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COMPARATIVE PERFORMANCE ANALYSIS OF 96 CHANNEL WDM SYSTEMS FOR NRZ MODULATION FORMATS AT DIFFERENT DISTANCES

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Abstract: *In this paper, the modulation formats used to create the optical pulses, which are Return to zero (RZ) wavelength-division-multiplexing (WDM) signals in optical communication system. The return-to-zero (RZ) pulse is efficient for long-distance, high-bit-rate, wavelength division multiplexed (WDM) transmission dispersion-managed systems. In this Quality Factor, Jitter performance and BER is evaluated at different distances (50Km, 100Km, 150Km). The wavelength-division multiplexed systems operating at data rate 10 Gb/s.*

Keywords—*Wavelength Division Multiplexing (WDM), return-to-zero (RZ), Non return-to-zero (NRZ), duo binary, quality factor, Jitter performance.*

I. INTRODUCTION

In WDM, the wavelengths used are generally spaced about 4 to 10 ns (nanosecond) apart. If an optical spectrum of 1,540 -1,570 nm is available for use on an optical link, this means that transmitters, receivers, and other components will exhibit acceptable error and speed performance within this range .Even with early WDM systems, at least four channels could be used over this optical link with wavelengths 1,540 , 1,550, 1,560 and 1,570 in use at the same time.[1]
There are three choices for the modulation format of the resulting optical bit stream and are known as the return-to-zero (RZ) and nonreturn-to-zero (NRZ) & Duo binary formats:
(a) In the RZ format, each optical pulse representing bit 1 is shorter than the bit slot, and its amplitude returns to zero before the bit duration is over.
(b) In the NRZ format, the optical pulse remains on throughout the bit slot and its amplitude does not drop to zero between two or more successive 1 bits. As a result, pulse width varies depending on the bit pattern, whereas it remains the same in the case of RZ format. An advantage of the NRZ format is that the bandwidth associated with the bit stream is smaller than that of the RZ format by about a factor of 2 simply because on–off transitions occur fewer times. However, its use requires tighter control of the pulse width and may lead to bit-pattern-dependent effects if the optical pulse spreads during transmission. The NRZ format is often used in practice because of a smaller signal bandwidth associated with it.
(c)Duo binary modulation can be described as a combination of a conventional ASK- based modulation and phase shift keying (PSK). Depending on the realization, optical duo binary transmission can be understood as a multilevel transmission with phase encoded bits and a reduced spectral width. Duo binary transmission technology was introduced for the first time by A.Lender in the 1960s as a mean of transmitting binary data over an electrical cable with high – frequency cut-off characteristics. [2]

II. INTRODUCTION OF SIMULATION TOOL

Optsim (optical simulator) is the tool used for this research, this is an advanced optical communication system simulation tool designed by Rsoft Inc. Rsoft design this tool with different types of single channel or multiple channel based models with all possible real world parameter. The simulation setup used to investigate the four wave mixing effect that occurs in the fiber while transmitting a signal through the optical fiber in the system. In this, we compared the four wave mixing effect on WDM system in different modulation format at 10 Gbpsbit rate [4]

In this setup here the scheme for 96 channel system is presented and to make this setup used for more channels, blocks are added and each block have different laser wave length. Channels are equally spaced and Channel spacing between two channels is 0.8 nm to make this possible wavelength of laser changes from 1544.4 nm to 1556.4 nm.

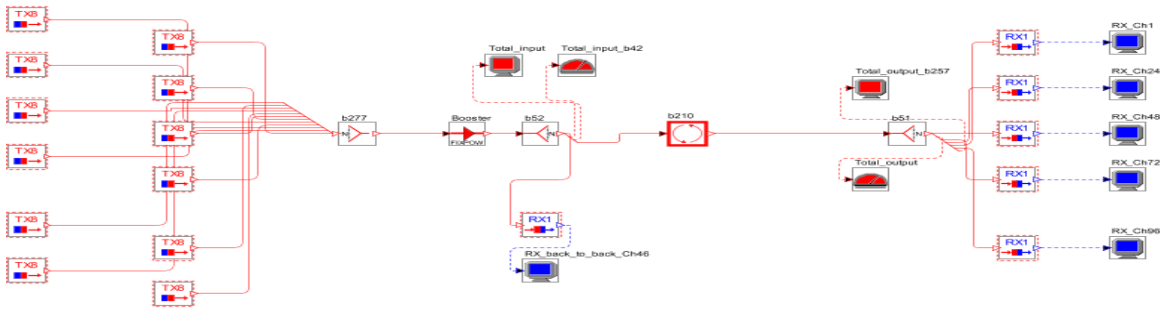

Fig 1. Experimental set up for 96 channel WDM system withRZ modulation format

III. RESULT &DISCUSSION

Different results have been obtained from the 96 channel system at length of 50 km, 100 km, 150 km at channel spacing of the 0.8 nm. The system is simulated using a tool called, optical simulator which have various component and defines their parameters and have their limits over these performance parameters and we obtained different results after simulation. All these parameters are discussed below:

Bit Error Rate:BER is one of the most important parameter for the performance of the system. The value of BER determine theis good or poor. In optical communication, the minimum acceptable value of BER is 10^{-10}. The BER and the Q-Factor of the system closely related to each other, BER improves

as Q of the system improves. From theabove all figures of eye diagram, we analyzed that the BER goes up to 10^{-40} to 0 as the distance increases. In 96 channel RZ modulation format the value of BER is 10^{-40} for 100km, while operating at 10 Gbps.

Q-factor: The other parameter used to determine the performance of the system is Q-factor. The Q-factor can change from value 6dB to 40dB in opsim software. As from the above result it is observed that the Q-factor is 23.366901dB at 100 km in RZ modulation format operating at 10Gbps. It means that the Q-factor is lowered as distance increases. So the performance of the optical signal is better with RZ modulation format.

Average Eye Opening: Eye diagram provides the information for monitoring the receiver performance means opening of eye is an indication of the fact that the receiver is performing properly. The noise and jitter lead to partial closing of the eye shows the degradation of the system performance. More the eye opening is, the better performance of the optical communication system. It is observed that the eye opening increases with the value of BER and Q-factor's improved and eye closure increases from duo-binary to NRZ to RZ modulation format. In other words, the system performance are better with RZ modulation system among all three format.

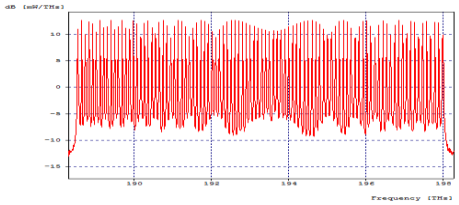

Fig. 2 Optical Spectrum of 96 channel RZ

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