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Investigating the Q-factor and BER of a WDM System in Optical Fibre Communication using Different Modulation Formats at Different Wavelengths

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Abstract: **In this paper we are doing comparative analysis of WDM system using different modulation formats (NRZ, RZ) and compensation schemes at different bit rates (10Gbps, 20Gbps and 30Gbps) and wavelength with standard and dispersion compensated fibre and investigate the Q-factor and bit error rate for fixed gain EDFA and length both type of fibre.**

Keywords: BER, Q-factor, WDM system, Optical Fibre.

I. INTRODUCTION

Q-factor and BER is one of the most important factors that limiting the transmission distance in optical communication systems. In order to transmit signals over long distances, it is necessary to have a low BER and high Q-factor within the fibre. Q factor measures the quality of an analogue transmission signal in terms of its signal-to-noise ratio (SNR). As such, it takes into account physical impairments to the signal –for example, noise, chromatic dispersion and any polarization or non-linear effects – which can degrade the signal and ultimately cause bit errors. In other words, the higher the value of Q factor the better the SNR and therefore the lower the probability of bit errors. In telecommunication transmission, the bit error rate (BER) is the percentage of bits that have errors relative to the total number of bits received in a transmission. For example, a transmission might have a BER of 10^{-6}, meaning that, out of 1,000,000 bits transmitted, one bit was in error. A WDM transmission link transport large amount of data traffic by multiplexing a number of lower capacity wavelength channels onto a single fibre. The use of WDM therefore allows increase in the capacity of long haul optical transmission systems or, decrease in the (10Gbps, 20Gbps, and 30Gbps) with standard and dispersion compensated fibre on the basis of Q-factor, eye-diagram and bit error rate for fixed gain EDFA and length both type of fibre. Generally a basic WDM system has been divided into three parts: (i) Transmitter section, (ii) Transmission link section and (iii) Receiver section.

II. SIMULATION MODEL

For Simulation work Optisystem Simulation Software is used. In transmitter section externally modulated transmitter is used. Pseudo random bit generator is used to generate digital data and pulse generator is used to convert it into electrical signal modulator mixes electrical signal with light source and generate optical signal which is sent to multiplexer .In receiver section PIN photo detector is connected to the output to detect the optical signal and convert it into electrical signal. Low Pass Bessel filter is used which pass the low frequency signal and discard high frequency carrier signal. BER analyzer is used to analyze the bit error rate and Q-factor. We are using Optisystem 10 for simulation and designing. It is an innovative, powerful and rapidly evolving software design tool. It enables users to test, plan and simulate almost all type of optical link. Transmitter has CW laser array with 16 output ports which has equally spaced emission frequency range from 191.5-194.5 THz, data modulator and the optical multiplexer. Data modulators are connected to each output port of CW laser array then signals from data modulator is fed to 16 input ports optical multiplexer having bandwidth 30GHz.loop control after multiplexer, EDFA (Erbium doped fibre amplifier) is placed after every fibre to compensate the losses of the fibre with constant noise figure. Signals are demultiplexed with demultiplexer and at the end we use photo-detector ,low pass filter and BER analyser to find out the output. In post compensation scheme DCF fibre is placed after SMF to compensate the dispersion and nonlinearities and two inline EDFA are used.

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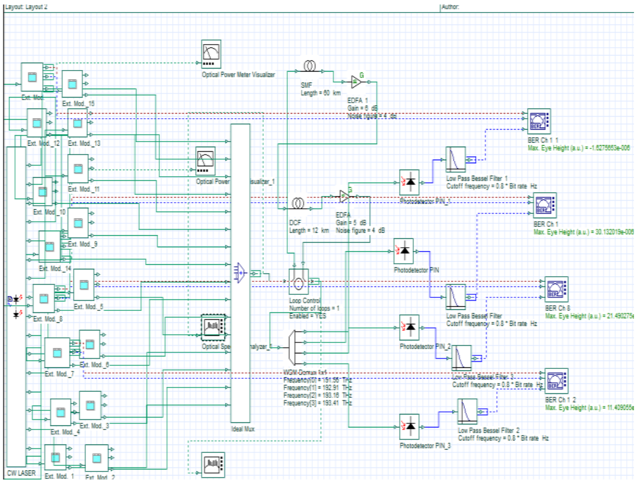

Figure 1: Simulation Model

III. RESULTS AND SIMULATION

In result section we describe the Eye diagram for 10 Gbps, 20 Gbps and 30 Gbps for 1565 nm and 1552 for Q factor and BER both for NRZ and RZ.

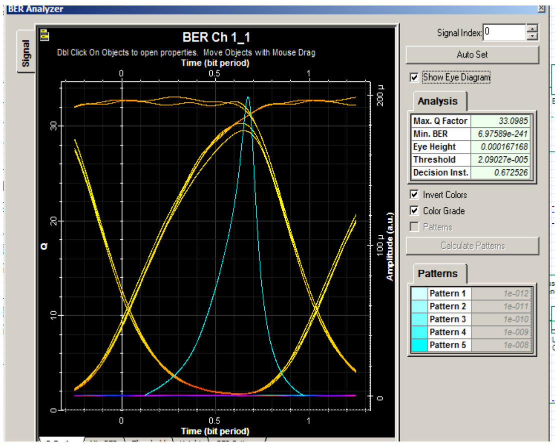

Figure 2 (a) Eye diagram for 10 gbps at 1565 nm of NRZ.

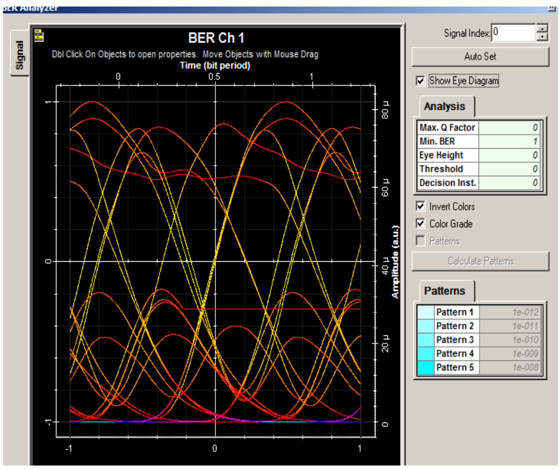

Figure 2(b) Eye diagram for 10 gbps at 1554 nm of NRZ.

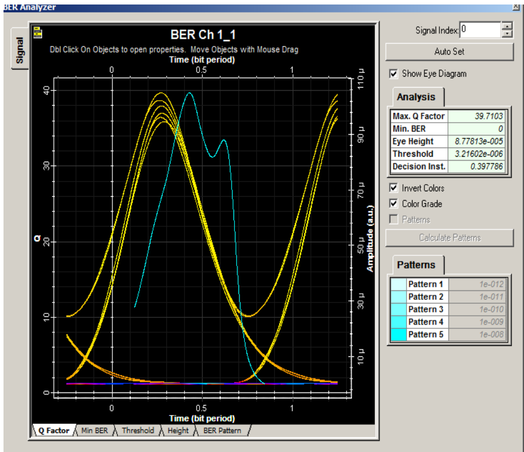

Figure 2(c) Eye diagram for 10 gbps at 1565 nm of RZ.

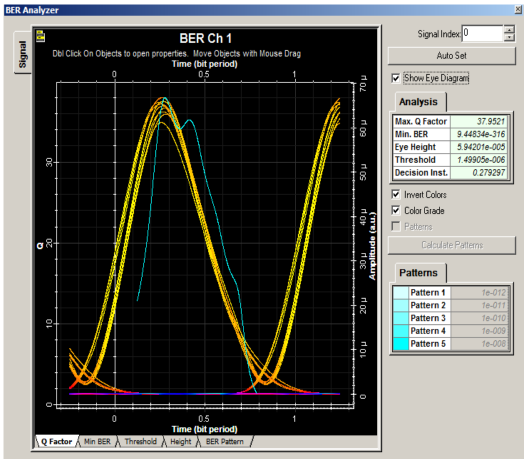

Figure 2(d) Eye diagram for 10 gbps at 1554 nm of RZ.

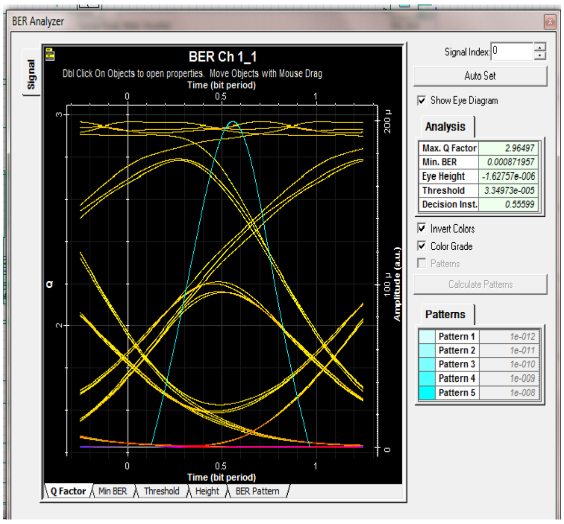

Figure 3(a) Eye diagram for 20 gbps at 1565 nm of NRZ.

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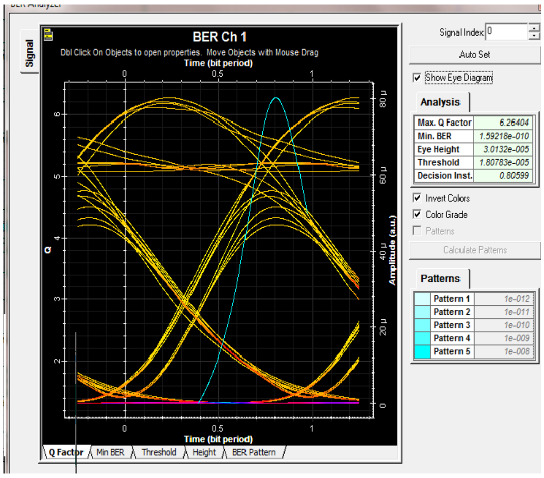

Figure 3(b) Eye diagram for 20 gbps at 1554 nm of NRZ.

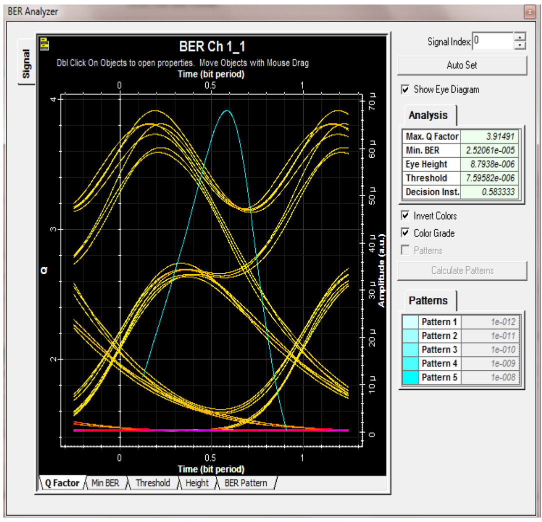

Figure 3(c) Eye diagram for 20 gbps at 1565 nm of RZ.

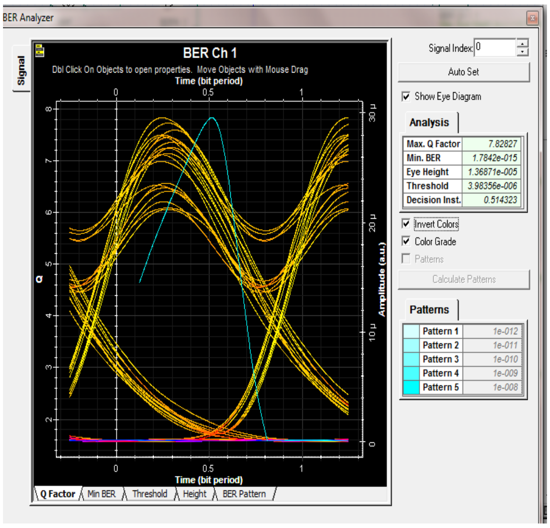

Figure 3(d) Eye diagram for 20 gbps at 1554 nm of RZ.

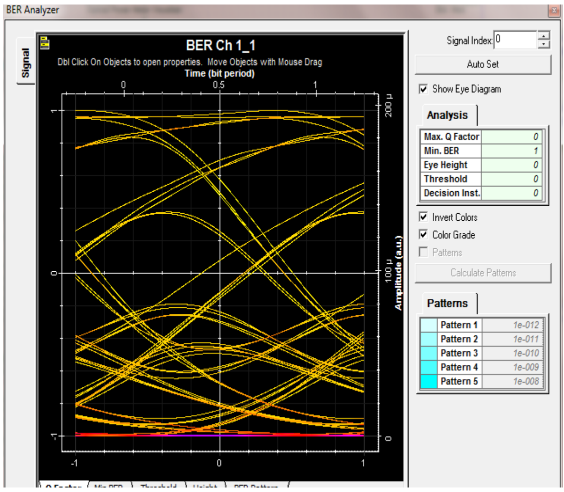

Figure 4(a) Eye diagram for 30 gbps at 1565 nm of NRZ.

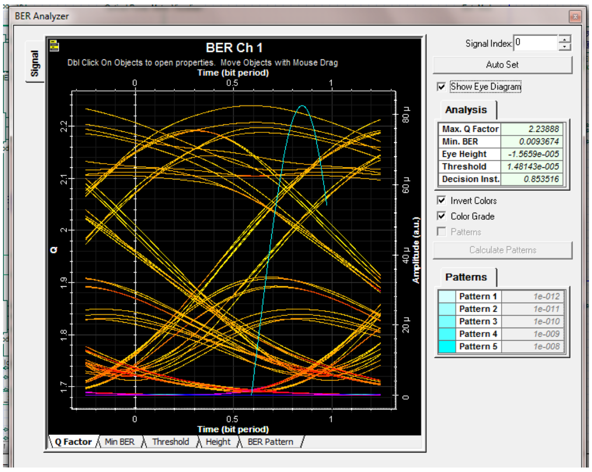

Figure 4(b) Eye diagram for 30 gbps at 1554 nm of NRZ.

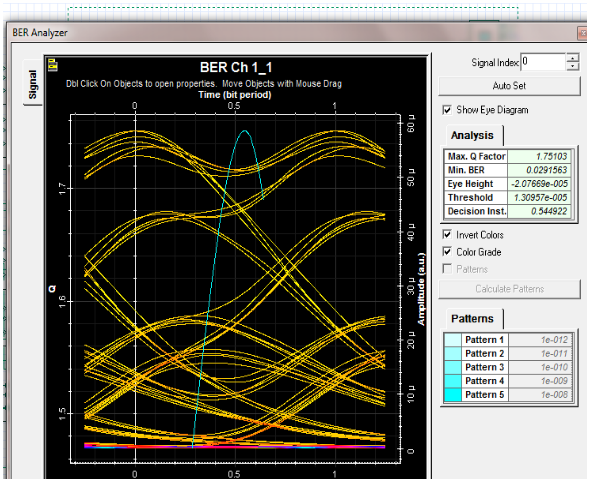

Figure 4(c) Eye diagram for 30 gbps at 1565 nm of RZ.

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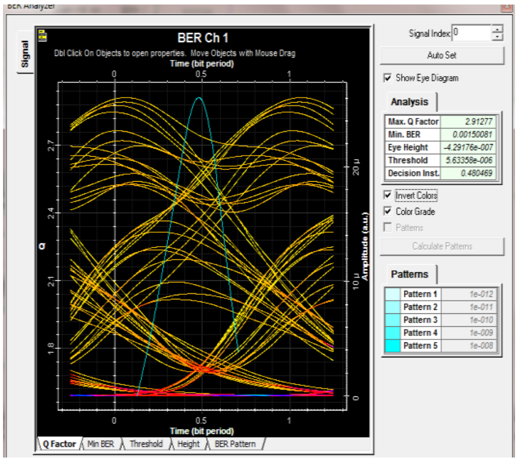

Figure 4 (d) Eye diagram for 30 gbps at 1554 nm of RZ.

Table 1 comparison table for Q factor of NRZ and RZ

Data Rate	Wavelength	NRZ	RZ
10	1565	33.0985	39.7103
10	1554	0	37.9521
20	1565	2.96	3.91491
20	1554	6.26	7.82827
30	1565	No result	1.75103
30	1554	2.2385	2.91277

Table 2 Comparison table for BER of NRZ and RZ

Date Rate	Wavelength	NRZ	RZ
10	1565	6.97589e- 241	0
10	1554	1	9.44834e- 316
20	1565	0.0087	2.52061e- 005
20	1554	1.592e- 010	1.7842e- 015
30	1565	No result	0
30	1554	0.0093674	9.44834e- 316

IV.CONCLUSIONS

In this paper we have analysed 8 channels DWDM optical communication system for post dispersion compensation scheme using DCF using different modulation system NRZ, RZ at different bit rates 10Gbps, 20Gbps and 30 Gbps. We observed that RZ format gives better performance on the basis of Q factor, bit error rate (BER) and eye opening. In this we can say that RZ modulation format is faithful for long distance communication.

V. REFERENCES

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VI. BIBLIOGRAPHY

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