A review to optical fiber and WDM network

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Abstract-In today's generation, high speed internet has become a prime priority. Thus it is necessary to have such system in place that matches this requirement. Optical fiber is a way in which high speed internet can be provided. This paper gives a brief description about its working and various details. We also have mentioned few routing and wavelength assignment methods.

Keywords—Optical fiber, WDM network, routing, wavelength assignment.

I. INTRODUCTION

Nowadays internet has turn out to be a part and parcel of life. Data availability has become a must. This requires a high speed internet connection. Initially we were using copper wire for transmission, which has lower bandwidth. Since it has a lot of disadvantages we shifted to optical fibers. As we all know optical fiber provides better transmission rate and is durable, hence it is preferred over any other transmission mode. In optical fiber. method of broadcast is into approximately at 1,000 Megabits (one Gigabit) per second. Wavelength division multiplexing (WDM) technology works best with optical fibers [1].

II. OPTICAL FIBER

A. Optical fiber

Optical fiber is a thin discoidal fiber of glass or any transparent dielectric medium [5]. The light is guided down the base of the fiber called core. Core is enclosed by apparelled that uses the mechanism of sharpening the light within the core using optical techniques, this phenomenon is called 'Total Internal Reflection'. The cladding and core is fabricated of ultra-pure glass. Buffer coating is the protective layer of the fiber.

B. Materials used in optical fiber

There are two main types of materials used for optical fibers. They are plastic optical fiber and glass optical fibers.

- Plastic is easier to handle as the diameter of the plastic fiber is 750-2000 microns whereas for glass fibers it is 10-600 microns [7].
- Plastic fibers is cheaper than glass fibers [7].
- Plastic fibers operates in the visible range of spectrum [7].
- Plastic fibers show high loss thus are mostly used for short distance transmission.
- In Glass, silica glass of high purity must be used for minimal loss during the light transmission as impurities are the reason for loss but pure silica is not possible [6].
- Thus, synthesized fused silica is used which reduces impurities to a part per billion.
- Thus, silica fibers are most preferred with low attenuation as compared to plastic fibers but then too plastic fibers are used for short distance light transmission [7].

III. CLASSIFICATION OF OPTICAL FIBER

There are two categories of optical fibres:-

- Single mode optical fibers
- Multi-mode optical fibers

A. Single-mode optical fiber

Single mode optical fiber have compact diametrical base that permits only one mode of light to transmit. The number of light reflection intensifies as the light passes through the core and thus allowing the signal to travel further and lowering the attenuation. Single mode optical fiber is thus used for higher bandwidth and longer distance [3].

B. Multi-mode optical fiber

It has large diametrical core that permits multiple mode of light to transmit, which allows more data to be passed through within the limited time by reducing the quality of the lane over long distances. Hence, it's used for shorter range.[3].

Multi-mode optical fibers are of two types

i. Step-Index multi-mode fiber
ii.Graded-Index multi-mode fiber

i. Step-Index multi-mode fiber

The refractive index is core and cladding in step-index multi-mode fiber is constant. zigzag manner or direct route re selected by light rays to travel. Due to various paths,various groups of light arrive at different timings in receiving point. The pulse is spaced limiting the amount of information to be sent to prevent overlapping. Thus step-index multi-mode fiber is used for short distance transmissions [4].

ii. Graded-Index multi-mode fiber

The refractive index of the fiber core depletes gradually from the core to the core cladding interface and the cladding as the uniform refractive index. In these type of fiber light in the core curves helically and not in zigzag manner which in turn lessens the travel distance. The percipitated path and the elevated pace permits light at the circumference to attain at a receiver at about the same time as the lagged but straight rays in the core axis. The graded-index multi-mode fiber is used in local area networks [4].

IV. WAVELENGTH DIVISION MULTIPLEXING

A technique or a technology used for modulating numerous data streams is called WDM Wavelength division multiplexing (WDM).It also has the mechanism for bi-directional communication and also the signal capacity can be multiplied.It enables combination of signal through multiplexer and splitting the signals through demultiplexer. There are many WDM systems which are shown below: -

- CDWM – This operates in 8 channels called "C-Band" or "erbium window". Its wavelength is about 1550 nm.
- DWDM – This operates in 80 channels at 50Ghz spacing or 40 channels at 100 GHz spacing in C-Band.

These capacities can be doubled by newer technology by using light in L-Band [8].The foremost step in WDM is choosing the type of fiber glass. Following step is to determine the amount of strands required. The media clergy are used in most of optical fibres. For example, HDMI (high-definition multimedia interface) is basically made up of four signals: TMDS Clock, TMDS 2, TMDS 1, and TMDS 0, where TDMS is nothing but a document management system regarding management of technical and engineering drawings or documents. HDMI 2.0 has a bandwidth which has been divided into several lanes. TDMS 0-2, each of them are of 6Gbps, and TDMS clock which is of a low bandwidth lane is combined with IR, RS232, along with several other signals. Infrared (IR) is a wireless mobile technology that are used for short ranges mainly for device communication. When the cabling/connecting of fiber optic strands is reduced to two, then multiplexing those two lanes together for every strand is important. The two signals have to be sent at independent distinct frequencies as independent beams on the particular cable by multiplexer. A filter network drag out each signal back out at the receiver. In the similar manner, if the cabling of fiber strands is reduced to one, then four signals mu multiplexed together and should be filtered back out a receiver. The amount or quantity of the strands ca eventually decided by the putting in the requirements w includes the extent of the cables installed, etc., which in helps in determining the type of cable required.

V. ROUNTING AND WAVELENGTH ASSIGNMEN

For any information transfer, there is a need for a physical connection. The selection and assigning the shortest route in-between the source and destination is called routing. In WDM network, allocating a wavelength for the selected route is necessary. The RWA problem has two approaches:

1) Static Light path Establishment (SLE)
2) Dynamic Light path Establishment (DLE).

1) Static Ligth path Establishment

In this approach the number of wavelength assignment is reduce by launching as many possible request connections over the physical topology. The goal is to exploit the number of light path for the specified request connection set or decrease the number of wavelength used. Here the routing and wavelength assignment is done offline as the light path request is known prior [1] [2].

2) Dynamic Ligth path Establishment

The connection requests, which arrive randomly, are served randomly in dynamic RWA. It is done online while the aim is to reduce the blocking probability and to serve all the requests [1] [2].

A. *ROUTING ALGORITHMS*

i. *Fixed routing:*

A priorly calculated route for each pair of source and destination is used when a connection request arrives. Whenever there is common wavelength available, then there is high chances of blocking.

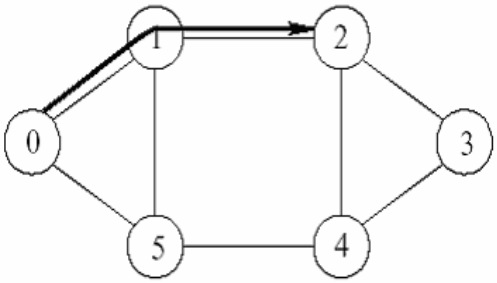

Figure 1: Fixed-shortest path routing [1]

ii. *Fixed-alternate routing:*

In this routing technique, the routing table is maintained which contains all the possible routes. Whenever a request occurs, it checks all routes one by one, if no route is available the connection is said to be blocked.

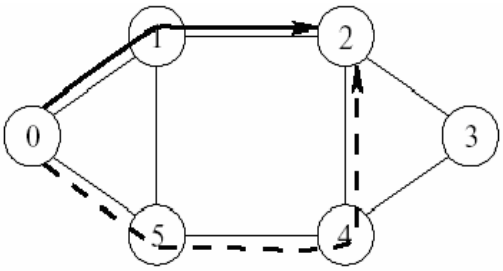

Figure 2: Fixed-alternative path routing [1]

iii. Adaptive routing:

It chooses the route dynamically that is reliant on the present state of the network state which reflects the resource usage. To establish a route between two nodes,

network controller also uses the state information.

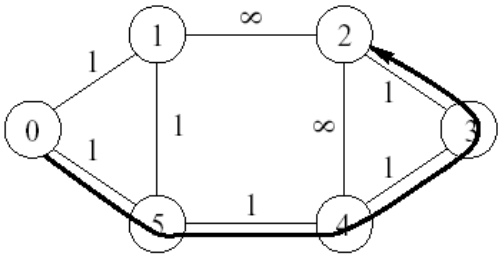

Figure 3: Adaptive routing [1]

B. *WAVELENGTH ASSIGNMENT*

i. *Random wavelength assignment:*

A wavelength is selected randomly from the available wavelengths. First this assignment will gather available wavelengths and picks any arbitrary one from the gathered lot [2].

ii. *First-fit assignment:*

Numbering is done for all wavelengths. From the wavelength which are available, we choose a wavelength which has the least number. The numbered wavelengths are tried in order, the one which is free on all the channels is selected [2].

iii. *Most-used assignment:*

The wavelength that are mostly used are selected for assignment. These connections are grouped into scarcer wavelengths. The wavelength which has the maximum number of channels in the network is called the most used wavelength. From the wavelengths that are existing on the path, such wavelengths are allotted [2].

iv. *Least Used assignment:*

The least used wavelengths are assigned. By this means we can distribute the load equally on all the wavelengths. Thereby more number of wavelengths are open for the afresh incoming requests. This methodology is usually applied to centralized control systems instead of the distributed ones. Also has more computational cost [2].

v. *Least loaded assignment:*

This type of assignment, picks the least loaded wavelength on almost all consignment channel. This wavelength is mandatory for the greater quantity of fibers in that path along the route for channelling [2].

CONCLUSION

Due to the advantages such as fast transmission, less attenuation and higher bandwidth, optical fibres are preferred over copper wires. When optical fibres are used with WDM technology many requests can be served simultaneously along with considerable speed.

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