Performance Analysis of Dwdm System With Different Modulation Techique And Photodiode

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---ABSTRACT---
For optical transmission application to perform better it become necessary to have small size, low cost, low BER and low power consumption. In this paper the proposed dense wavelength division network (DWDM) system in 1310 nm wavelength domain over a standard single mode fiber transmission system. No nonlinearities in SMF are taken into consideration. Advance optical modulation technique like EAM and QPSK are stimulated and the result prove that using these modulation technique the 1310 nm wavelength domain network are less complex and of low cost. Two different photodiode PIN and APD are tested on the receiver side. For analyzing the effect of amplification both POST amplification and PRE amplification are tested andthe results obtained can be used in the future network for high speed and greater capacity.

KEY WORDS : Optical fiber communication, BER,photodiode,wavelength-division-multiplexing and eye opening factor.

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I.   INTRODUCTION

DWDM technology is a kind of technology that multiplex the optical signal of different frequency and transmit optical signal by using tremendous bandwidth provided by SMF's and DCF. This technology is very useful in optical transmission application that needs to have small size, low power consumption and low cost. DWDM of 100G Ethernet standard work in application of the 1310 nm wavelength domain where 4×25 Gb/s transmission is utilized [1]. Clear eye diagrams at 50 Gb/s transmitted signal after 40 km SSMF using a praseodymium doped fiber amplifier are presented in [2]. Here, we propose the 1310 nm wavelength domain to realize high capacity, low cost and low complexity transmission. The 8 channel DWDM system simulation model is designed in this paper, I part include the introduction, II part discuss about consideration that are taken under system, III part discuss the experimental setup withdifferent modulation technique and photo detection technique at the receiver side. IV and V part discuss result and conclusion respectively.
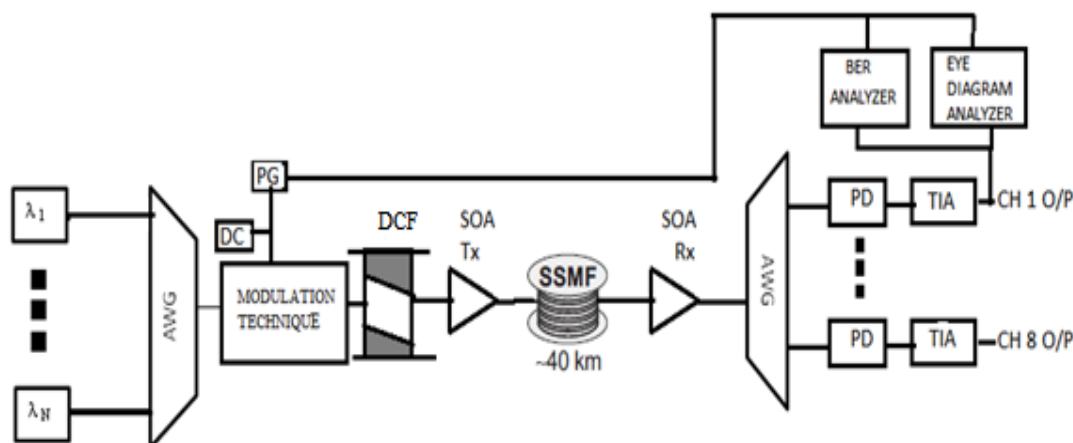

Fig. 1: Experimental setup of DWDM system the 1310-nm transmission window.

II. CONSIDERATION

Considering the single mode fiber of 1310 nm wavelength domain effected by chromatic dispersion as well as FWM. Taking the dispersion in 1310 domain for SSMF [3] and the tolerance to dispersion is at available bandwidth is the function of fiber length. For the 40 km fiber the fiber value defined in [3]. The channel spacing is taken 250GHz because below 200 GHz the signal is distorted by FWM but dot effecting For 400 Gb/s transmission with the channel spacing of 250 Ghz the higher data rate signal will occupy less bandwidth. The channel spacing can maximum set to 600 GHz and to 500 GHz for the 40 and 50 GB/s signal respectively. These bit rates can apply for 400 Gb/s transmission.

III EXPERIMENTAL SETUP

Figure 1 shows the experimental setup of the DWDM network that is created and stimulated in the software

3.1.TRANSMITTER:The transmitter side consists of 8 CW laser at wavelength 1311.5-1321.2 nm the spacing between channel is uniform of 1.4 nm. There is no polarization between the channel the adjacent channel. After CW laser thesignal pass through AWG (arrayed waveguide grating)[5]. AWG channel spacing of 250 GHz is sufficient for the Modulators used in the simulation are EAM and QPSK. Each of the modulator is experimented separately. The modulator are driven by the pseudo random bit sequence of length $2^{31}-1$ coming from a pattern generator (PG) and was driven with the electrical signal of the voltage swing 2.4 Vpp and the DC-bias (DC) set to 1.9 V shown in figure 2.Table 1 illustrates the important parameter .

Component name	Specification/ value
DCF of length	2.5 km
DCF dispersion value	42.5 ps/nm
DCF attenuation	2 dB
SSMF of length	38.1 km
SSMF attenuation	0.325 dB/km
Dispersion at 1310 nm	0.281 ps/nm*km
Dispersion slope	0.087 ps/nm2*km

Table 1

After the transmission link, the signals entered a DWDM receiver. The bit rate in the simulation is taken 40 Gb/s.
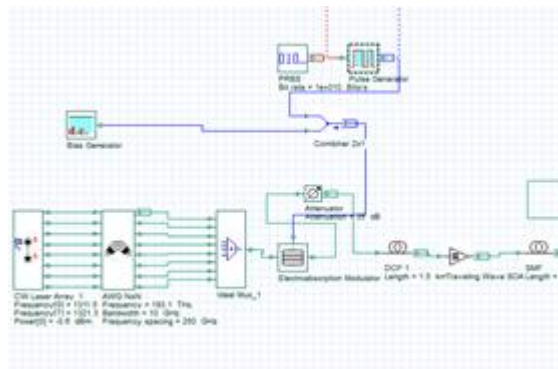

FIGURE 2: simulation model at transmitter side with EAM modulation

3.2.RECEVER

At the receiver side to type of output ate experimented one with SOA at the receiver Figure 3 and one without SOA Figure 4.The signal are passed through demultiplexing AWG. The receiver AWG had a loss of 4.5dB.Two photodiode are experimented at the receiver side, figure shows the subsystem at the receiver side each subsystem contain a photodiode, amplifier and a filter and each modulation is experimented with two type of photodiode at the receiver PIN and APD [6] From the above discussion it is clear that for modulation technique is being simulated with different consideration lets discuss each of the setup and also analyze the result that has been calculated.
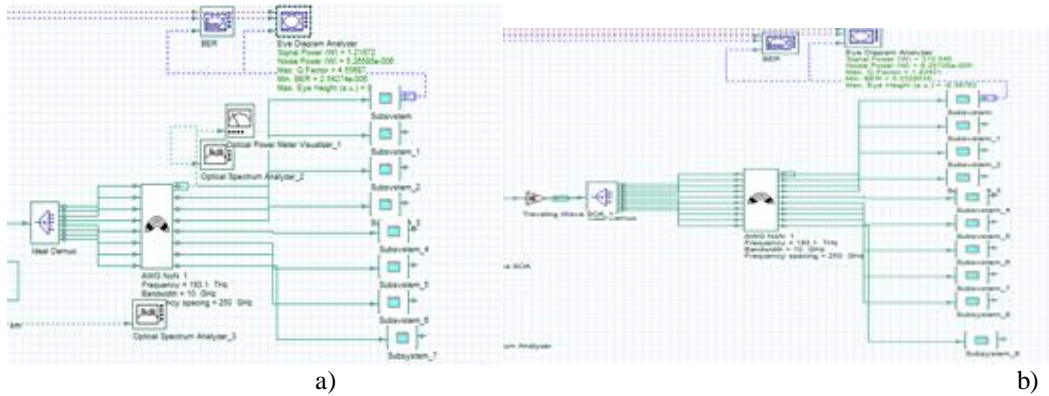
a)   b)

FIGURE 4: simulation model at receiver side a) without pre amplification b) with pre amplification

I SETUP

In first simulation model EAM modulation shown in figure 2. This technique is used which modulate the intensity of laser beam via an electrical voltage. It is used after AWG as shown in the figure using EAM modulation, APD and PIN diode and post and PRE amplification four combinational circuits came in front and the result are shown in table2.

	EAM PIN POST	EAM APD POST	EAM PIN PRE	EAM APD PRE
Signal Power (dBm)	30.8625	40.405014	54.9213	64.463725
Noise Power (dBm)	-22.7853	-8.406887	-12.034	3.736291
Min. BER	2.54E-06	2.55E-06	6.26E-05	0.032791
LOG of Min. BER	-5.5948	-5.5929	-4.2036	-1.48425

Table 2

The eye diagram at channel 1 in above four cases are shown in figure 5.
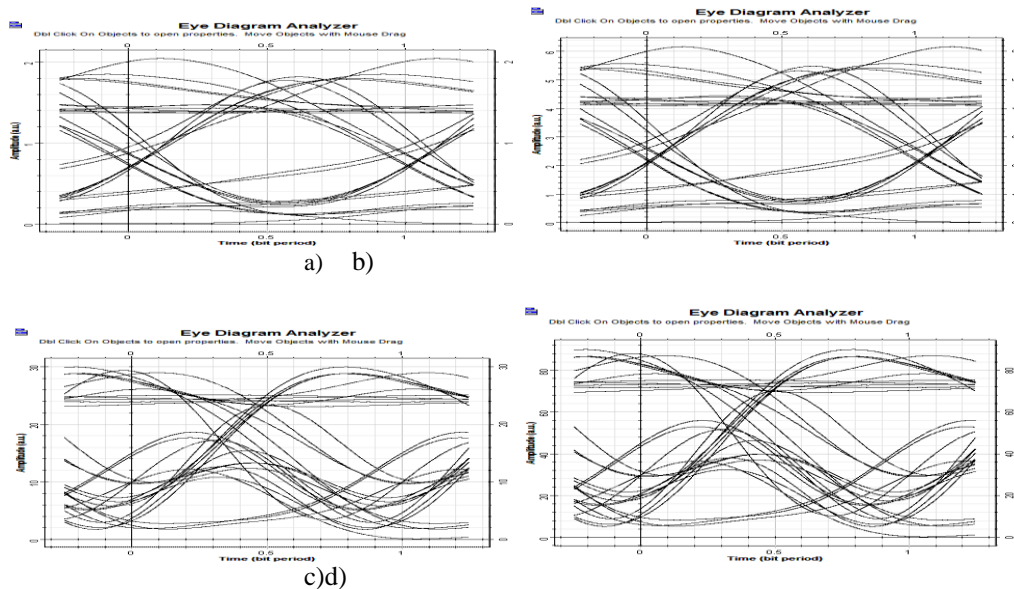

a)   b)

c)d)

FIGURE 5: a)EAM PIN POST, b)EAM APD POST, c)EAM PIN PRE, d)EAM APD PRE

From the above figures it is clear that POST amplification give the more clear eye diagram and therefore less BER, high eye opening factor and high Q factor can be achieved the best curve is shown by the combination of APD and POST amplification. Still the signal power increases in case of PPE amplification but this will not give as good result as POST amplification. From the table 1 it is clear that APD perform much better than PIN.

II SETUP

In second simulation model QPSK modulation technique .It is used after AWG as shown in the figure 6. QPSK modulation is formed by a common (-vπ, vπ) MZM followed by a (0,π/2) phase modulator (PM) in a serial configuration [6].
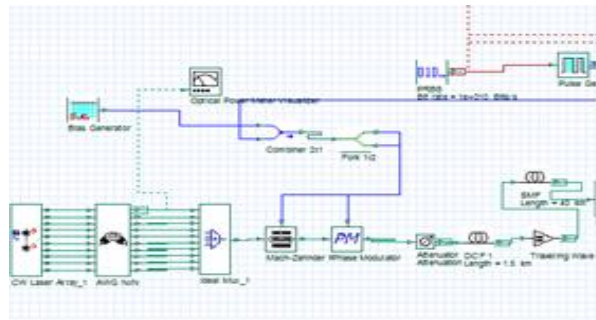

FIGURE 6: simulation model at transmitter side with QPSK modulation

Using QPSK modulation , APD and PIN diode and post and PRE amplification four combinational circuit came in front and the result are shown below in table 3

	QPSK PIN POST	QPSK APD POST	QPSK PIN PRE	QPSK APD PRE
Signal Power (dBm)	30.575306	40.117731	54.204807	63.74723
Noise Power (dBm)	-23.21833	-8.775623	-11.54241	3.05329
Min. BER	1.45e-09	1.25e-09	0.002166	0.002156
Min. LOG BER	-8.83803	-8.90413	-2.66444	-2.66635

TABLE 3

The eye diagram at channel 1 in above four cases are shown in figure 7
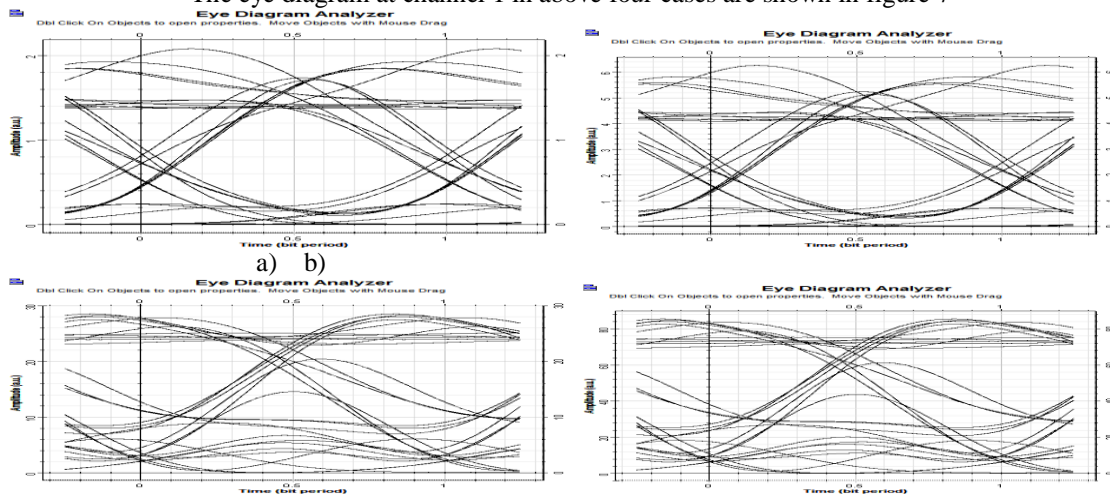

a) b)

FIGURE 7: a)QPSK PIN POST, b)QPSK APD POST, c)QPSK PIN PRE, d)QPSK APD PRE

From the above figures it is clear that POST amplification give the more clear eye diagram and therefore less BER, high eye opening factor and high Q factor can be achieved the best curve is shown by the combination of APD and POST amplification. Still the signal power increases in case of PPE amplification but this will not give as good result as POST amplification. From the table 2 it is clear
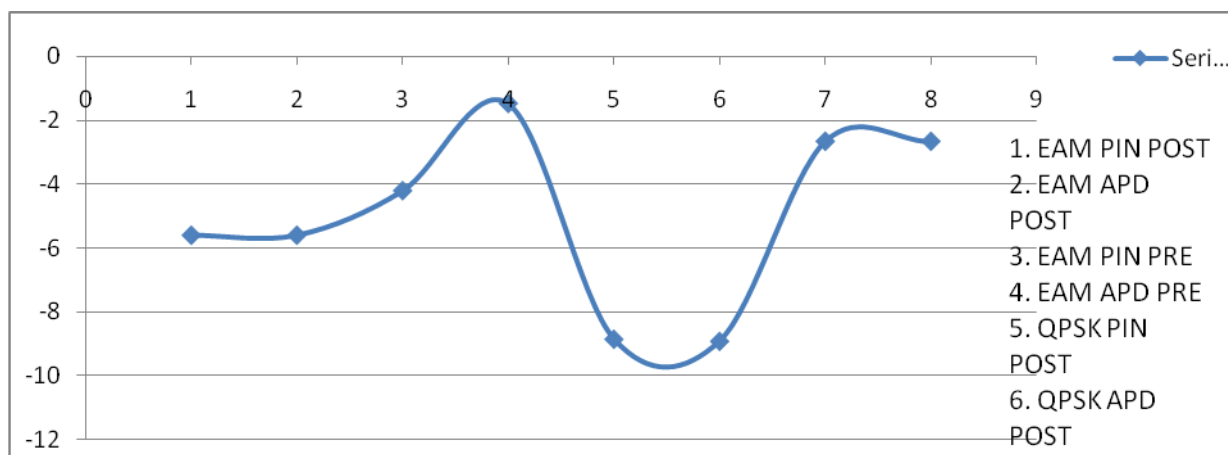
FIGURE 8: BER Comparison

that APD perform much better than PIN it is also discovered that BER decreases in case of QPSK and EAM has higher BER with a very minute difference in signal power.

IV RESULT

After transmission there is a very minute difference in the channel power. The eye diagram shown above shows that post amplification show the clear eye diagram and all other channel show the similar performance. Figure 8 shows the BER measurement result. Changing the bit rate to 54 Gb/s the capacity and BER improved but the signal power decreases. Different modulation techniques are simulated and the best result which comes in front in case of QPSK APD POST the BER for all channels is ≤1.25e-09 was measured figure. The experiments conducted above have eight channels. Adding two more channels does not cause any significant effect in the performance of the network.

V CONCLUSION

From the above result discussion it is clear that by using APD instead of PIN we can improve the system performance. It was observed that signal power has increased with the decrease in BER but the noise power has also increase significantly with signal power. Eye opening factor and threshold has also improved which give a good eye opening to the eye diagram i.e. the clear eye. From the above result it is clear that QPSK has highest Q factor i.e. its BER will also be less.

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