Performance Analysis of 40 GB/s DWDM School LAN Modulation Mode

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Abstract. With the development of optical fiber communication in the direction of large capacity and ultra-high speed, the needs of teachers and students in schools are increasingly requiring high-speed network support, therefore, DWDM with 40 GB/s is developing towards campus LAN. 40 GB/s DWDM technologies were used for the performance analysis of the school LAN modulation.

Keywords: Campus LAN · 40 GB/s dense wavelength division multiplexing · Modulation style

1 Introduction

Since 1995, with the increasing number of information transmission, large-capacity, high-speed, and other transmission problems have plagued people. In order to solve this problem, DWDM (Dense Wavelength Division Multiplexing) has become a focal research object by scientists from various countries [1]. DWDM communication technology greatly increases the transmission capacity of the optical fiber, and the bandwidth to the maximum extent, effectively solving the biggest problem of the communication network.

In today's schools, teachers and students are equally increasingly demanding information. They are necessary to large-capacity information transmission fibers, and high-rate information transmission rate fibers. DWDM technology that people gradually adopt can also enter inside the campus [2].

2 Application Analysis of School LAN and Its 40 GB/s System

With the advent of the era of optical transmission information represented by DWDM dense wavelength division multiplexing technology, DWDM can use it in the School-LAN. With the continuous development and improvement of DWDM technology. Compared with the backbone network in the city center, the special application environment of the campus LAN has new requirements for DWDM technology [3]. The first is the cost, cannot be too high to ask for the cost of the campus. The DWDM

J. Jin et al. (Eds.): GreeNets 2019, LNICST 282, pp. 143–149, 2019.
https://doi.org/10.1007/978-3-030-21730-3_16

on campus should have a lower cost. Secondly, information transmission in the campus has complex and varied characteristics, and it also requires the flexibility and randomness of the campus LAN DWDM. School LAN DWDM can be applied to many levels, including the core layer, aggregation layer and access, layer. According to the different network topology of DWDM, it can be divided into several basic application types. System blocks diagram show in Fig. 1.

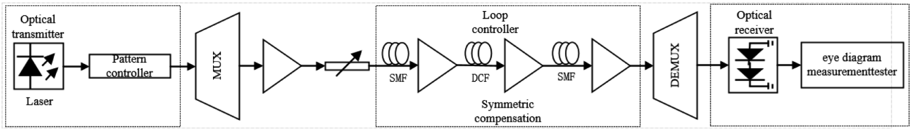

Fig. 1. System block diagram

In order to study the transmission performance of DWDM school LAN, this paper builds a simulation system. The transmitting end is constructed by a CW laser, a code pattern modulator and an optical multiplexer. The entire system is symmetrically compensated style and consists of SSMF (single mode fiber), EDFA (doped fiber amplifier), DCF (dispersion compensation fiber), EDFA, SSMF, EDFA. Because this way is better in the compensation method. The transmission part is by each distance is the same, and the number of spans is supervised by the loop controller [4]. The optical receiver is composed of a demultiplexer, a photoelectric detector, a low pass filter and an observer.

The WDM signal transmitter is sent from a continuous laser array and also requires data modulation and optical multiplexers. A continuous laser array with 32 output ports, each transmit port with the same transmit frequency spacing. The transmitted signal spacing frequency is the same, and the transmitted frequency range is between 193.1 and 194.7 Hz. And the adjacent channel frequency interval is 50 Hz.

3 40 GB/s Campus LAN DWDM Transmission Technology Research

CSRZ is carrier-suppression and is generated by modulation of two MZ modulators and one phase modulator. In the CSRZ transmitter, the electrical signal first generates an NRZ optical signal through the MZ modulator, and the generated optical signal passes through a sine wave generator having a frequency of 40 Hz and a phase of −90°, and through the phase modulator generates an RZ optical signal. The spectrum is changed by a phase modulator with a phase difference of 180. DRZ is a dual binary line code that can improve the dispersion tolerance. Since the bandwidth is narrower than the normal channel, the DWDM channel spacing can be lowered.

He performs preceding, pulse amplitude modulation, pattern transformation, sampling, etc. from an ordinary binary signal, and finally becomes a double binary pulse signal. MDRZ is to further suppress the inter-symbol interference between signals, called carrier-suppression duodenal return-to-zero code. First, a delay subtraction circuit is generated to drive the first MZM, and then cascaded with an MZM having a frequency of 40 Hz and a phase of −90. In a binary signal, the phase of the signal changes only when the "1" bit after the "0" bit occurs, and in the modified binary signal the phase of the "1" bit alternates between 0 and π, all The phase of the "0" bit is kept constant, and the "1" bit is added with a phase change of 180°, which makes the MDRZ have greater dispersion tolerance. I mainly use the OptiSystem simulation software, which can conveniently change the parameters of the components of the system, thus providing a good reference for the campus LAN construction [5]. For a 40 GB/s system, the specific modulation method and simulation diagram are as follows (Figs. 2, 3, 4, 5, 6 and 7):

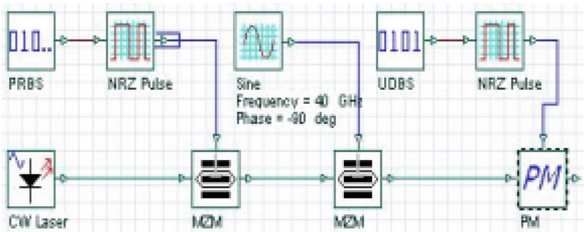

Fig. 2. CSRZ carrier suppression transmitter structure diagram

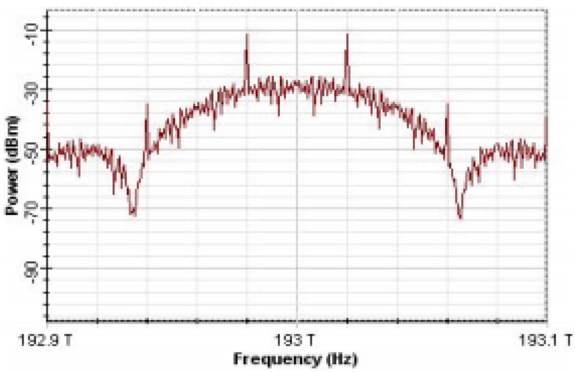

Fig. 3. CSRZ simulation diagram

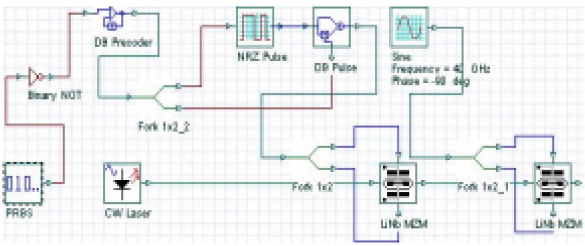

Fig. 4. DRZ dual binary transmitter structure diagrams

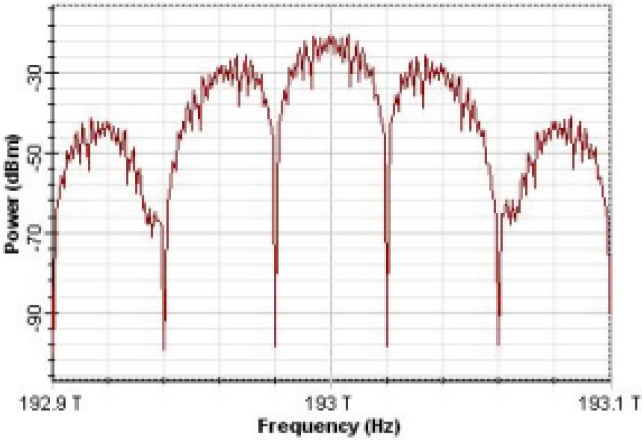

Fig. 5. DRZ simulation diagram

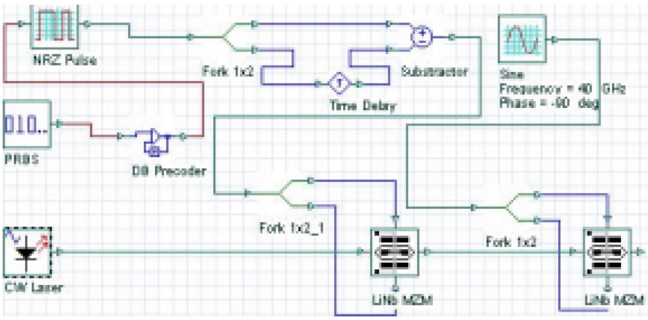

Fig. 6. MDRZ improved dual binary transmitter structure diagram

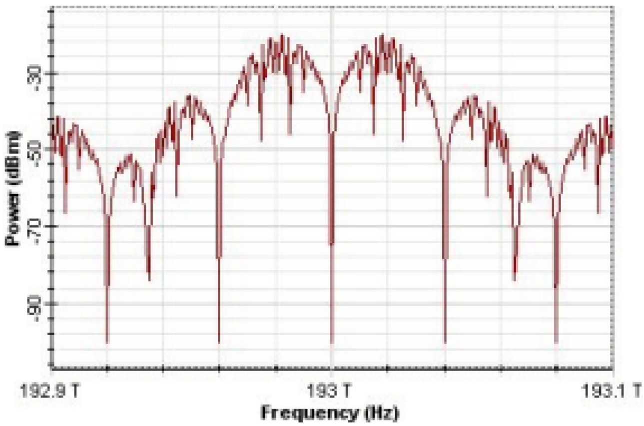

Fig. 7. MDRZ simulation diagram

3.1 Research on Transmission Performance of High-Speed DWDM 40 GB/s System

Since the dispersion causes an increase in the bit error rate and becomes a major limiting factor for high-speed transmission, the management of dispersion is important for high-speed transmission of 40 GB/s. In the 40 GB/s transmission system, the pure link is very critical, and the transmission distance is generally in the range of 50 km to 150 km [6]. First, the SMF fiber length in the simulation system should be set to 50 km, and the sensitivity of the receiving terminal PIN photodiode is 1 A/W, dark current is 0.1 nA, filtered by Bessel, the cutoff frequency is 50 GHz, and the depth is 100 dB. In this paper, the performance of the simulation system is measured by the Q factor, mainly in three different modulation modes [7]. When the simulated fiber input power is −4 dBm, 0 dBm, 2 dBm, 8 dBm, the following is a simulation diagram of the transmission performance of CSRZ, DRZ and MDRZ three modulation modes in 32-channel 40 Gbit/s system (Figs. 8, 9, 10 and 11):

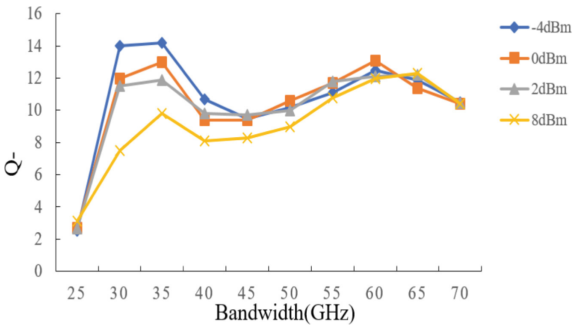

Fig. 8. MDRZ improved dual binary modulation (receive bandwidth is 25 GHZ–70 GHZ)

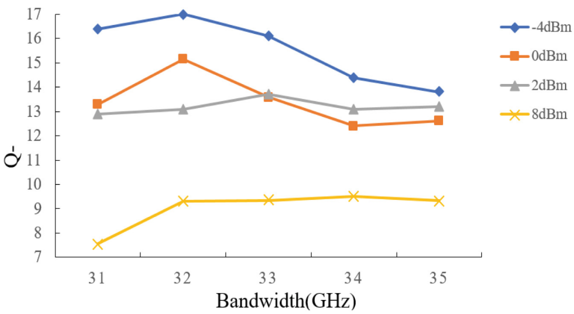

Fig. 9. MDRZ improved dual binary modulation (receiver bandwidth is 31 GHZ–35 GHZ)

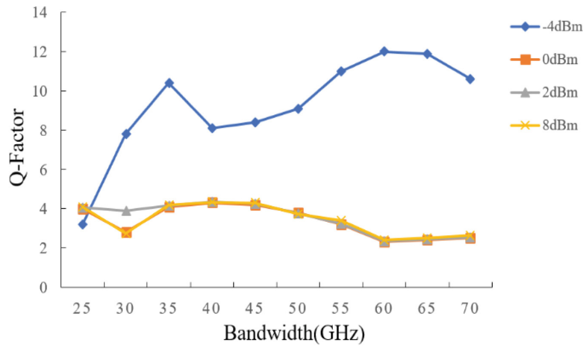

Fig. 10. DRZ dual binary modulation (receive bandwidth is 25 GHZ–70 GHZ)

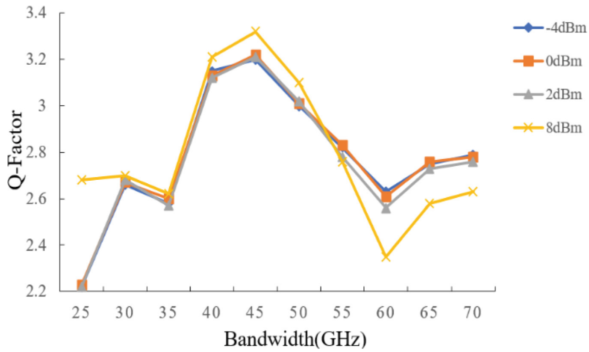

Fig. 11. CSRZ carrier suppression modulation (accepting bandwidth is 25 GHZ–70 GHZ)

As can be seen from the above figure, this is any of the three modulation methods. For the case of constant signal power, there is just an optimum value for the Q value. Whether the accepted bandwidth is greater or less than this value, the Q value of the entire system will be worse. This is explained by the fact that the bandwidth of the receiver affects the waveform of the input signal after passing through the filter [8]. Therefore, the wider the receiver bandwidth and the smaller the distortion effect of the waveform, the clearer the information of the original signal will be transmitted. However, if this optimal value is exceeded, the receiving bandwidth will be larger, and the noise entering the receiver will be larger, which will reduce the ability to transmit the original signal information. Therefore, in order to reduce the noise, it is necessary to find the optimal value of the receiving bandwidth, which is called the optimal optical receiving bandwidth [9].

It can be seen from the figure that the optimal Q value of the MDRZ modulation mode is between 30–35 GHz, and the Q value decreases with the increase of the channel power, which is greater than 6, but for the Q value of the bandwidth of 32 GHz, They are relatively high and relatively stable. For the DRZ modulated signal, the reception effect is best only when the input power of each channel is −4 dBm/ch, and when it is greater than −4 dBm/ch, the Q value is substantially unchanged, and less than 5 are basically impossible to use [10]. Therefore, it can be seen that in a system with high density and high rate, this modulation method cannot be used. For the CSRZ modulation method, regardless of the incident power, the Q value is always low, and below 3.5, it cannot to use.

4 Summary

In this paper, a DWDM model with a single channel transmission rate of 40 Gb/s is established. The transmission performance of three different modulation modes, MDRZ, DRZ and CSRZ, under in 32 channel conditions is compared and analyzed. Through the simulation platform, we can roughly see that the most suitable modulation method for high-speed DWDM campus LAN is MDRZ type, which has the best Q value.

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