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Simulative Analysis of Hybrid Dispersion Compensation Based on 16x40 Gbps DWDM System Using RZ Modulator

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Abstract

In this paper 16x40 Gbps hybrid dispersion compensation schemes with RZ modulation format over SSMF link based on DWDM optical system. Power losses substitute by the EDFA and DCF. Error probability is minimizing the system and optimizing the system performance for all users and channel using in system. The average total output power of the system is -53.65 dBm and the maximum Q-factor is 5.87 and range of BER is $<10^{-12}$. *The simulation results show that data transmission rate successfully transmitted with low cost effective infrastructure with good system performance.*

***Keyword**: BER, Q-factor, DWDM, ISI, DCF, RZ, EDFA, OSNR*

1. Introduction

An optical WDM network and its applications can contribute and provide unlimited bandwidth with the less cost, for all ranges of fiber optical communication services such as internet, FTTH, VOIP and video. WDM plays a key role f current and future optical network solution due to its transparency, flexibility, efficiency and protection. Optical system with data rate of 10 Gbps and higher require precise dispersion compensation and careful and link engineering. On the other hand, DWDM enables multiple shift usage of transmission fiber with several wavelengths into the fiber through optical filters. To ensure that the wavelength stability of semiconductor laser must be select channel spacing >50GHz in current commercial DWDM system. DWDM is a revolution in optical communication field that allowing continues its exponential growth. DWDM technology is progressing in rapid manner enabled by high speed electronics the potential bit rate DWDM increased to 40 Gbps and higher. Raman EDFA and there are new fibers and new dispersion techniques for broadband dispersion management. Specifically, DWDM is current favorite multiple technologies for long haul communication in optical communication network in this all the user's needs to operate only at the bit rate of DWDM channels which is chosen arbitrarily. And the transparency property of DWDM system support mny data rate format and future protocol. For DWDM system data rate>10 Gbps the deleterious effects of dispersion and nonlinearity must be managed to achieve transmission over any appreciable distance. In optical networks to management dispersion utilize the SSMF, and, DCF with different parameters to retain the total accumulated dispersion low has been carried out in order to find the optimum modulation format for high bit rate transmission

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2. Simulation Setup

In DWDM system results with multiple channels by this we investigate the transmitter waveform at end side of receiver. If bandwidth is reduced eventually ISI (Inter-Symbol Interference) as the waveform takes longer to move from one logic level to another. The simulation is done by using opt system 7.0 of optiwave corporation. In the system design a multichannel DWDM system design a multichannel DWDNM system (16 channels with 40 Gbps) multiplexer connected at the transmitter side to multiplexes or combine all the input channels so these all can be transmitted through optical fibers link. At the receiving end firstly demultiplexer must be added or connected which will separate all channel in the frequency domain. The sequence length of Pseudo random code (64 bits), sample per bit (256) and number of samples is (16384)

2.1. The Optical Transmitter

In DWDM system multiple transmitter and with different parameters for each components and also they require different modulation formats. Using multiple components user can customize the design these all are complicate and also time consuming. But in DWDM encapsulate the different components and also allowing users to select the different modulation formats and multiple channels one component. In this the first component is Pseudo Random Bit Sequence(PRBS) some internal parameters presents in the PRBS such as bit rate, order and etc. the second component is modulator here are three types of modulation RZ, NRZ and off RZ, NRZ. The PRBS patterns have been standardized by the ITU for testing digital transmission system. Last component of the transmitter side is the optical source and modulation schemes. The multiplexer output is connected to the loop control DWDM system properties are frequency (190THz), channel spacing (200 GHz), power (-6.6666 dBm) and bit rate (40 Gbps) with RZ modulation format.

2.2. Optical Fiber Link

In the optical fiber link firstly loop control are present which is connected both multiplexer and demultiplexer and another two ports or terminals connected with fibers (SMF,DCF) AND optical amplifiers. The length of SMF is (100 km) split with (2 SMF) and which has properties dispersion (17ps/nm/km), attenuation is (0.2 dB/km) and EDFA gain(10,5,10,5 dB) and Noise Figure (6,6,6,6) and there are two DCF(10 each) with the properties of length(10km),attenuation(0.5 ps/nm/km),. Dispersion (-85 ps/nm/km) and dispersion slope (-0.3 ps/nm/km) for each DCF and after that one round trip to the loop control and enters to the receiver side.

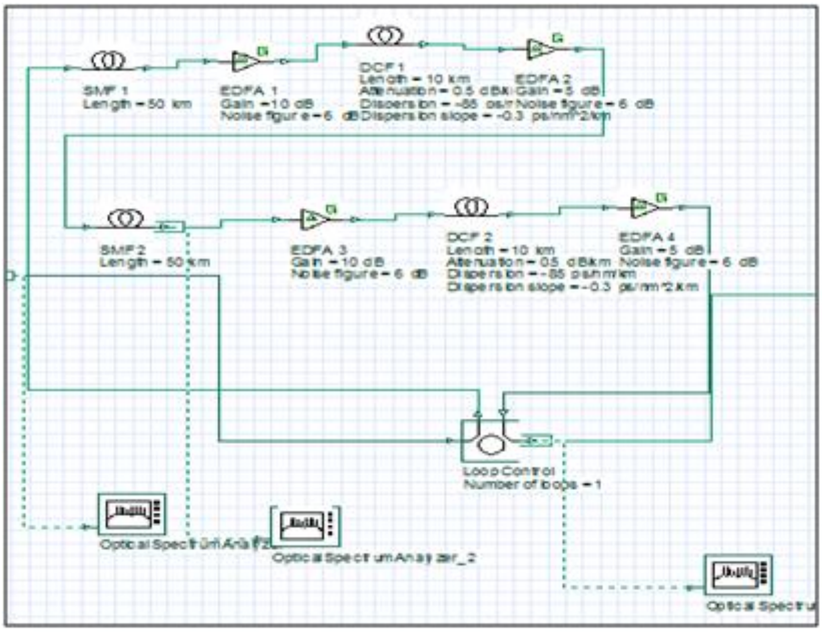

Figure 1. Hybrid Dispersion Compensation Fiber Link

2.3. Optical Receiver

DWDM receiver design consist of demultiplexer (1to 16) and one channel receiver side connected to each output port. DWDM receiver has equal channel spacing (200 GHz), frequency (190 THz), bandwidth (80 GHz) and depth (100 dB) and this demultiplxer is connected to optical receiver. This optical receiver has inbuilt low pass Bessel filter two type of photodiodes (PIN, APD) and 3R generator. Depending upon the choice PIN and APD the switches select components will redirect the signal into proper photo detector type after this each subsystem outputs connected to the BER analyzer to analyze or monitored the output signal by BER and Q-factor. The 3R generators performed in electrical domain with the expansive optical-electrical-optical (O-E-O) conversation required for each channel of the system. After 3R generator BER is connecting to the system to evaluate the transmission performance clearly demonstrate.

3. Results and Discussion

Figures clearly demonstrates the performance in a 40 Gbps 16 channel DWDM optical system with 100 GHz channel spacing SMF (100) and DCF (20km). Dispersion is managed through compensating by hybrid DCF and improves the signal strength. Based on the above fig evaluating the performance of the system was analyzed BER with large eye opening. This means ISI is low. Maximum eye opening means greatest protection against noise. From the BER analyzer ($<10^{-12}$) optical power level for all channels is (53.56 dB) with the minimum Q-factor (5.36).

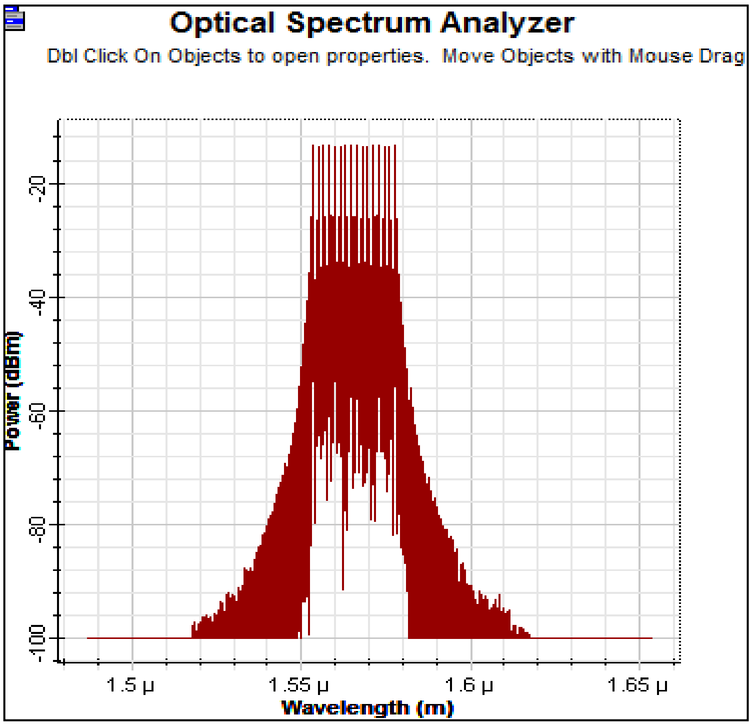

Figure 2. OSA for all Channels when Span link=0km

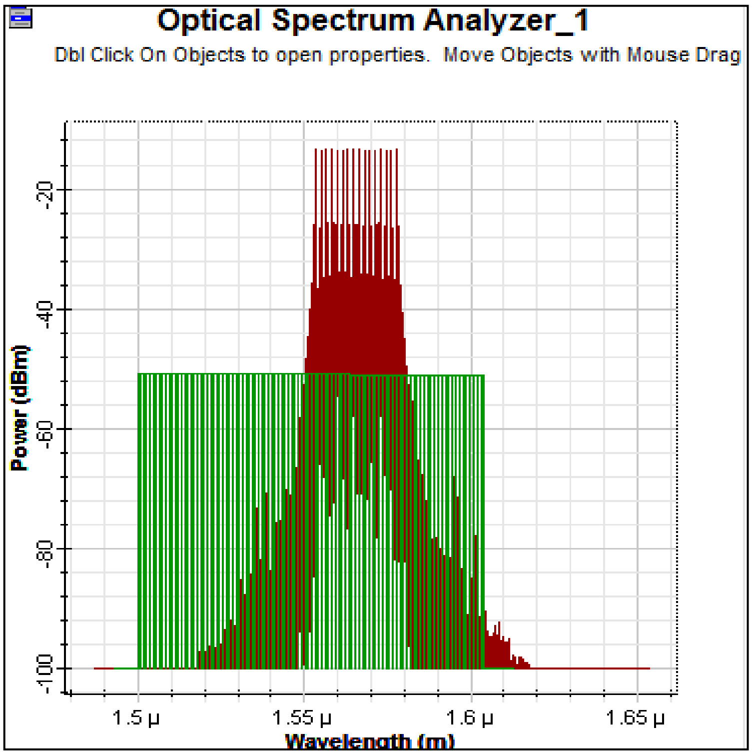

Figure 3. OSA for all Channels when Span Link=100km

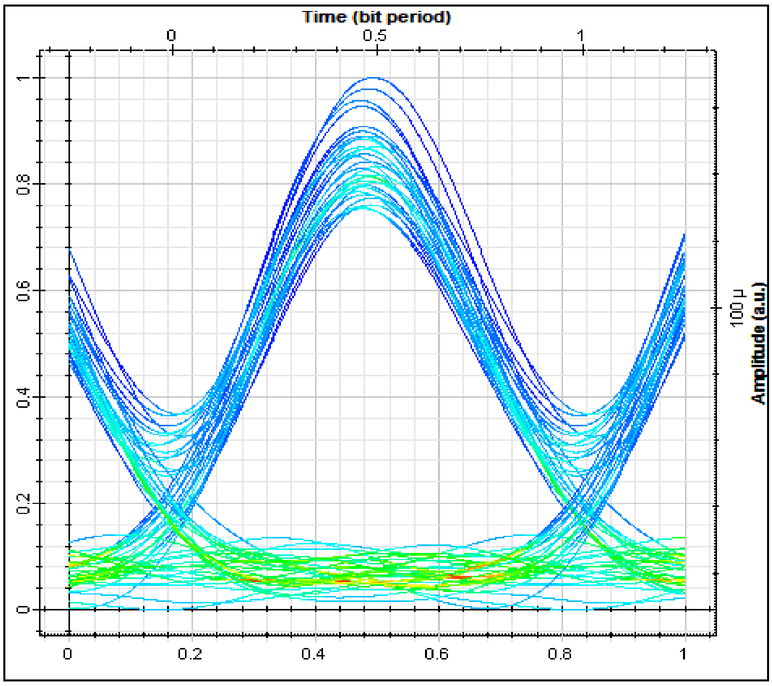

Figure 4. BER Analyzer for Output Channel 1 (190THz) when Span=120km

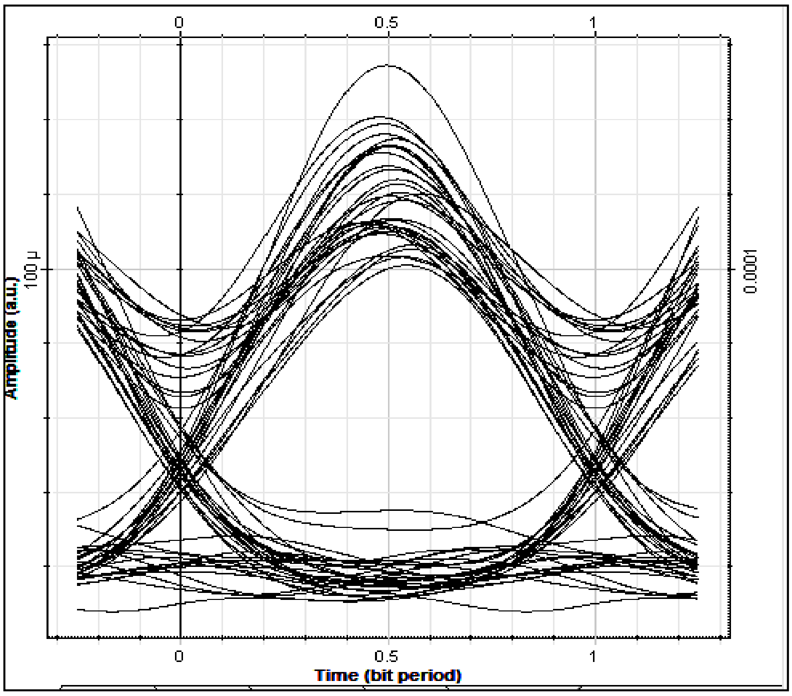

Figure 5. BER Analyzer for Output Channel 1 (193THz) when Span=120km

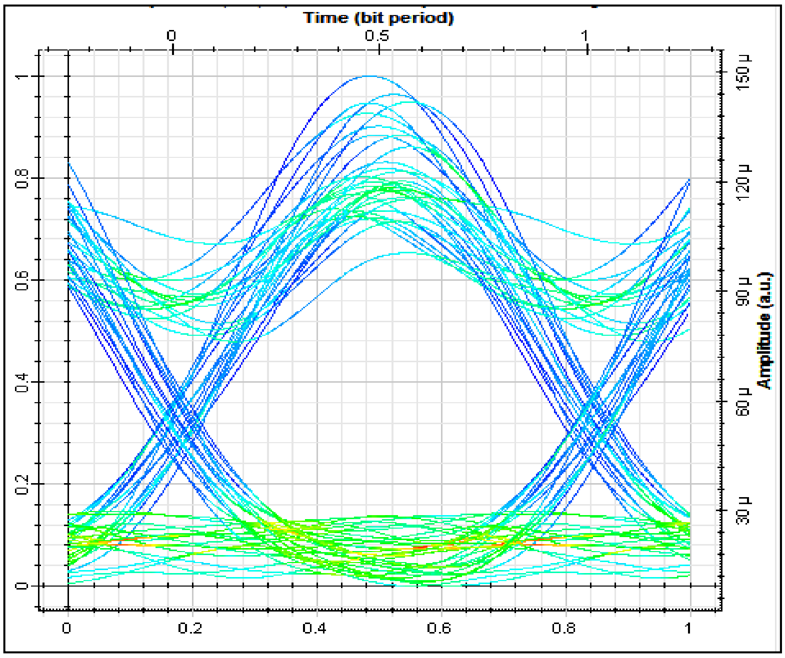

Figure 6. BER Analyzer for Output Channel 16 (190THz) when Span=120km

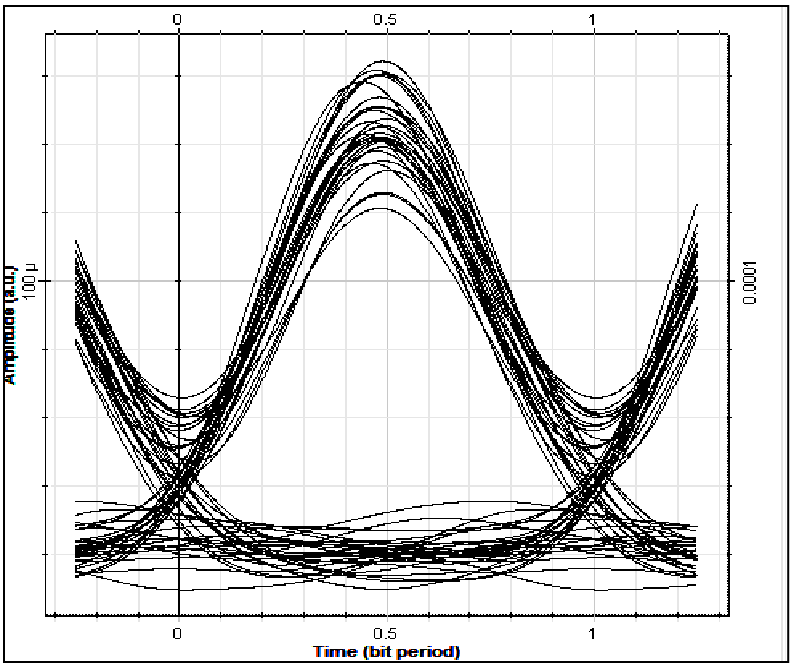

Figure 7. BER Analyzer for Output Channel 16 (193THz) when Span=120km

4. Conclusion

In 16x40Gbps DWDM system over 120 km optical link with less system impairments in the presence of passive and active components should be considered. Non-linearities overcome the optical signal to noise ratio (OSNR) and dispersion compensating by hybrid DCF as a compensator. The simulation results show that the data transmission rate successful transmitted and cost effective infrastructure and good performance of the

DWDM system. High speed low data rate and availability of multiple channels on a development of multi destination over a light wave DWDM system.

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