount of bits sent may be described as BER. Due to noise on digital signal, bit errors arise as the result of erroneous judgments taken at a receiver. In the meanwhile, Q-factor is a signal quality measurement. It matches the signal-to-noise ratio of the system. The BER is usually too tiny for the optical system to measure, thus the Q-factor is more suitable for usage. The figure 1. Shows the simulation model of Is OWC with using EDFA. In this model, using frequency is 850 nm and 950 nm and range 300km and EDFA is an operational amplifier. In this model, we analyze the effect of noise on IsOWC by adding or removing of noise in this system model.

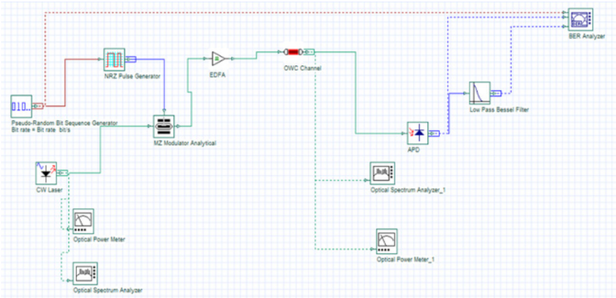

Fig.1: IsOWC simplex model.

III. Results of Noise Effect on 850 nm Wavelength and Range 300 km

In APD only Add signal-ASE noise, figure2. Shows the eye diagram of IsOWC. The Q factor for 850 is 10592.7 and the BER is 0.

In figure 3. Again different noise add in this system, but only one noise we are added the ASE-ASE noise. And also shows the eye diagram of IsOWC. The Q factor is 10598.7 & the BER is 0.

In figure 4. Again different noise add in this system, the thermal noise is add. Figure4. it Shows the eye diagram of IsOWC the distance and wavelength is same. The Q factor is 22.511 and the BER is 1.6116e-112.

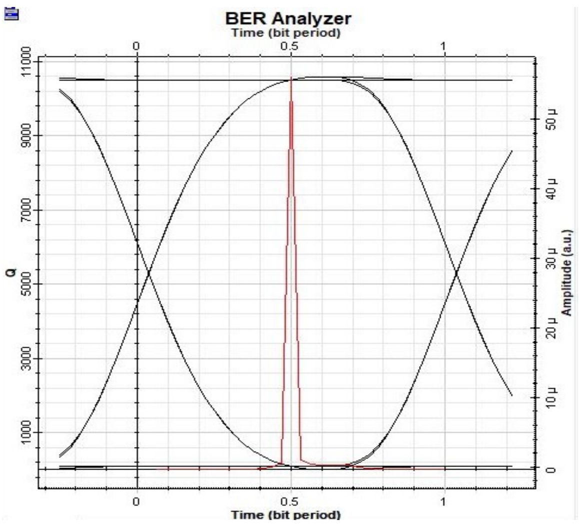

Fig. 2: Eye Diagram of IsOWC Using Only Add Signal ASE Noise.

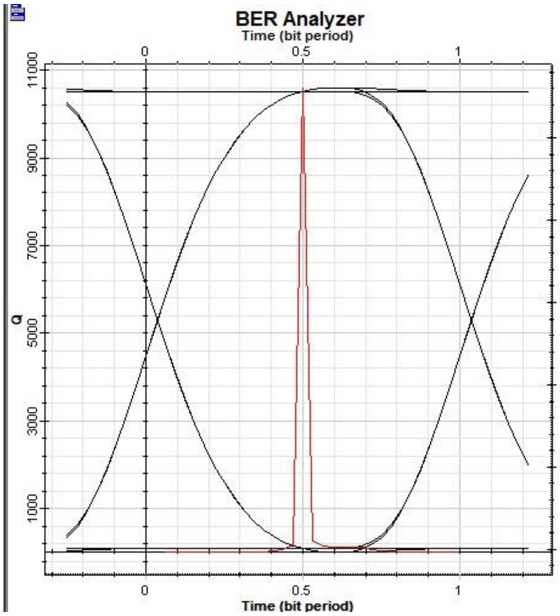

Fig. 2: Eye Diagram of IsOWC Using Only Add Signal ASE-ASE Noise.

In figure 5. Againdifferent noise add in this system, the shot noise is add. Figure 5. Shows the eye diagram of IsOWC the distance and wavelength is same. The Q factor is 33.1338 and the BER is 2.71645e-241.

In figure 6. The four noises are adding signal-ASE noise, ASE-ASE noise, the thermal noise and shot noise. Figure 6. Shows the eye diagram of IsOWC the distance and wavelength is same. The Q factor is 17.4683 and the BER is 1.19814e-068.

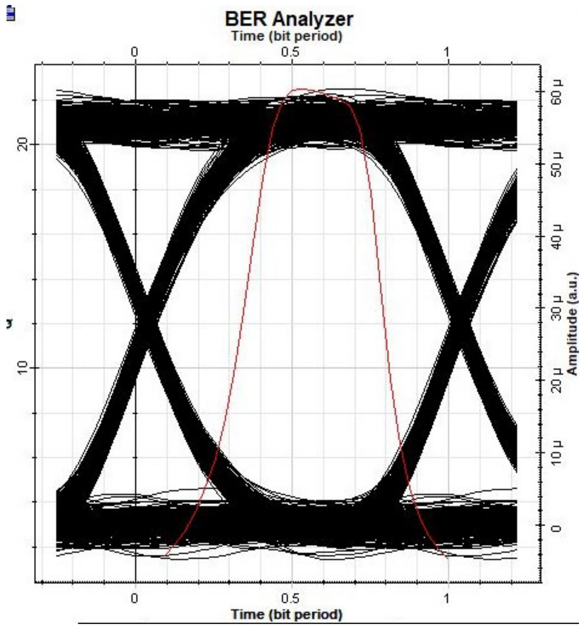

Fig. 4: Eye Diagram of IsOWC add Thermal Noise.

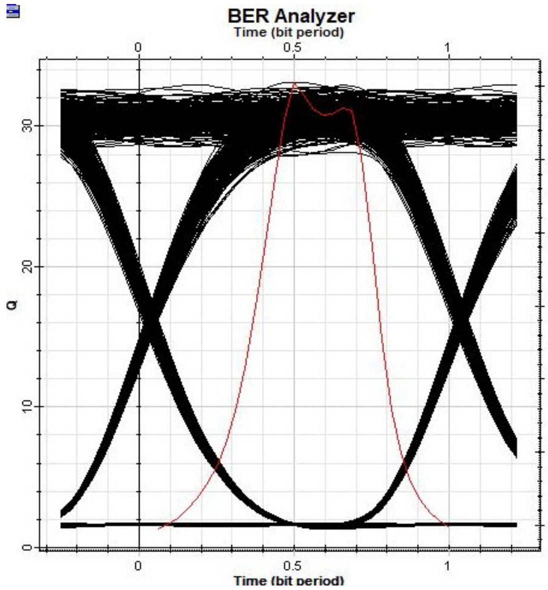

Figure 5. Eye Diagram of Isowc Add Shot Noise.

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In figure 7. The four noises are removed are signal-ASE noise, ASE-ASE noise, the thermal noise and shot noise. Figure 7. Shows the eye diagram of IsOWC the distance & wavelength is same. The Q factor is 10614.1 and the BER is 0.

IV. Results of Noise Effect on 950 nm Wavelength and Range 300 KM

In APD only Add signal-ASE noise, figure8. Shows the eye diagram of IsOWC. The Q factor for 950 is 22.905 and the BER is 1.96074e-116.

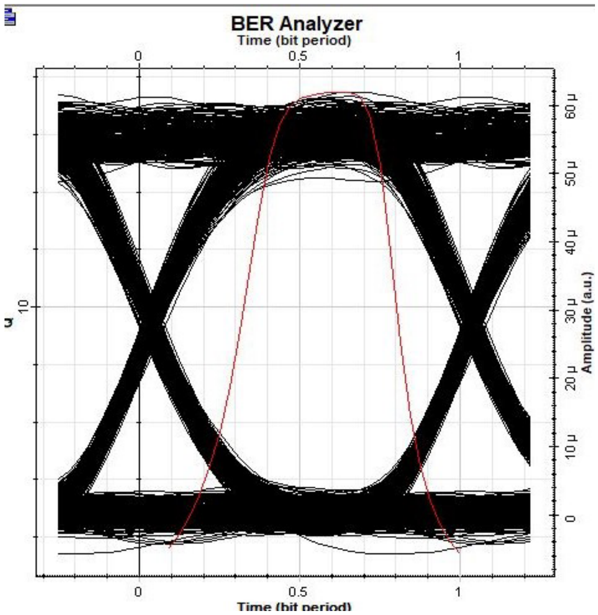

Fig. 6: Eye Diagram of IsOWC Add All Noise.

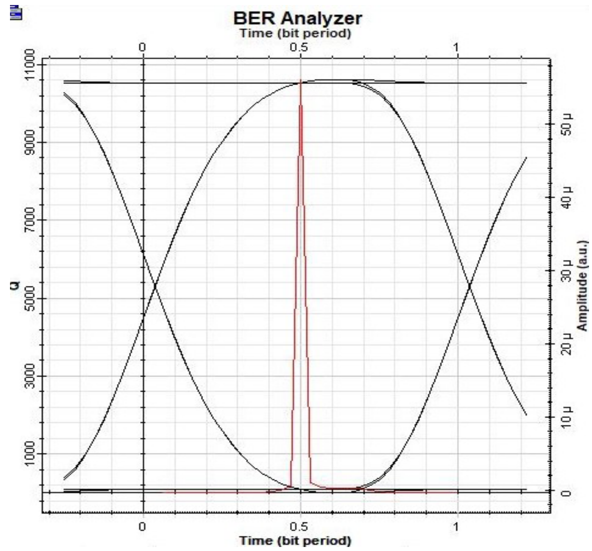

Fig.7: Eye Diagram of IsOWC Remove All Noise.

In figure 9. Again different noise add in this system, but only one noise we are added the ASE-ASE noise. And also shows eye diagram of IsOWC. The Q factor is 9076.3 and the BER is 0.

In figure 10. Again different noise add in this system, the thermal noise is add. Figure10. Shows eye diagram of IsOWC the distance and wavelength is same .The Q factor is 30.7911 and the BER is 1.71633e-208.

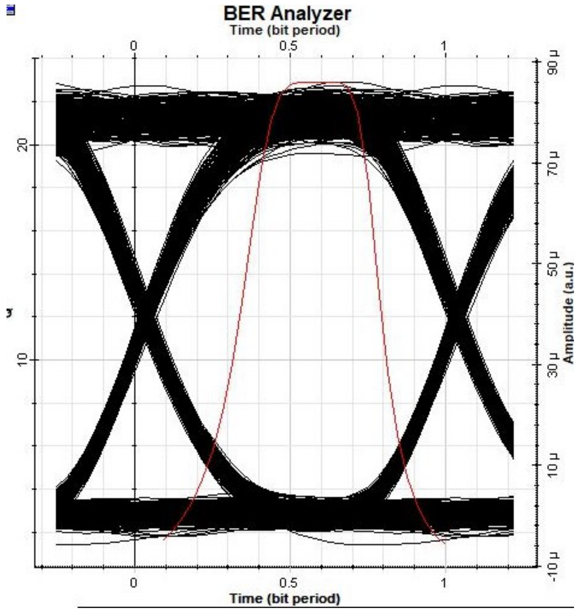

Fig.8: Eye Diagram of IsOWC Using Only ADD Signal ASE noise.

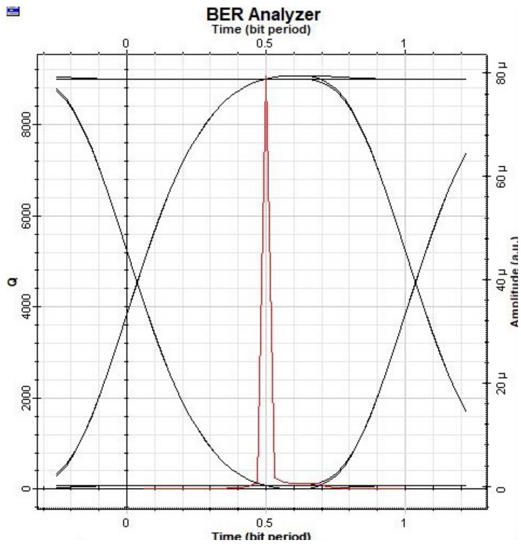

Fig. 9: Eye Diagram of IsOWC Using Only ADD Signal ASE-ASE noise.

In figure11. Again different noise add in this system, the shot noise is add. Figure 11. Shows the eye diagram of IsOWC the distance and wavelength is same. The Q factor is 38.6231 and the BER is 0.

In figure 12. The four noises are adding signal-ASE noise, ASE-ASE noise, the thermal noise and shot noise. Figure 12. Shows the eye diagram of IsOWC the distance and wavelength is same. The Q factor is 23.3693 and the BER is 4.15882e-121.

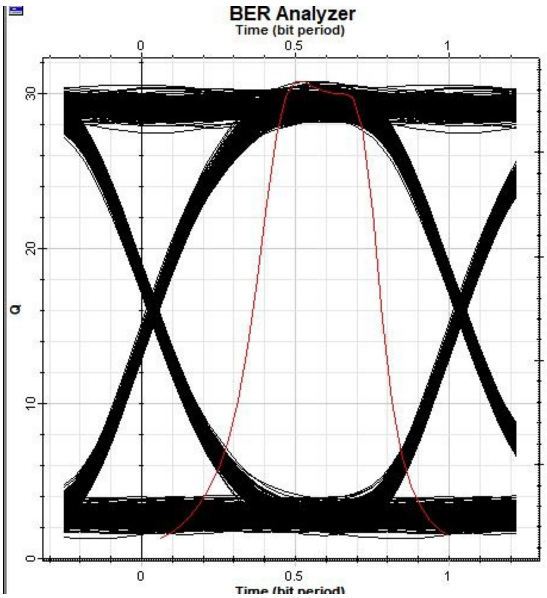

Fig. 10: Eye Diagram of IsOWC Add Thermal Noise.

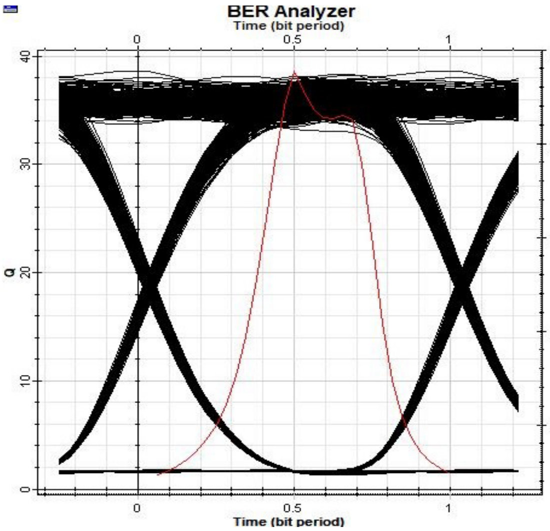

Fig. 11: Eye Diagram of IsOWC Add Shot Noise.

In figure 14. Fournoises are removed are signal-ASE noise, ASE-ASE noise, the thermal noise and shot noise. Figure 7. Shows the eye diagram of IsOWC the distance and wavelength is same. The Q factor is 9093.97 and the BER is 0.

V. Conclusion

In this paper, the effect of noise and the effect of without noise on IsOWC system is optimized in term of BER and Q factor which are effected by noise. Impact of using APD photodetector and 850 nm and 950 nm improving wavelength in the quality of the IsOWC has been considered. In this paper, the effect of without noise on IsOWC system the BER is 0for both 850 nm and 950 nm on 300 km range.

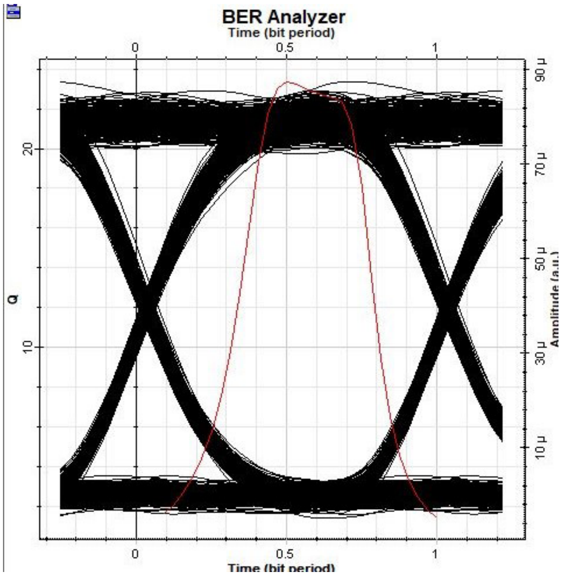

Fig.12: Eye Diagram of IsOWC Add All Noise.

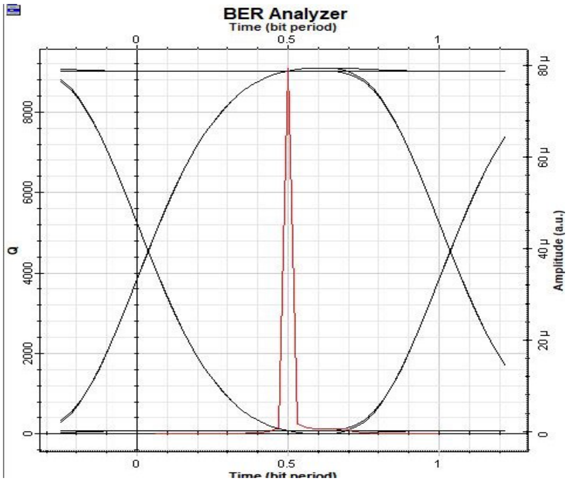

Fig.14: Eye Diagram of IsOWC Remove All Noise.

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