Performance Analysis of Four Wave Mixing Technique & Optical Add Drop Multiplexer(OADM) in Optical Fibre Communication System

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Abstract

Optical fiber communication is the best for transmitting data at a high rate. While the fiber channel may be capable of transmitting terabit-per-second data rates, no existing single communication system can make complete use of this speed. Optical fibers in discussion that guide signals in the form of light are typically made of from two glasses. It is a cylindrical in shape waveguide consisting of a higher refractive index solid glass core which runs down middle of the fiber. The other solid glass with a lower refractive index surrounds the core and makes the homogeneous cladding. The two glasses are made of from the common material silica. Photonic crystal fibers can be divided into two modes of operation, according to their mechanism for confinement. Alternatively, one can create a photonic band gap fiber, in which the light is confined by a photonic band gap created by the micro structured cladding â??" such a band gap, properly designed, can confine light in a lower-index. Here, four wave mixing technique provides operational flexibility.

Index terms— OADM, WDM, FWM, DWDM, crosstalk, power penalty, dispersion etc.

Introduction n optical communications system the transmitter is a light source whose output acts as the carrier wave. An optical fiber transmission consists of three main parts: the transmitter block where the electrical signals will be transferred into optical fibers. The transmitter block consists of three major parts: the modulator, the carrier source, the channel coupler. First a transducer converts a non-electrical message into an electrical signal. This signal is called the message origin. Then the modulator converts it into proper message format. For long length transmission, laser diodes are used because of the narrow spectral width and high optical power that is used as carrier source to carry data over long distance. The light is then coupled into the transmission channel via the channel coupler to the optical fiber cable, where most of the dispersion and attenuation takes place. The receiver block which is the last part of the system which converts the optical signal back into the replica of the electrical signal using PIN-type photodiode then to the amplification stage before reaching the end. Narinder Kapany, the man who first coined the term "fiber optics" in 1956, developed the first fiberscope. This imagetransmitting device used the first all-glass fiber. The early all-glass fibers experienced large amount of optical losses thus limiting the transmission distance. This was because the transparent transmitting rod was surrounded by air and as a consequence, excessive losses occurred at any discontinuities of the glass-air interface. This realization motivated scientists to develop glass fibers that included a separate glass coating. The fiber was made of two layers. The innermost region of the fiber referred to as the core, was used to transmit the light while the glass coating or the cladding prevented the light from leaking out of the core by reflecting it within its boundaries.

1 II.

2 Multiplexing

Multiplexing is an essential technique for fibre optic communication. It is a method by which multiple analogue message signals or digital data streams are combined into one signal over a shared medium. The aim is to share an expensive resource. The multiplexed signal is transmitted over a communication channel, which may be a physical transmission medium. The multiplexing divides the capacity of the high-level communication channel into several low-level logical channels, one for each message signal or data stream to be transferred. Multiplexing technologies may be divided into several types. Such as space-division multiplexing (SDM), frequency-division multiplexing I Keywords :

(FDM), time-division multiplexing (TDM), and code division multiplexing (CDM), Board WDM, Coarse WDM, Dense WDM, etc. CWDM, DWDM, OADM are mostly used in telecommunication & computer networks. Wavelength Division Multiplexing is the technology enabling cost efficient upgrade of capacity in optical networks. This explains the fundamental principles for optical networks.

3 III.

4 FOUR-WAVE MIXING

Four-wave mixing is an inter modulation phenomenon in non-linear optics, whereby interactions between two wavelengths produce two extra wavelengths in the signal. It is similar to the third-order intercept point in electrical systems. When optical communication systems are operated at moderate power it is important to consider the effect of nonlinearities. In case of WDM systems, nonlinear effects can become important even at moderate powers and bit rates. One type of nonlinear effects are caused by the dependence of refractive index on the intensity of the optical power. This is called four-wave mixing.Effectively, the FWM powers introduced before and after this point are summed instead of the electric fields being added in phase, resulting in a smaller FWM penalty.

5 IV. Optical ADD-DROP Multiplexer

OADM is a device used in wavelength-division multiplexing systems for multiplexing and routing different channels of light into or out of a single mode fiber. This is a type of optical node, which is generally used for the construction of optical telecommunications networks. An OADM may be considered to be a specific type of optical cross-connect. A traditional OADM consists of three stages: an optical demultiplexer, an optical multiplexer, and between them a method of reconfiguring the paths between the optical demultiplexer, the optical multiplexer and a set of ports for adding and dropping signals. The optical demultiplexer separates wavelengths in an input fiber onto ports.The optical multiplexer multiplexes the wavelength channels that are to continue on from demultipexer ports with those from the add ports, onto a single output fiber. All the light paths that directly pass an OADM are termed cut-through light paths, while those that are added or dropped at the OADM node are termed added/dropped light paths. Using a pair of MUX/DMUX'es at the intermediate node enables manual selection of the wavelengths to add and drop, using patch-cords for configuration. Gradual and flexible upgrade is then possible, adding capacity between the bandwidth is observed. When dimensioning an optical network using add/drop multiplexing, insertion loss of the MUX/DMUX units becomes a critical parameter for the link budget since several devices are coupled in series.

6 V. SYSTEM CROSSTALK & POWER PENALTY

Crosstalk occurs in multi channel optical transmission systems. Crosstalk can be caused by the following: the spectral skirts of one channel entering the de-multiplexing and filtering pass-band of another cause crosstalk, practical limits on selectivity and isolation cause crosstalk. Non-linear effects within the fiber at the high power densities possible in single mode systems can cause crosstalk or cross modulation, the mechanism is Raman scattering, which is a non-linear stimulated scattering effect that allows the optical power at one wavelength to affect scattering and thus the optical power in another wavelength. In optical communication the receiver sensitivity is defined with respect to the receiver noise for several basic detection scenarios. The power penalty is equal to the increase in signal power that is needed to keep the Q-factor and BER at the same level that would exist if no impairments were present. The impact of different impairments can cause different power penalties such as Power Penalty due to Extinction Ratio, Power Penalty due to Intensity Noise, etc. 2

7 ADVANTAGES OF OPTICAL ADD DROP MULTIPLEXER

The main advantages of OADM -Its multiplexing happens to coincide with the minimum loss area of single-mode fiber. This reduces the transmission loss of the light signal which can be transmitted relatively far distance.

It is transparent to digital signal format and data rate.

It is so wide that dozens or even hundreds of channels can be transmitted in the same fiber.

It has low noise figure close to the quantum limit.

Its gain saturation recovery time is long, and has a very small crosstalk between the respective channels.

Narrow channel spacing or wavelength selection, giving rise to denser channels in the same wavelength range.

With selective wavelength spacing, four-wave mixing is possible.

Multiple channels of information carried over the same fiber, each using an individual wavelength.

Repeater or amplification sites are reduced, resulting in a large savings of funding.

8 IX. Advantages of Four Wave Mixing

The main advantages of Four Wave Mixing -High optical fiber transmission capacity.

Improve the utilization of the resources of optical fiber.

High Mechanical sensitivity.

Very good flexibility.

Easily used in metro network.

Excellent performance. Here, investigations are made according to the specific wavelength range. From the numerical simulation results, better power level, low losses, better eye diagram, Q factor in the telecommunication operation. Moreover, Optical communications by OADM enabling high-speed, high capacity optical communication system for the Internet age. In addition, to the stability required for sources passive modules such as mux/demux and add/drop modules used in systems OADM also need to have very narrow filtering or wavelength separating characteristics that stay stable over a considerable temperature range. Moreover, to maintain proper operation with less losses and to confirm operational flexibility four wave mixing is used. In addition, we can choose the parameters in four wave mixing to achieve the desirable dispersion compensation over different communication band.

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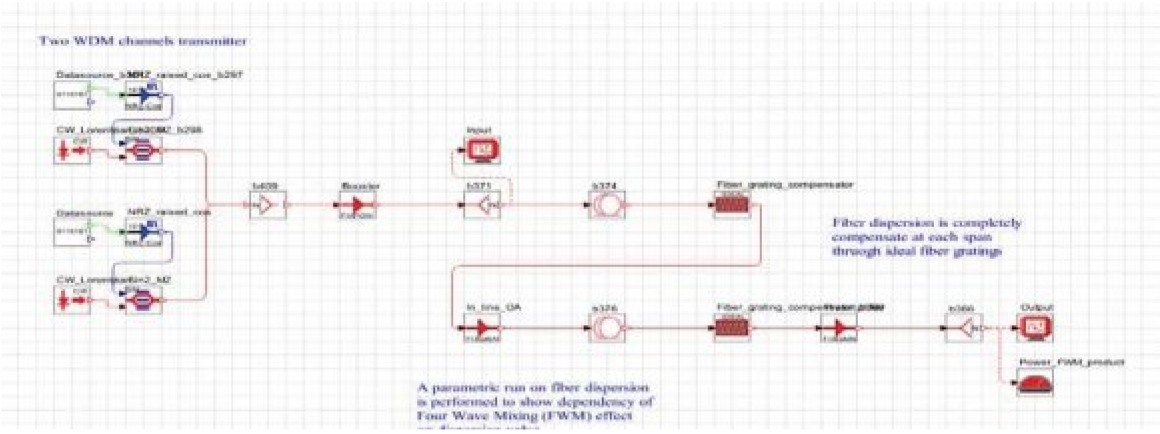
1 

Figure 2: Figure 1 :

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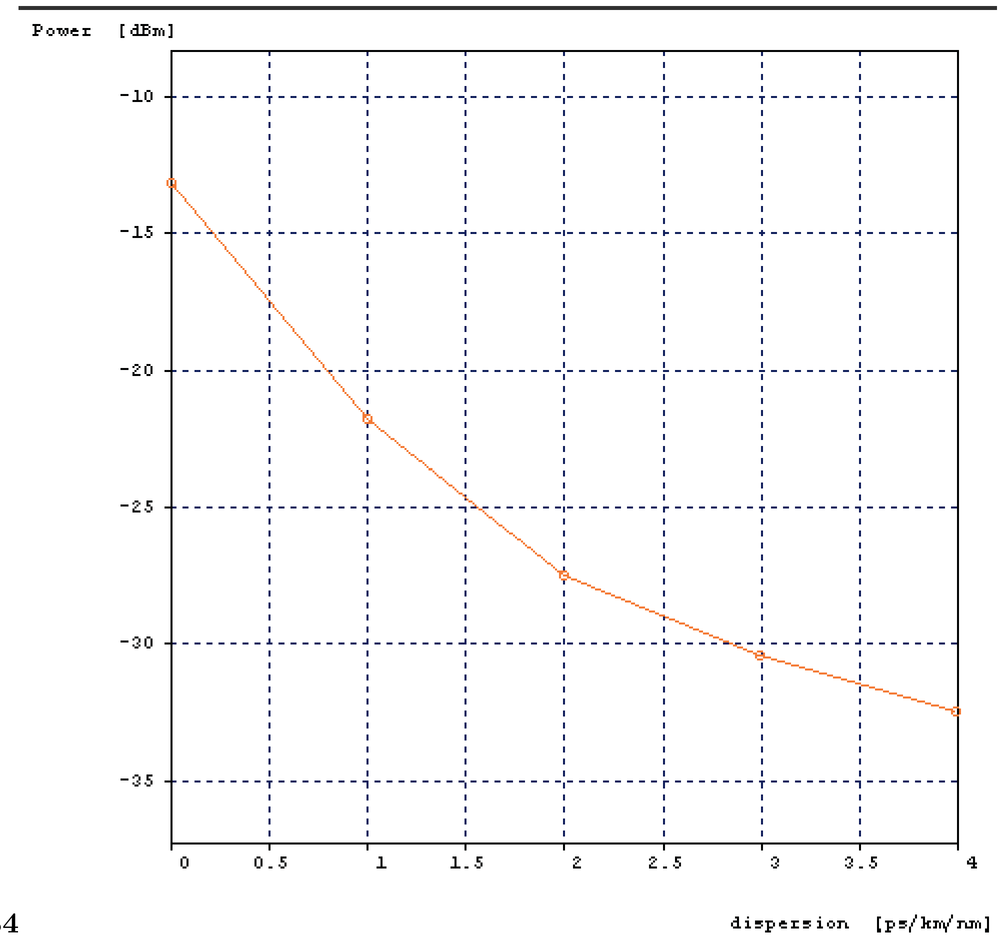
Figure 3: Figure 2 :



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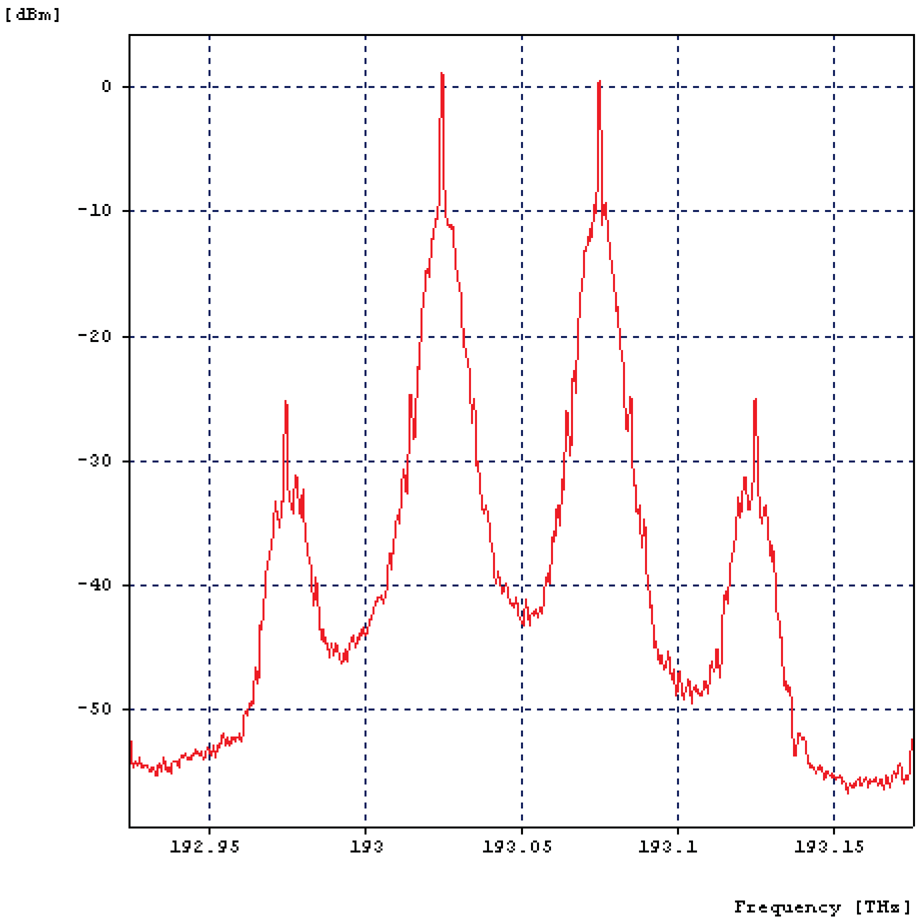

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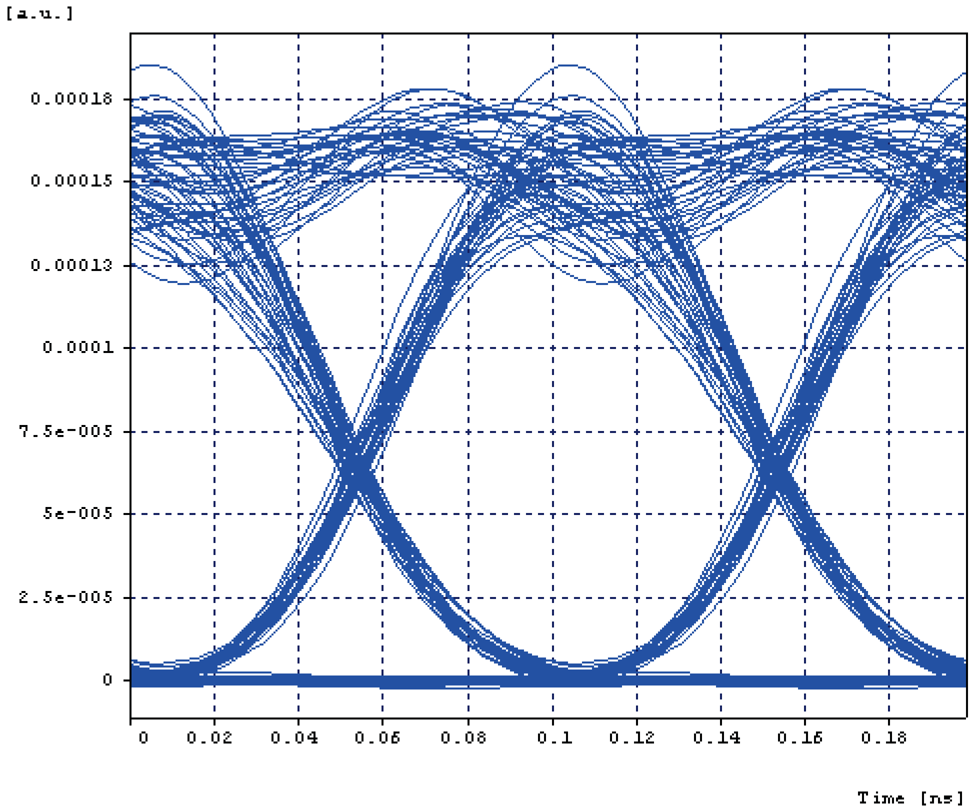

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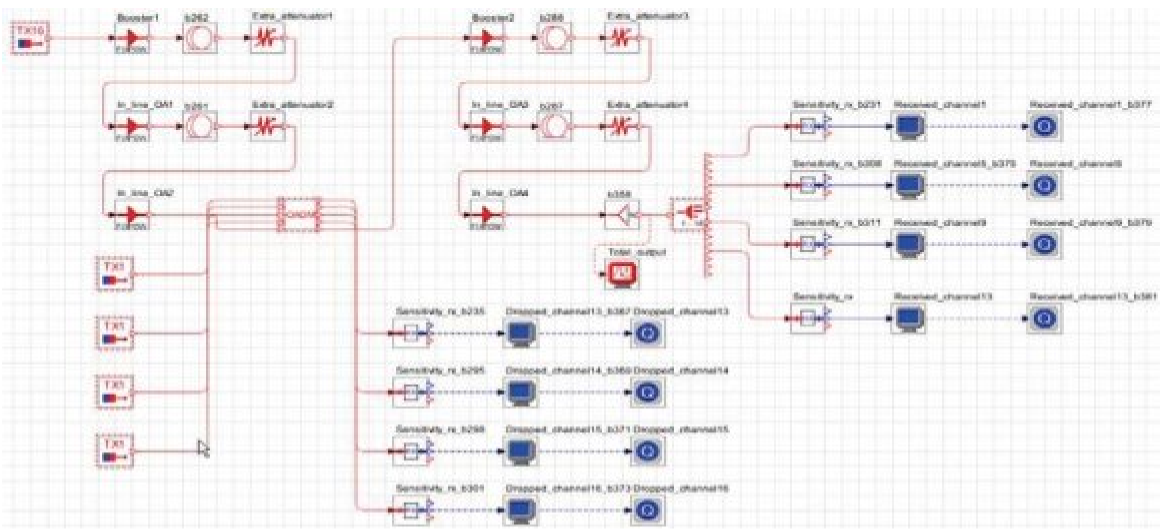

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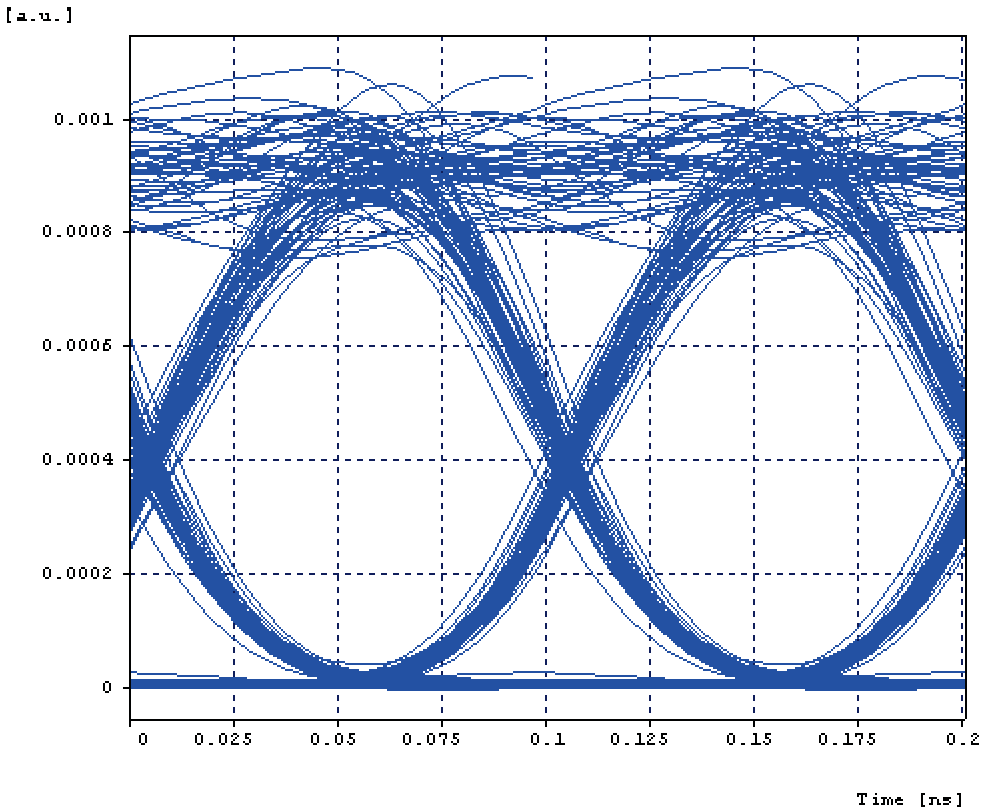

Figure 8:

[1]Performance Analysis of Four Wave Mixing Technique & Optical Add Drop Multiplexer(OADM) in Optical Fibre Communication System nodes according to where an increased need for more

[2]© 2013 Global Journals Inc. (US)

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[Photonic Crystal Fiber as Low Loss Dispersion Flattened Fiber and Ultra-Low Confinement Loss by Rajni Idiwal1,Rekha Mehra *Photonic Crystal Fiber as Low Loss Dispersion Flattened Fiber and Ultra-Low Confinement Loss by Rajni Idiwal1,Rekha Mehra2*, (Manish Tiwari)

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