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A COMPARATIVE STUDY OF XPM NON LINEAR EFFECT ON WDM LINK HAVING 2,4,16 CHANNEL

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***Abstract*— In this paper simulation models with NRZ modulation for reducing the XPM nonlinear effect having varying number of channels are developed to compare them. Firstly we find the effect of XPM nonlinearity on the received output signal. The simulation results shows two channel four channel and 16 channel WDM network with XPM effect. The performance of these network are evaluated in term of a Q-factor, BER and eye diagram in presence of dispersion and XPM nonlinear effect. The two main reason of nonlinear effects are change in inelastic scattering and refractive index gradient of the fiber. The XPM effect is analyzed using optsim tool. It has investigated that as the input power and length of fiber increase XPM increases but presence of dispersion manage the XPM effect. Also as the number of channels are increase the nonlinear effect is also become dominating.**

Keywords—XPM, WDM, Modulattion, SPM, BER.

I. INTRODUCTION

As requirement for number of channel per fiber increasing rapidly, so fulfill the requirement of increase in channel per fiber different multiplex technique are used. Among these multiplexing technique wavelength division multiplexing is of our interest. The deployment of wavelength division multiplexing technology has been the first breakthrough that stimulate the increase of the fiber capacity. Coherent WDM system are used in the current 100 GB/s standard technology. To meet the continuous growth of global demand for large capacity communication, the WDM communication system can operate at 400 GB/s but due to increase in input power and reduction in channel spacing nonlinear effects create the big threat for further expansion. These nonlinear effects are intensity and power depended. So that it is necessary to study these nonlinear effects. The nonlinear effects those occur due to change in reflective index of medium with intensity are

* SPM
* XPM
* FWM

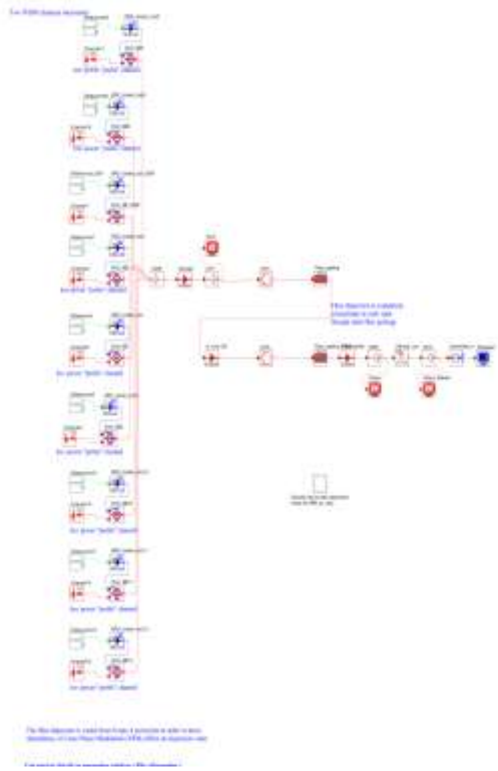
The third order susceptibility is responsible for these nonlinear effects. In a WDM system all the channel having equal spacing and having 2-3 mw power by each channel, so effect of XPM are strong on WDM channel who carry small power. XPM can cause pulse broadening which is not symmetric. These nonlinearity induces the phase modulation of propagating signal is also called as kerr effects. The cross phase modulation is occur in multiple wavelengths.

<u>Cross Phase modulation</u>:-

With the need of multichannel transmission WDM system are implemented. In such system major problem encounter is nonlinear phase modulation which is also called cross phase modulation. The intensity dependency of refractive index leads to another nonlinear effects that is XPM. In XPM refractive index is not only depends on the intensity of that beam but also on the co-propagating beam. This nonlinear effect converts the power fluctuation of that pulse in to the phase fluctuation of the co-propagating pulse. The shape of the pulse will change and asymmetric spectral broadening is also result due to the XPM. The cross phase modulation is dependent on the interaction length of fiber. During transmission fluctuating power and fluctuating index gradient interact. There is need to adders this nonlinear effect for long houl WDM networks. The cross phase modulation is inversely proportional to the number of channel increasing and spacing between the channels.

<u>Experiment set up:</u>

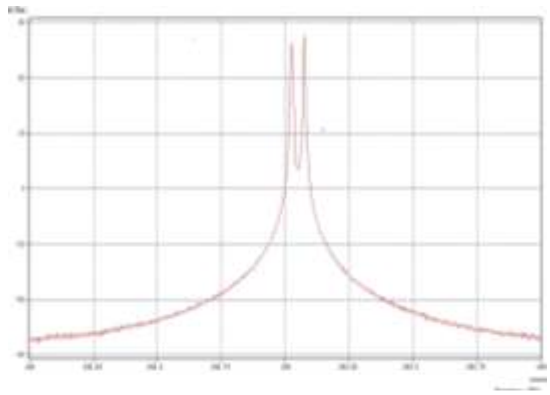
The WDM system consist of transmitter section and transmitting fiber and receiver section. In transmitter section number of modulated signal are multiplexed and transmitted through the fiber. The fixed gain amplifier is used with the transmission fiber to increase the gain of overall signals. In the path fiber bragg grating is also use to counterbalance the losses and linear effects. In the receiver section PIN diode is used with filter to extract the signal. The Q estimator, BER estimator and electroscope are used at the receiver to check the results.

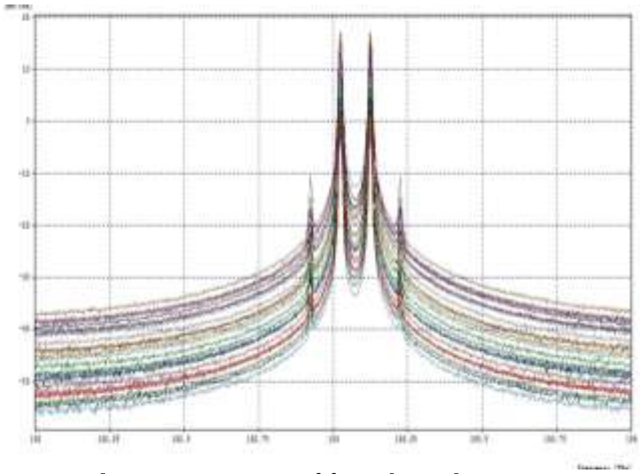


II. SIMULATION WORK

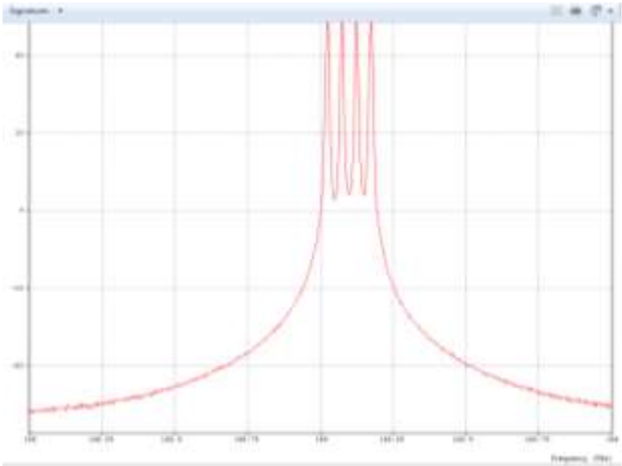
Hi We simulate WDM by varying the number of channel in the system. we check the impact on XMP in the WDM network in the absence of dispersion and in the presence of dispersion in two channel WDM network. we use the central frequency for first channel is 193.025 and for second channel 193.075. Similarly for 4 channel and 16 channel we use spacing of 0.050GHz. Here we use optical match filter for good results. The optical spectrum is used to measure spectrum of the signal and frequency of the signal which is transmitted through the fiber with nonlinear effect XPM and dispersion. At the receiver end may receive the output and analyzed it given below:

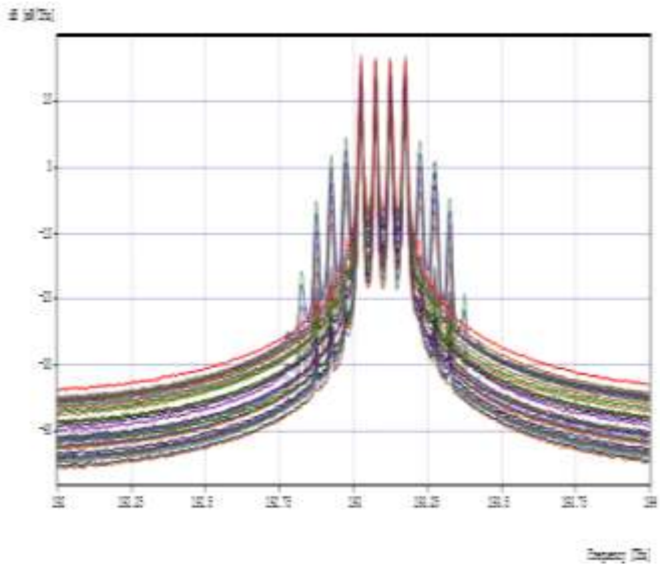
Input and Output spectrum of two channel WDM system





Input and Output spectrum of four channel WDM system





Input and output of sixteen channel WDM system

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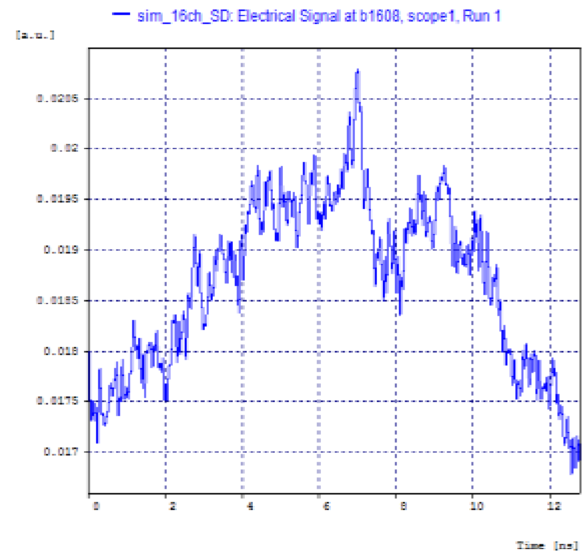
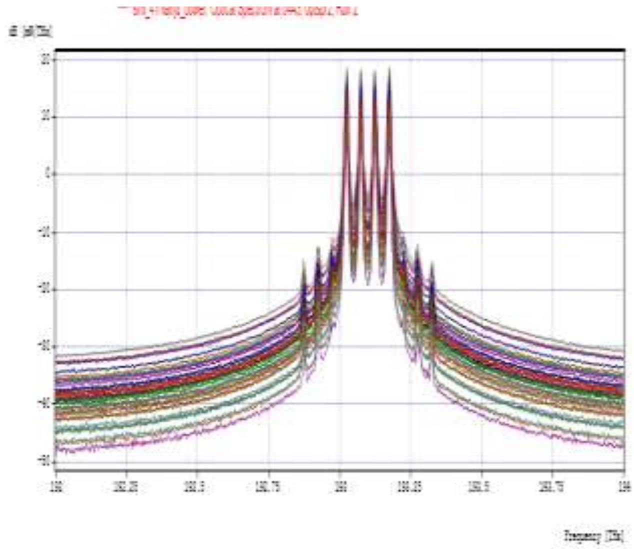


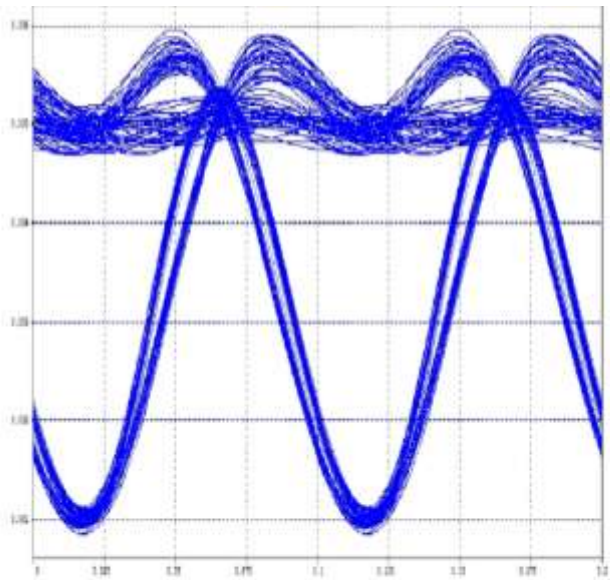


It is interpreted from the spectrum of the output that the received signal is appear broaden which is due to the presence of nonlinear effect.

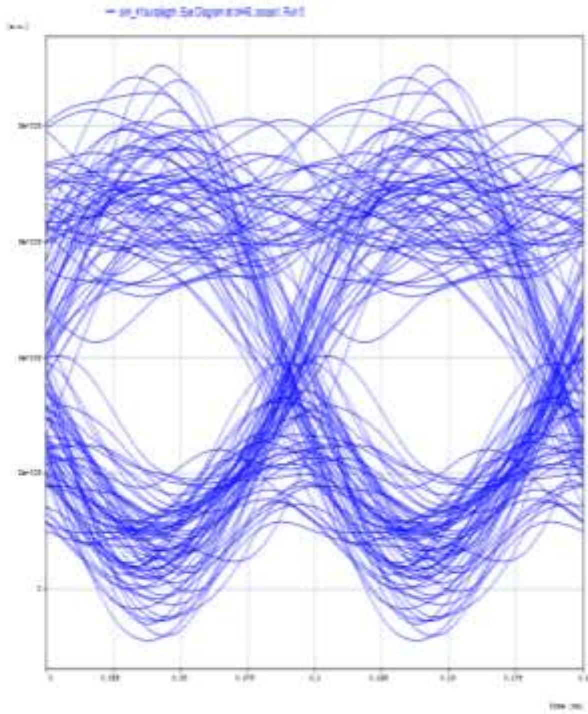
Eye Diagram

An eye diagram tells the quality of signal which is received at the receiver. The eye diagram are obtained using electrical scope at the receiver end. The opening of eye tells the quality of the signal and quality of the transmitting media also.

Eye diagram for two channel



Eye diagram for four channel



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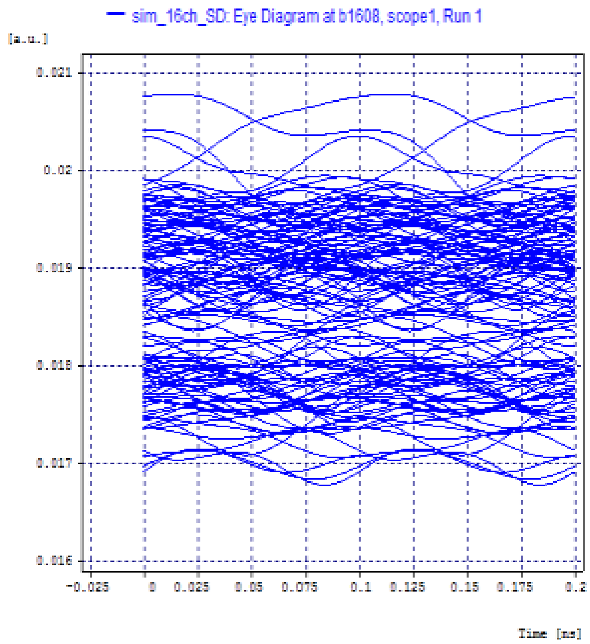
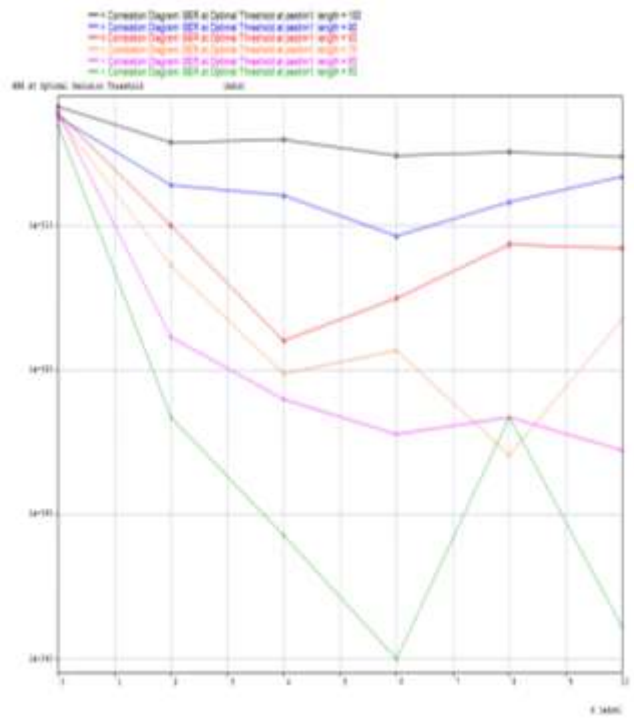


Eye diagram of sixteen channel WDM

BER

The graph given below BER vs dispersion shows that the BER will decrease with the increase in dispersion which verify that the dispersion can also create problem even though it nullify the effect of XPM in the channel.



III. CONCLUSION

Results obtained for WDM system using NRZ modulation format with narrow channel spacing to evaluate the performance of the signal in the presence of dispersion and XPM. The performance is obtained in terms of spectrum of signals, BER and eye diagram. The result shows that the presence of dispersion improves the result by defeating the cross phase modulation effect but also increase BER. Analysis of XPM on WDM link against different parameter is obtained. The performance of system is analyzed in terms of spectrum of signal, BER and eye diagrams. To receive a signal of high quality the value of quality factor should be greater than 16dB and the BER should not be greater than 10^{-9}. We have obtained the result at the center frequency 193.075 THZ and the reference frequency 193.1 THZ. The value of quality factor will be increase with dispersion and decrease with increase in length. But by increasing the power we can minimize the XPM effects. It has also studied that as the channel spacing increasing the value of quality factor and BER will be improved. The result have obtained for WDM system using NRZ modulation format with narrow channel spacing to evaluate the performance in terms BER and eye diagrams. Four different frequency (193.025, 193.075, 193.125 and 193.175) have been taken for evolution of WDM in terms of BER and eye diagrams. The system with NRZ modulation format shows good result up to 120 km distance for optical fiber communication.. The value of BER are 6.82031e-024 is found to be at length 120, power 12mw and the dispersion 4ps/nm/km. We conclude that by increasing the power and dispersion up to certain limit we can minimize the XPM nonlinearity. Sometimes due to increasing the power nonlinearity increase but by using some dispersion compensation technique like fiber grating we can minimize this nonlinearity effects. The XPM increase on decreasing the channel spacing. We investigates that by increasing the value of dispersion up to a certain limit we can minimize the nonlinearity.

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