ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijareeie.com

Vol. 7, Issue 3, March 2018

Analysis of Chaos Masked Signal Transmission in Optical Communication Network

V.Gnanalakshmi[1], B.R.Santhoshi[2], R.N.Aswathy[3]

Assistant Professor, Dept. of ECE, Mepco Schlenk Engineering College, Sivakasi, Tamilnadu, India[1]

UG Student, Dept. of ECE, Mepco Schlenk Engineering College, Sivakasi, Tamilnadu, India[2]

UG Student, Dept. of ECE, Mepco Schlenk Engineering College, Sivakasi, Tamilnadu, India[3]

ABSTRACT: Now a day's Telecom networks are going through various technological changes to support Huge data traffic. Newly developed technologies and applications such as internet services, interactive games, telemedicine etc along with existing video and voice services are making traffic and insecurity enormous day by day. In order to solve these security issues, the semi-conductor laser chaos generation which is being used to hide multi level data signal .Duo binary modulation plays a vital role in transmitting secured message comparing with NRZ, RZ, and other modulation techniques, because it has increased spectral efficiency and used to increase channel capacity by improving the bandwidth utilization. The secure duo binary signal transmission in optical communication network was processed using chaotic laser i. e. Laser rate equations are designed to model chaotic laser through semi-conductor laser so that the message gets secured. Synchronization is done to obtain Eye- diagrams and Quality factor.

KEYWORDS: semi-conductor lasers, chaos masking scheme Software used: OPTISYSTEM.

I. INTRODUCTION

This paper introduces the technique for secured communication using chaotic laser in optisystem software. Chaotic communication signals are spread spectrum signals which utilize large bandwidth and low power spectrum density. chaos masked signal is used to provide security data signal[1].The message is encrypted at the transmitter and decrypted at the receiver using chaotic modulation. Comparison is done in terms of Q-factor and bit error rate. Q-factor denotes the minimum required optical signal to noise ratio to obtain a certain bit error rate. The demand for capability and high bit rate has been rapidly growing in the current scenario. So, chaotic modulation technique is introduced in optical duo binary signals. Duo binary modulation is a scheme for transmitting R bits/sec using less than R/2 Hz of bandwidth [3], [4] .The amount of Inter symbol interference is very much reduced in this technique. The main advantage for choosing duo binary signal in chaos generation is to undergo transmission over longer spans of fiber communication and it reduces non-linear effects in optical communication systems. .The synchronization between the transmitter and receiver in the optical communication networks is achieved to obtain the acceptable eye diagrams and quality factor. Eye diagram defines the composite view of very long data stream. It allows seeing all data patterns in a single display. The good eye diagram represents the reduction in distortion due to dispersion. The opening of eye represents bit error rate. If potential of errors increases, size of eye opening decreases. The bit error rate defines the ratio of bit errors to the total number of transmitted bits. The bit error rate is affected by attenuation, noise, dispersion, cross talk between adjacent channels, non linear phenomena, jitter and bit synchronization problems. The chaos signal masking scheme is introduced for secured transmission and reception. Chaos signal masking is to mask the information bearing signal i. e the message, with the chaotic signal by addition and later recover this message at the receiving end of the communication channel. The laser diode rate equation which is used to model the electrical and optical performance of chaotic laser [4]. Benefiting from the wide bandwidth of chaotic semiconductor laser, fiber fault

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijareeie.com

Vol. 7, Issue 3, March 2018

detection using chaotic laser has advantage of higher spatial resolution over the conventional method using optical pulse.

II.PROPOSED METHODOLOGY

In our scheme we combined both the effects of duo binary and chaos masking to obtain security and high data rate at the same time. The chaos generated is of pulsating nature in order to have more chaotic behavior.

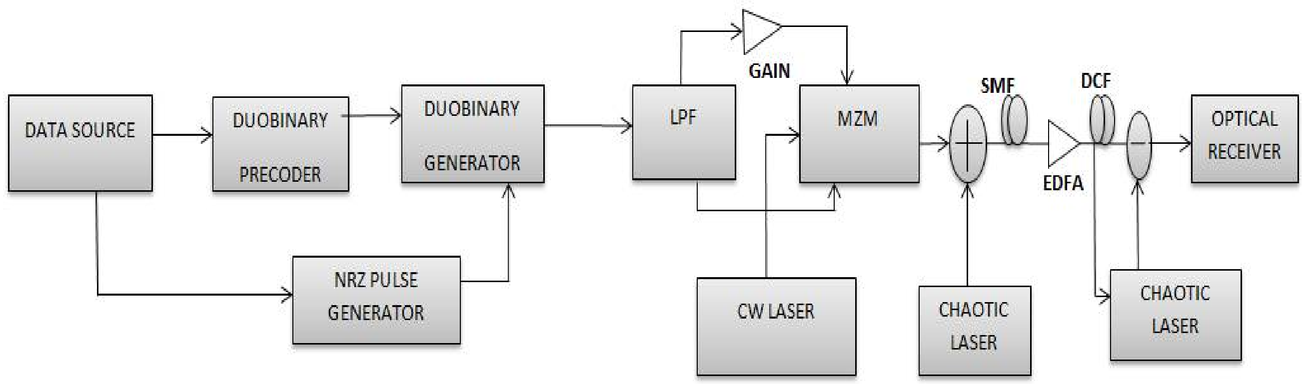

Figure 1. Block diagram of chaotic optical communication format using duo binary modulation

A. Generation of input signal

The first step is to generate duo binary modulated signal. In duo binary modulation scheme, the modulator drive signal can be produced by adding one bit delayed data to the present data bit which give rise to three levels i. e 0, 1, and 2. This three level signal can be demodulated by using an optical receiver into a binary signal i. e two level signal 0 and 1. The duo binary generator is used to convert data into duo binary pulses coming from pseudo random data sequence or user defined data source. The pre coder is used to undergo data transmission without error. The input duo binary coded message signal is three level and it is converted into two level by modulation through Mach- Zehnder modulator. A continuous wave (CW) laser is also used for this modulation. The power of continuous wave laser is about 20 dBm.

B. Chaos masking scheme (CMS)

In order to obtain secure communication, chaotic laser plays a vital role. An information bearing signal is masked with chaotic oscillations and recovered through chaos synchronization in a optical receiver. The transmitter and receiver circuits simulate the system. The non linear optical devices with electronic feedback are used to produce chaos. The duo binary modulated signal at the transmitter side is recovered from chaos through subtraction rule.

C .Performance of chaos encrypted and decrypted optical communication system.

The transmitter consists of a semiconductor laser which is made to be chaotic carrier and modulated using an external modulator. The chaotic carrier signal and modulated duo binary signal added in order to produce encrypted signal [6]. The receiver is either a semi-conductor laser diode similar to that of transmitter or a laser diode coupled to an external cavity, forming an open or a closed loop configuration respectively. The encrypted signal is transmitted to the single mode fiber, added with the chaotic signal and decrypted signal is obtained at the receiver.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijareeie.com

Vol. 7, Issue 3, March 2018

III.RESULTS AND DISCUSSION

The three level signal shown in figure.2 is generated by electrical low pass filter which gives the system performance degradation depending on word length due to imperfection of electrical low pass filter. This type of electrical duo binary modulation is considered as the best way to obtain high capacity because of its low band width requirement due to the presence of electrical or optical components and more tolerance to chromatic dispersion. It also shows equalization requirement for the high speed serial link.

Figure 2.Duobinary message generated by transmitter.

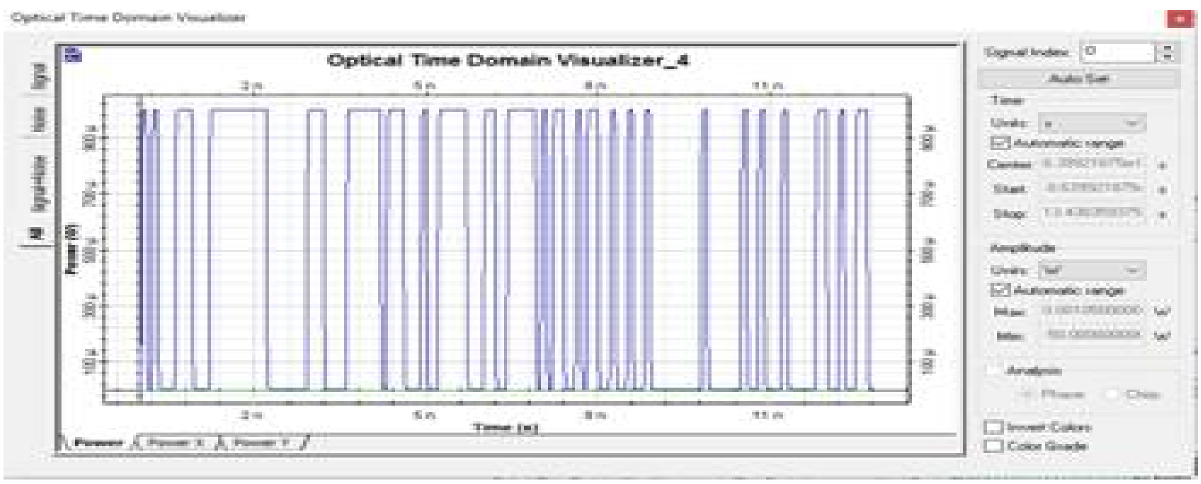

Figure 3.Two level optical signal.

The three level signal is converted into two level signal by modulation through continuous wave laser by setting its power to 20 dBm and wavelength to 1550 nm. The three level signal results in smaller harmonics but on the other hand it requires more components and it is more complex to design. In addition to this the continuous wave modulation produces higher duty cycle than other modulation techniques. Figure.3 shows the optical spectrum of duo binary

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijareeie.com

Vol. 7, Issue 3, March 2018

modulated signal measured using optical spectrum analyzer. The optical spectrum analyzer is a key tool for characterizing multichannel systems, measuring power and bandwidth for each channel, and determining channel separation and dynamic ranges. These parameters give network providers the information needed to monitor optical network performance as well as characterize optical source and fiber transmission characteristics.

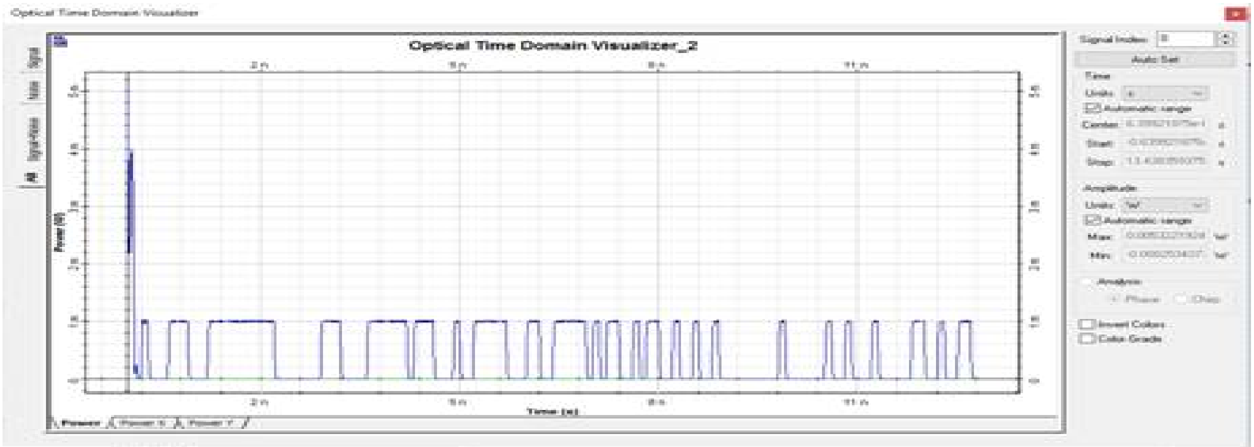

Figure 4. Time domain plot of chaos embedding duo binary waveform.

Figure.4 shows the waveform produced after masking the duo binary modulated signal with chaotic waveform. The power of chaotic laser is also set to 20 dBm and it also operates at 1550 nm in order to hide the signal completely.

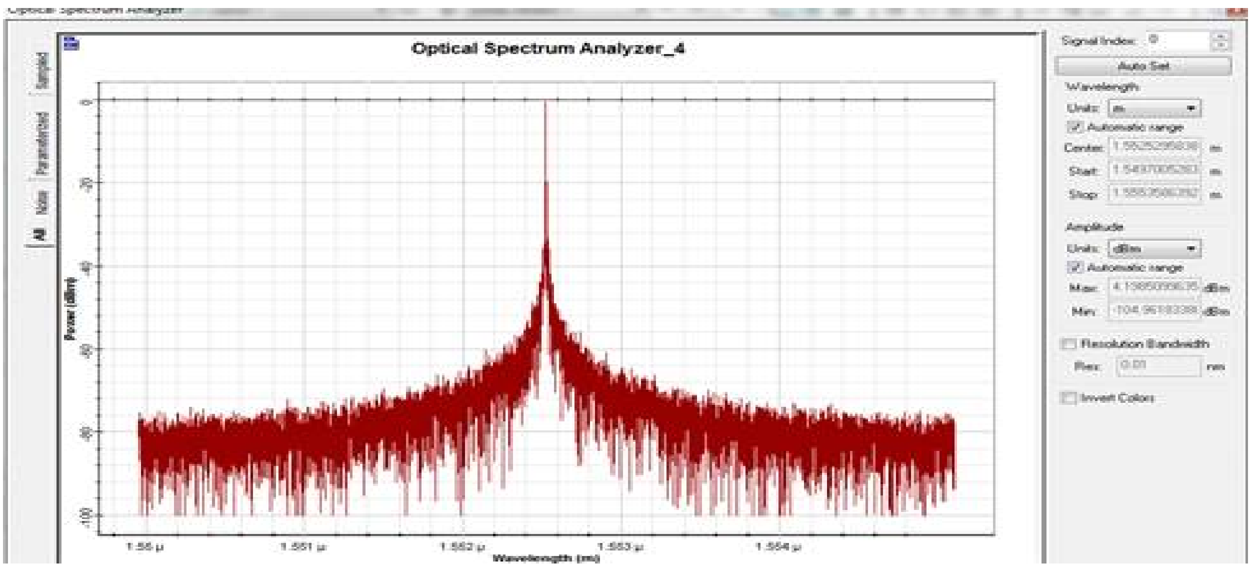

Figure 5.Optical spectrum of duo binary message.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijareeie.com

Vol. 7, Issue 3, March 2018

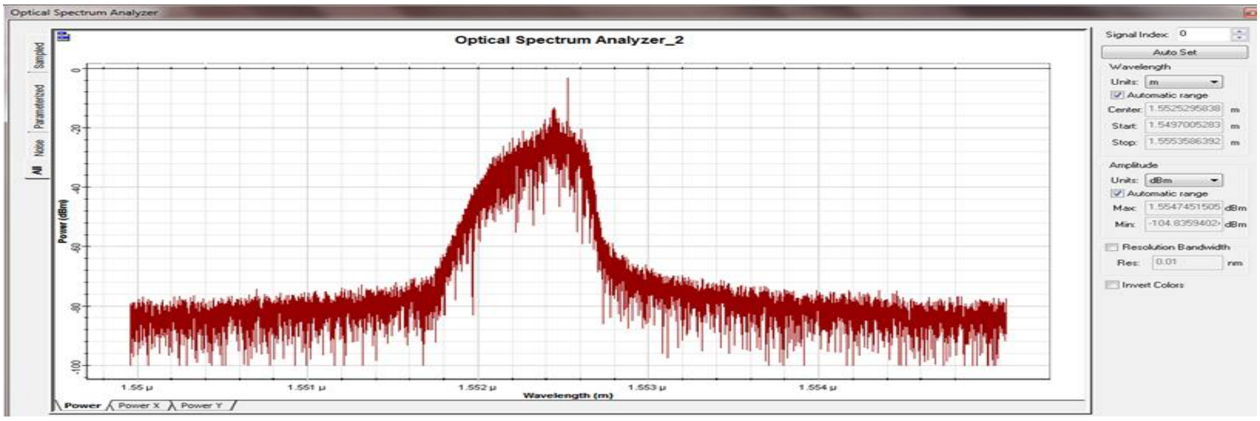

Figure 6.Optical spectrum of chaos embedding duo binary message.

Figure.6 shows the change in optical spectrum due to the application of chaos which is inaccessible for the eavesdroppers. Even if the intruder gets the chaos modulated signal they will not be able to obtain the original message without knowing the chaotic signal produced by the chaotic sources.

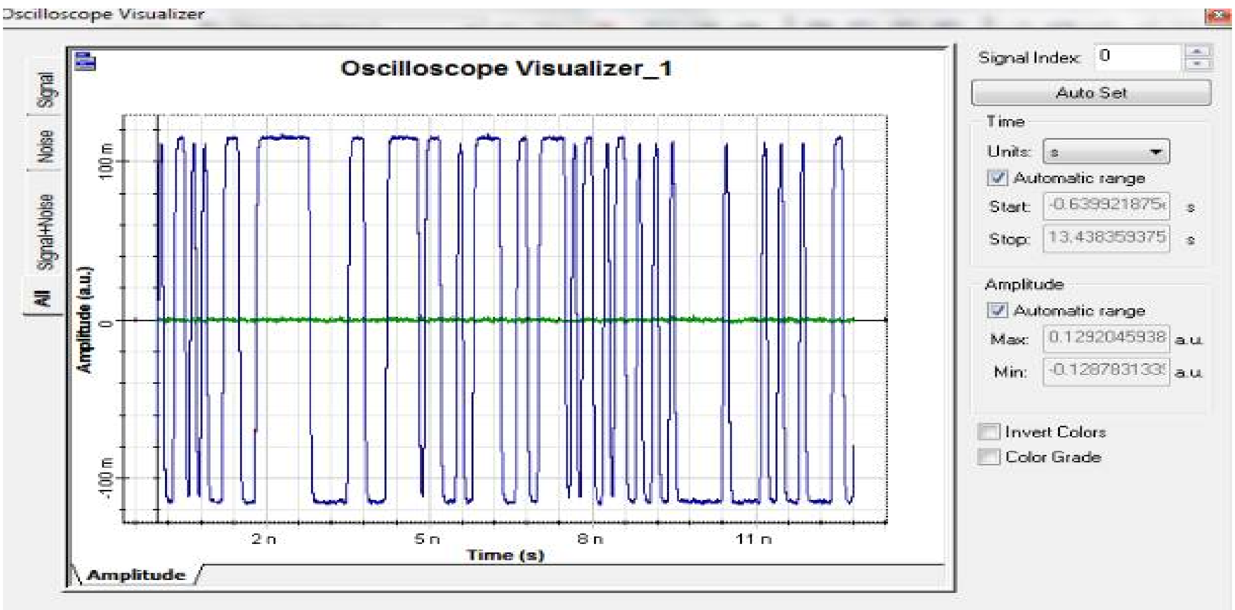

Figure 6.Decrypted signal.

The Duo binary signal modulated using mach-zehnder modulator is demodulated using optical receiver into a binary signal again.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijareeie.com

Vol. 7, Issue 3, March 2018

Table 1. Bit Error Rate comparison for different fiber lengths.

FIBER LENGTH(km)	BIT ERROR RATE	Q-FACTOR
10	1.414e-006	25.47
50	2.507e-006	7.32
70	8.217e-006	4.64

Table.1 shows the bit error rate and Q-factor comparison for different fiber lengths. The bit error rate as well as the Q-factor was analyzed for different fiber lengths and it was concluded that bit error rate was increasing for increasing fiber lengths. Q-factor on the other hand was decreasing on increasing the fiber length. This drastic decrease in Q-factor with increase in fiber length is due to non linear impairments like amplifier and fiber non- linearities. The bit error rate may be affected by transmission channel noise, interference, distortion, bit synchronization problems and attenuation.

IV. CONCLUSION

Simulation analysis were made by using optisystem 15.0 .Synchronization was successfully done between transmitter and receiver part in optical communication network using chaotic laser. The duo binary modulated signal is transmitted over the SMF fiber of different lengths and DCF fiber is used to reduce the dispersion effects before the process of synchronization. Our work provided detailed view of the implementation of more secure duo binary optical communication system from the beginning of generation of duo binary message till the restoration of the original message successfully.

REFERENCES

[1]. Farhan Qamar ,Muhammad Khawar Islam, Syed Zafar Ali Shah, Romana Farhan , Mudassar Ali, “Secure duo binary signal transmission in optical communication networks for high performance and reliability,” IEEE Access., vol 5,sep. 2017

[2] Kaur, Rupinder, and Sanjeev Dewra. "Duo binary modulation format for optical system-a review." Int. J. Adv. Res. Electr. Electron. Instrum. Eng. Vol.3, pp. 11039, 2014.

[3] A .Lender, “Correlative digital communication techniques,” IEEE Trans. Commun., Vol.COM-12,pp.128-135,1964.

[4] J. Proakis, Digital Communication Systems.

[5] Numai, Takahiro. "Fundamentals of semiconductor lasers." Fundamentals of Semiconductor Lasers. Springer Japan, pp. 89-186, 2015.

[6] T. Wu, W. Sun, X. Zhang, S. Zhang, Concealment of time delay signature of chaotic output in a slave semiconductor laser with chaos laser injection, Opt. Commun. 381 (2016) 174–179.

[7] I.V. Ermakov, S.T. Kingni, V.Z. Tronciu, J. Danckaert, Chaotic semiconductor ring lasers subject to optical feedback: applications to chaos-based communications, Opt. Commun. 286 (2013) 265–272.

[8] R.M. Nguimdo, M.C. Soriano, P. Colet, Role of the phase in the identification of delay time in semiconductor lasers with optical feedback, Opt. Lett. 36 (22) (2011) 4332–4334.

[9] S. Tang and J. M. Liu, “Message encoding/decoding at 2.5 Gb/s through synchronization of chaotic pulsing semiconductor lasers,” Opt. Lett., vol.26,pp.1843–1845,Dec.2001.

[10] Ali, Syed Zafar, Muhammad Khawar Islam, and Muhammad Zafrullah. "Effect of parametric variation on generation and enhancement of chaos in erbium-doped fiber-ring lasers." Optical Engineering, Vol. 49, no. 10, pp. 105002-105002, 2010.

[11] Ali, S. Zafar, M. K. Islam, and M. Zafrullah. "Generation of higher degree chaos by controlling harmonics of the modulating signal in EDFRL." Optik- International Journal for Light and Electron Optics, Vol. 122, no. 21, pp. 1903-1909, 2011.

[12] S.Xianget al., “Conceal time-delay signature of chaotic vertical-cavity surface-emitting lasers by variable-polarization optical feedback,” Opt. Commun., vol. 284, no. 24, pp. 5758–5765, Dec. 2011.