ADVANCE TECHNIQUES OF WDM OPTICAL FIBER COMMUNICATION NETWORKS

[1]Naveen Kumar, [2]Ajay Kumar Yadav

[1] M. Tech., EC Department, Mewar University Chittorgarh, Rajasthan, INDIA

ABSTRACT

Optical fiber is used by many telecommunications companies to transmit telephone signals, Internet communication, and cable television signals. Due to much lower attenuation and interference, optical fiber has large advantages over existing copper wire in long-distance and high-demand applications. However, infrastructure development within cities was relatively difficult and time-consuming, and fiber-optic systems were complex and expensive to install and operate. Due to these difficulties, fiber-optic communication systems have primarily been installed in long-distance applications, where they can be used to their full transmission capacity, offsetting the increased cost. Since 2000, the prices for fiber-optic communications have dropped considerably. A technique for detecting a fiber fault in a WDM optical access network includes launching a test signal into a fiber trunk line linking a central office (“CO”) to a remote node (“RN”) of the WDM optical access network. The test signal is generated by an optical time domain reflectometry unit to simultaneously fault test fiber access lines linking the RN to customer premises The most common type of channel used in communication system is Optical Fiber. This has been proved that optical fiber has the widest bandwidth in comparison to any other media such as wireless, copper wire, sonar, and even free-space-optics. Now days, optical fibers are not only used in telecommunication links but also used to achieve high signaling rates in the internet and long haul networks.

1. INTRODUCTION

In fiber-optic communications, wavelength-division multiplexing (WDM) is a technology which multiplexes a number of optical carrier signals onto a single optical fiber by using different wavelengths (i.e., colors) of laser light. The term *wavelength-division multiplexing* is commonly applied to an optical carrier, which is typically described by its wavelength, whereas FDM typically applies to a radio carrier which is more often described by frequency. This is purely convention because wavelength and frequency communicate the same information.

A WDM system uses a multiplexer at the transmitter to join the several signals together, and a demultiplexer at the receiver to split them apart. With the right type of fiber it is possible to have a device that does both simultaneously, and can function as an optical add-drop multiplexer. The optical filtering devices used have conventionally been etalons (stable solid-state single-frequency Fabry–Pérot interferometers in the form of thin-film-coated optical glass). As there are three different WDM types, whereof one is called "WDM", the notation "xWDM" is normally used when discussing the technology as such.The concept was first published in 1978, and by 1980 WDM systems were being realized in the laboratory. The first WDM systems combined only two signals. Modern systems can handle 160 signals and can thus expand a basic 100 Gbit/s system over a single fiber pair to over 16 Tbit/s. WDM systems are popular with telecommunications companies because they allow them to expand the capacity of the network without laying more fiber. By using WDM and optical amplifiers, they can accommodate several generations of technology development in their optical infrastructure without having to overhaul the backbone network. Capacity of a given link can be expanded simply by upgrading the multiplexers and demultiplexers at each end.This is often done by use of optical-to-electrical-to-optical (O/E/O) translation at the very edge of the transport network, thus permitting interoperation with existing equipment with optical interfaces.

Most WDM systems operate on single-mode fiber optical cables, which have a core diameter of 9 µm.

Certain forms of WDM can also be used in multi-mode fiber cables (also known as premises cables) which have core diameters of 50 or 62.5 µm.Early WDM systems were expensive and complicated to run. However, recent standardization and better understanding of the dynamics of WDM systems have made WDM less expensive to deploy.Optical receivers, in contrast to laser sources, tend to be wideband devices. Therefore, the demultiplexer must provide the wavelength selectivity of the receiver in the WDM system.

WDM systems are divided into three different wavelength patterns, **normal** (WDM), **coarse** (CWDM) and **dense** (DWDM). Normal WDM (sometimes called BWDM) uses the two normal wavelengths 1310 and 1550 on one fiber. Coarse WDM provides up to 16 channels across multiple transmission windows of silica fibers. *Dense wavelength division multiplexing* (DWDM) uses the C-Band (1530 nm-1565 nm) transmission window but with denser channel spacing. Channel plans vary, but a typical DWDM system would use 40 channels at 100 GHz spacing or 80 channels with 50 GHz spacing. Some technologies are capable of 12.5 GHz spacing (sometimes called ultra dense WDM). New amplification options (Raman amplification) enable the extension of the usable wavelengths to the L-band (1565 nm-1625 nm), more or less doubling these numbers.

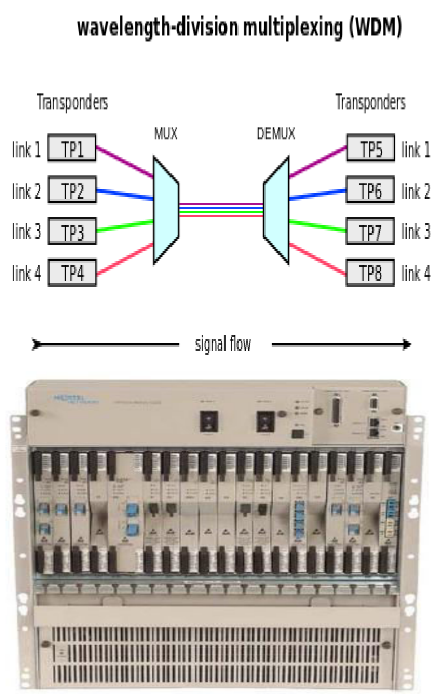

Fig. 1 Wavelength division multiplexing

2. WAVELENGTH DIVISION MULTIPLEXING

Fiber optic technology can be considered our saviour for meeting our above-mentioned need because of its potentially limitless capabilities; huge bandwidth, low signal attenuation, low signal distortion, low power requirement, low material usage, small space requirement, and low cost. Also modulation and multiplexing techniques are key design elements of sensitivity-constrained and capacity-constrained systems, used to harvest the bandwidth advantages that optical technologies fundamentally offer. Spectrally efficient modulation will stay a key area of research for capacity-constrained systems

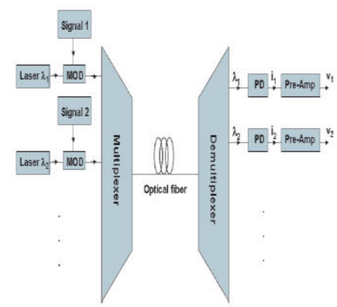

Fig. 2: Schematic diagram of a point-to-point WDM link

3. SIMULATION AND TESTING

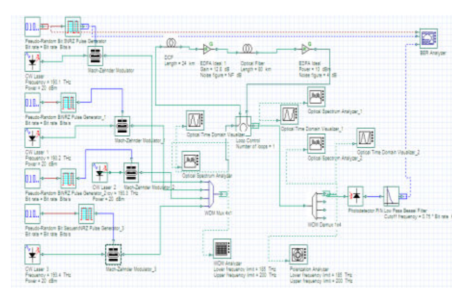

Fig. 3: Dispersion compensation using Pre DCF

The dispersion compensation in Pre DCF compensation scheme is achieve by place the DCF before a certain conventional single-mode fiber, or after the optical transmitter. The length of DCF is 24 km. In the transmission medium signal not only dispersed but also there are more transmission losses. So for minimizing these losses on optical hand we are using EDFA amplifier and on electrical hand we are using low pass Bessel filter. It may be mentioned that a few hundred metres to a kilometre of DCF can be used to compensate for dispersion over tens of kilometres of the fiber length .

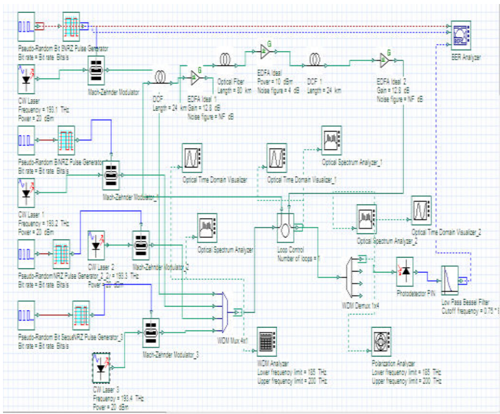

Fig. 4: Dispersion compensation using Symmetrical DCF

The circuit for simulation is shown in figure In our simulation, we have used EDFA optical amplifiers before and after of optical fiber to compensate the span loss. The main advantage of this technology is the fact that it provides a broadband operation with a smooth dispersion property and good optical characteristics. Very long lengths of dispersion compensating fibers are required to compensate for the dispersion of even modest lengths of transmission. So, it is proposed by using the symmetrical optimization for the optical fibers using Pre & Post compensation both .

4. RESULT AND DISCUSSION

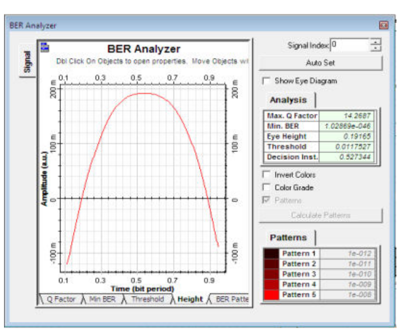

Fig 5: Graph Showing Signal height using Erbium Doped Fiber Amplifiers for dispersion compensation

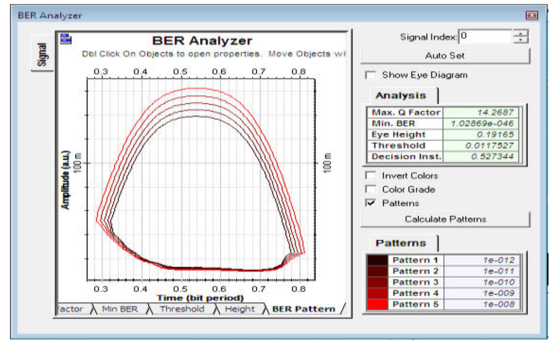

Figure.6: Graph Showing bit error rate using Erbium Doped Fiber Amplifiers for dispersion

5. CONCLUSION

In all the techniques we find that losses are reduced including dispersion but all performance parameters are changed with one technique to another technique. In each technique where eye opening is high and we get sharp eye diagram with a better value of noise and signal power. The eye-opening is larger when less attenuation occurs.Q-factor depends on the filter used. Higher value of BER, Q-factor and eye opening after using different compensation technique through fiber show the good communication through it. Q-factor is more with NRZ modulation format and different combinations of length and filters than RZ modulation format. So NRZ modulation format is better in WDM Technique.

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