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Comparative Analysis between NRZ and RZ Coding of WDM System

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Abstract: An ameliorated performance of optical wireless transmission system is obtained from wireless system which deploys the lengthy fibers. Inter-satellite links are necessary between satellites in orbits around the earth for data transmission and also for orderly data relay from one satellite to other and then to ground stations. Inter-satellite Optical Wireless Communication bestows the use of wireless optical communication using lasers instead of conventional radio and microwave systems. Optical communication using lasers cater many benefits over conventional radio frequency systems. The utmost complication existing in this wireless optical communication for inter-satellite links is the affects of satellite vibration, which leads to severe pointing errors that degrade the performance. Performance of this system also depends on numerous parameters such as transmitted power, data rate and antenna aperture which are analyzed using Opti-System simulation software. The main objective of this is to introduce WDM in existing ISOWC system to improve the system capability, to implement Model with different coding NRZ and RZ, to propose a new approach for increasing system capability for multi users and also analysis the Performance parameters like BER, Q-factor of optical systems.

Keywords: BER, FSO, Inter Satellite Link (ISL), IsOWC, Q-factor, Return-to-zero(RZ), Non Return-to-zero(NRZ).

I. INTRODUCTION

In the communication cosmos, optical satellite communication is one of the vital fields that remain to be extensively explored [1]. Optic Inter satellite links (OISL) provide an attractive substitute to microwave systems for both military and commercial implementations. The dominance of optical ISL is that it includes higher bandwidth, smaller antenna size and reduced power necessities. It is crucial in optical satellite communication to dissipate least power and acquire minimum BER. ISL link is based on line of sight (LOS). To couple satellites of same orbit as well as of different orbits, IsOWC system is employed. To impart the data over thousands of kilometers using small payload size, optical communication is demanded. The first inter satellite link communication using optical link was successfully attained on March 2003 amongst Advance Relay and Technology Mission Satellite (ARTEMIS) & SPOT-4 [5]. An IsOWC system offers high bandwidth, small size, low power and low cost as compared to microwave satellite systems [5]. In IsOWC systems, the main priority is to use minimal power and achieve lesser BER.

Wavelength Division Multiplexing (WDM) is a technology which multiplexes several optical carrier signals onto a single optical fiber via different wavelengths (i.e.colors) of laser light. This system enables bidirectional communications over one filament of fiber and multiplication of capacity.

The term wavelength-division multiplexing is usually applied to an optical carrier, while Frequency-division multiplexing usually applies to a radio carrier .Whereas, wavelength and frequency are coupled together throughout a simple directly inverse relationship, in which the frequency and wavelength equals c (the propagation speed of light) i.e. (c=frequency & wavelength) the two terms really describe the similar concept.

II. SYSTEM MODEL

IsOWC system employs a laser beam as a wireless connectivity between transmitter and receiver for carrying information through free space.. Thus, the selection of modulation technique is paramount in the design of the system [4]. Modulation technique is one of the most compelling processes in ISL system where the RF electrical signal is applied to two types of methods: Direct modulation and External modulation.

In Direct modulation, the amplitude of laser beam agonizes from frequency chirp effects which degrade the performance of the system. This can be eradicated by using external modulation scheme that attune the phase of optical carrier [2]. Fundamental model of the system consists of 3 main parts: transmitter, receiver and propagation medium [8]. For IsOWC system, the coverage distance demanded is thousands of kilometres, thus, it uses only LOS system. Transmitter comprises of pseudo-random bit sequence (PRBS) generator succeeded by an optical transmitter. The outcome of the transmitter is sent via propagating channel, which embodies transmitter telescope, wireless communication channel and receiver telescope. The turnout of the receiver telescope is fed to the optical DPSK receiver, which coherently detects the optical signal with a local oscillator (laser). It takes help of balanced-detection technique and generate the information signals in the electrical domain. This signal is then

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amplified, filtered by low pass filter and given to an M-array threshold detector. Block diagram of IsOWC system is shown in fig 1.Then, the PSK decoder is employed to produce binary sequences. Then, BER, eye diagram, eye opening etc is observed using bit error rate (BER) analyzer.

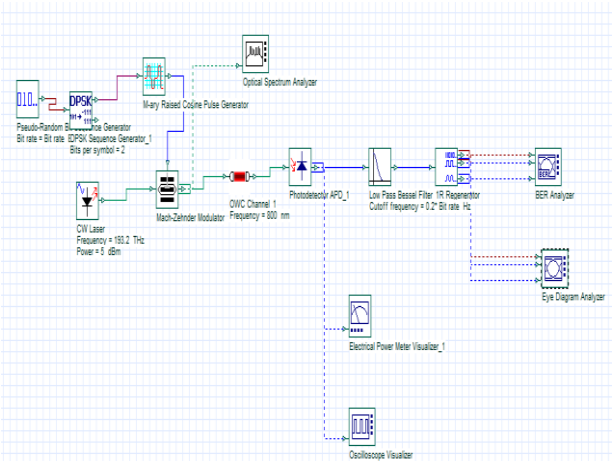

Fig:1 Is OWC System

III. MODULATING SIGNALS

Classification on the basis of Modulation types:

1. Return-to-zero(RZ)
2. Non Return-to-zero(NRZ)

1. Return-to-zero (RZ)

Return-to-zero (RZ or RTZ) explain the line code use in telecommunications signals in which the signal drops to zero among each pulse. This takes place even if a no. of consecutive 0s or 1s occurs in the signal. The signal is self-clocking. This means that a different clock does not require to be sent alongside the signal, but it suffers from using twice the bandwidth to attain the similar data-rate as compared to non-return-to-zero format.

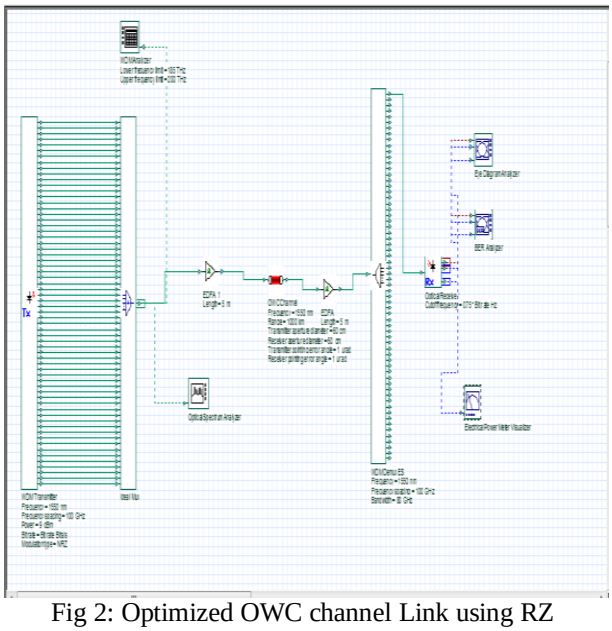

Fig 2: Optimized OWC channel Link using RZ

The "zero" between every bit is a neutral or rest form, such as zero amplitude in Pulse Amplitude Modulation (PAM) and zero phase in Phase-Shift Keying (PSK), or a mid-frequency in frequency-shift keying (FSK). That "zero" form is normally halfway among the significant state representing a 1 bit and other significant state representing a 0 bit.

While return-to-zero (RZ) contains a provision designed for synchronization, it still has DC module resulting in a "baseline wander" through a long strings of 0's or 1's shown in fig 2 as just alike the line code i.e. non-return-to-zero.

2. Non Return-to-zero (NRZ)

NRZ line code is a dual system in which ones are represented by individual significant form, typically a positive voltage, whereas zeros are represented by several other significant situations, typically a negative voltage, with no additional neutral or rest situation. The pulses in NRZ contain more energy than a RZ code, which also has an added rest state beside the situation for ones and zeros. It is not inherently a self-clocking indicator, so some other synchronization technique must be used for avoiding fragment slips; examples of such techniques are a run length inadequate constraint and a parallel synchronization indicator.

For a specified data signaling rate, i.e. bit rate, the NRZ code requires merely half the baseband bandwidth requisite by the Manchester code (the passband bandwidth is same). While used to represent data in an asynchronous communication system, the non appearance of a neutral position requires other mechanisms for bit synchronization while a separate clock signal is not available. NRZ-Level itself is not a synchronous organization but slightly an encoding that can be used in moreover a synchronous or asynchronous transmission environment, i.e. with or without an explicit clock signal is involved. Because of this, it is not necessary to discuss how the NRZ-Level encoding acts "on a clock edging" or "during a clock cycle" since all these transitions occur in the given quantity of time representing the genuine or implied integral clock sequence.

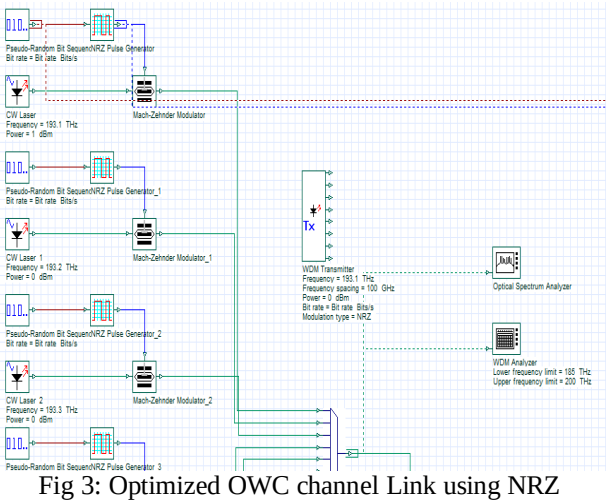

Fig 3: Optimized OWC channel Link using NRZ

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The real question is that of sample—the high or low state will be established suitably provided the transmission line has stabilized for that bit when the physical line stage is sampled at the receiving end. On the other hand, it is helpful to see NRZ transitions as occurrence on the trailing (falling) clock edge in organized to compare the NRZ-Level to other encoding methods, such as the mentioned Manchester, which require clock edge information (is the XOR of the clock and NRZ, in reality) see the dissimilarity between NRZ-Mark and NRZ-Inverted as shown in fig 3.

IV. SIMULATION RESULTS

The following figure represents the results obtained by applying proposed system. The following parameters are calculated. Parameters like BER, Q-factor etc, are calculated shown in fig 4 and 5.A comparison graph on the basis of the BER, Range of WDM channel, power etc is obtained. The value obtained is calculated for traditional and the proposed approach.

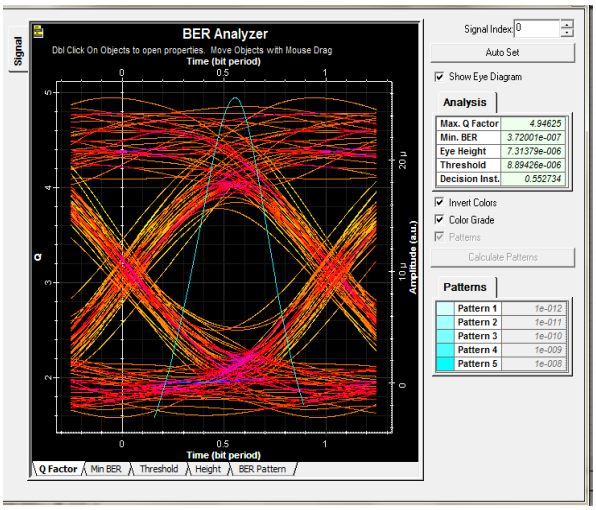

Fig 4: This graph represents the Q-factor of the proposed system.

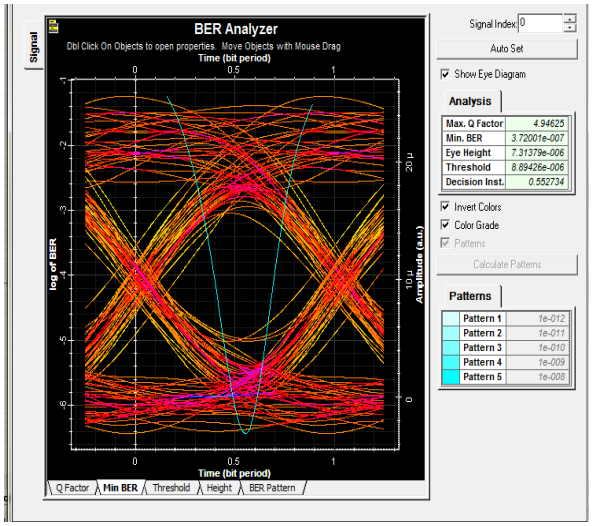

Fig 5: This graph represents the BER of the proposed system.

V. SIMULATION PARAMETERS

The execution of the WDM communication over Inter satellite Optical Wireless System with different coding format is done. NRZ and RZ are compared and the analysis of various performance parameter like and BER, Q-factor analysis with different wavelength and different coding formats is done.The selection of optical wavelength for WDM system especially ISLs is primarily based on optical transmission windows, eye safety reasons, expenses, atmospheric effects, the possibility of receiver and transmitter components as well on the desired applications [3].The parameters are considered as per the practical scenario of WDM and the telecommunication standardisation sector of the international telecommunication union (ITU-T).

TABLE 1. SIMULATION PARAMETERS OF WDM SYSTEM

Para-meter	Modu-lation	POWER(dbm) RANGE (km)	Minimum Value	Maximum Value
1. BER	NRZ	POWER	7.9346	3.5567
		RANGE	1.2304	7.9346
	RZ	POWER	1.6855	5.3484
		RANGE	1.6855	1.9123
2. Q-Factor	NRZ	POWER	12.8589	16.6872
		RANGE	16.6872	18.1896
	RZ	POWER	12.4691	13.2709
		RANGE	12.5514	13.2709
3. O/P POWER	NRZ	POWER	-18.24	-14.09
		RANGE	-14.09	-12.26
	RZ	POWER	-16.86	-13.43
		RANGE	-15.56	-13.43

In the below mentioned parameters, we calculated the values of BER,Q-factor and Output power of the WDM System and also calculated their Minimum and Maximum values. On the behalf of these values we calulate that which modulation scheme is better i.e. NRZ or RZ.

The next table fig 6 shows the comparison between all the graphs on the basis of Parameter like as BER and Q-Factor:

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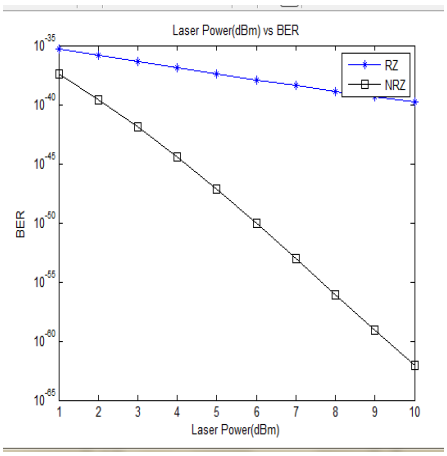
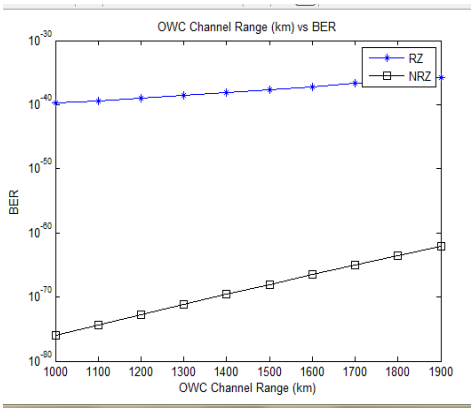
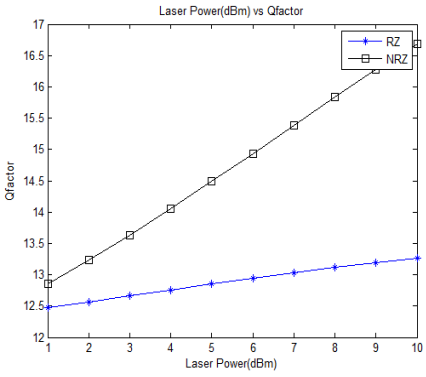
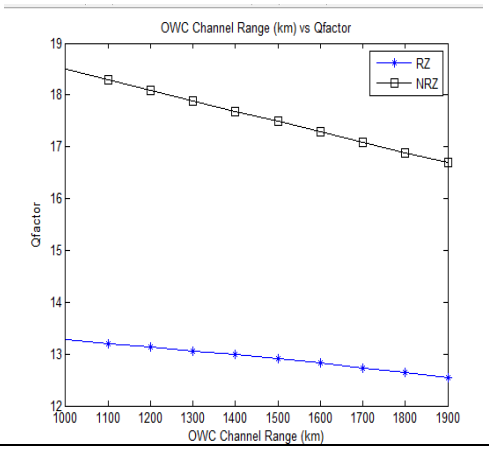
GRAPH 1	Comparison graph between the RZ and NRZ on the basis of the BER vs laser power.	
GRAPH 2	Comparison graph between the RZ and NRZ on the basis of the BER vs Channel range.	
GRAPH 3	Comparison graph between the RZ and NRZ on the basis of the Q-factor vs laser power.	
GRAPH 4	Comparison graph between the RZ and NRZ on the basis of the Q-factor vs OWC channel range.	

Fig 6: Comparison graph

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1. In the first Graph i.e. BER vs Laser power the modulation scheme RZ is better than that of the NRZ scheme.
2. In the second graph i.e. BER vs Channel range the modulation scheme again RZ is better than that of the NRZ scheme.
3. In the third Graph i.e. Q-factor vs laser power the modulation scheme NRZ is better than that of the RZ scheme.
4. In the fourth Graph i.e. Q-factor vs Channel range the modulation scheme again NRZ is better than that of the RZ scheme.

References

Examples of reference items of different categories shown in the References section include:

- example of a conference paper in [1]
- example of a conference paper in [2]
- example of a journal article in [3]
- example of a journal article in [4]
- example of a journal article in [5]
- example of a conference paper in [6]
- example of a journal article in [7]
- example of a journal article in [8]
- example of a journal article in [9]
- example of a journal article in [10]
- example of a journal article in [11]
- example of a journal article in [12]
- example of a journal article in [13]

VI. CONCLUSION AND FUTURE SCOPE

Inter-satellite Optical fiber helps to communicate data. It uses LASER source that is considered to be better than the traditional light source uses.

The main purpose of designing IsOWC system is to minimize BER and Power dissipation of the system. These systems are used as the bandwidth of the system is high, its small in size and it cost is low as compared to the traditional satellite systems. In this paper a system is designed for calculating the BER from the signal. In this the WDM is used for the increasing the number of users. From the results obtained it is concluded that the proposed system is efficient and better than the traditional system. Along with this RZ and NRZ coding form are compared. The results are obtained by varying laser power, length of the OWC channel and analysing its effect on the BER, Q factor etc.

So it is concluded that BER of Return –to-zero modulation scheme is better than that of the NRZ but the Q-factor of Non return to-zero modulation scheme is better than that of the RZ.

Though this system is considered to be efficient but in future further enhancement can be done to increase the efficiency of the system. The efficiency depends on the minimum BER and power dissipation of the system. Along with this some other coding format can be used for results calculation.

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