MERITS AND DEMERITS OF OPTICAL FIBER COMMUNICATION

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ABSTRACT

A fiber optic communication system consists of three components: an optical transmitter, a fiber optic cable, and an optical receiver. The optical transmitter converts electrical signal to optical signal; the fiber cable carries the optical signal from the transmitter to the receiver; and the optical receiver reconverts the optical signal to electrical signal. Most optical fibers are made of silica or sand, raw material abundant compared with copper. With just a few pounds of glass, approximately 43km of optical fiber can be produced. Optical fibers can be used as a medium for telecommunication and networking because it is flexible and can be bundled as cables. It is especially advantageous for long-distance communications, because light propagates through the fiber with little attenuation compared to electrical cables. The fiber optics is superior to metallic conductors as a T/N line for signals because of its high bandwidth, low attenuation, interference, low cots and light in weight. Due to these advantages the fiber optic is used in field of telecommunication. In this paper, I present the advantages and disadvantages of optical fiber communication.

Keywords: *ATTENUATION, FIBER OPTIC CABLE, T/N LINE, INTERFERENCE, OPTICAL TRANSMITTER , OPTICAL RECEIVER.*

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I. INTRODUCTION

The use of light for transmitting information from one place to another place is a very old technique. In 800 BC., the Greeks used fire and smoke signals for sending information like victory in a war, alerting against enemy, call for help, etc. Mostly only one type of signal was conveyed. During the second century B.C. optical signals were encoded using signaling lamps so that any message could be sent. There was no development in optical communication till the end of the 18th century. The speed of the optical communication link was limited due to the requirement of line of sight transmission paths, the human eye as the receiver and unreliable nature of transmission paths affected by atmospheric effects such as fog and rain. In 1791, Chappe from France developed the semaphore for telecommunication on land. But that was also with limited information transfer. In 1835, Samuel Morse invented the telegraph and the era of electrical communications started throughout the world. The use of wire cables for the transmission of Morse coded signals was implemented in 1844. In 1872, Alexander Graham Bell proposed the photo phone with a diaphragm giving speech transmission over a distance of 200 m. But within four years, Graham Bell had changed the photo phone into telephone using electrical current for transmission of speech signals. In 1878, the first telephone exchange was installed at New Haven. Meanwhile, Hertz discovered radio waves in 1887. Marconi demonstrated radio communication without using wires in 1895. Using modulation techniques, the signals were transmitted over a long distance using radio waves and microwaves as the carrier. During the middle of the twentieth century, it was realized that an increase of several orders of magnitude of bit rate distance product would be possible if optical waves were used as the carrier.

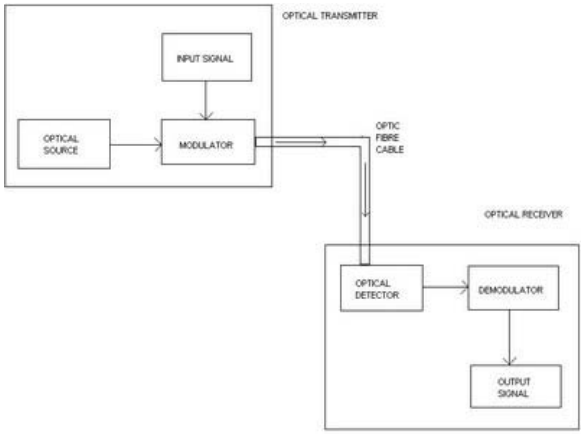

Fig: Block Diagram of Optical Fiber Communication

A new era in optical communication started after the invention of laser in 1960 by Maiman. The light waves from the laser, a coherent source of light waves having high intensity, high monochromaticity and high directionality with less divergence, are used as carrier waves capable of carrying large amount of information compared with radio waves and microwaves.

II. ADVANTAGES OF OPTICAL FIBER COMMUNICATION:

1. Extremely high bandwidth – No other cable-based data transmission medium offers the bandwidth that fiber does.

2. Easy to accommodate increasing bandwidth – Using many of the recent generations of fiber optic cabling, new equipment can be added to the inert fiber cable that can provide vastly expanded capacity over the originally laid fiber. DWDM, or Dense Wavelength Division Multiplexing, lends fiber optic cabling the ability to turn various wavelengths of light traveling down the fiber on and off at will. These two characteristics of fiber cable enable dynamic network bandwidth provisioning to provide for data traffic spikes and lulls.

3. Resistance to electromagnetic interference – Fiber has a very low rate of bit error (10 EXP-13), as a result of fiber being so resistant to electromagnetic interference. Fiber-optic transmission is virtually noise free.

4. Early detection of cable damage and secure transmissions – Fiber provides an extremely secure transmission medium, as there is no way to detect the data being transmitted by "listening in" to the electromagnetic energy "leaking" through the cable, as is possible with traditional, electron-based transmissions. By constantly monitoring an optical network and by carefully measuring the time it takes light to reflect down the fiber, splices in the cable can be easily detected.

5.When high freq signal are propagated through convention coaxial cable ,it loss half of its power only after a few hundred meters where as the optical fiber loss the sauce amount of power in 15km or more .Thus repeater will be required at very long distance.

6. The T/N rate is possible on optical fiber is 10GB/sec while in coaxial cable is 1GB/sec.

7. Because of very small size and light in weight and large Flexibility, it produces a number of advantages over cupper wires at the installation time.

8. As the fiber optic has no electrical conductivity, there fore Grounding and protection are not necessary.

9. Insensitivity to electromagnetic interference, such as when a telephone wire loses some of its signal to another.

10. Fiber do not lose any light, therefore the transmission is also secure and cannot be

disturbed.

11. Lack of electrical signals in the fiber, so it cannot shock or other hazards. This makes fibers suitable for work in explosive atmospheres.

12. Easy to install and Compatibility with digital technology.

13. Lightness and small size of the cable, capable of carrying a large number of signals.

III. DISADVANTAGES OF FIBER OPTICS:

1. Installation costs, while dropping, are still high – Despite the fact that fiber installation costs are dropping by as much as 60% a year, installing fiber optic cabling is still relatively costly. As installation costs decrease, fiber is expanding beyond its original realm and major application in the carrier backbone and is moving into the local loop, and through technologies such as FTTx (Fiber to the Home, Premises, etc,) and PONs (Passive Optical networks), enabling subscriber and end user broadband access.

2. Special test equipment is often required – The test equipment typically and traditionally used for conventional electron-based networking is of no use in a fiber optic network. Equipment such as an OTDR (Optical Time Domain Reflect meter)
is required, and expensive, specialized optical test equipment such as optical probes are needed at most fiber endpoints and connection nexuses in order to properly provide testing of optical fiber.

3. Susceptibility to physical damage – Fiber is a small and compact cable, and it is highly susceptible to becoming cut or damaged during installation or construction activities. Because railroads often provide rights-of-way for fiber optic installation, railroad car derailments pose a significant cable damage threat, and these events can disrupt service to large groups of people, as fiber optic cables can provide tremendous data transmission capabilities. Because of this, when fiber optic cabling is chosen as the transmission medium, it is necessary to address restoration, backup and survivability.

4. Wildlife damage to fiber optic cables – Many birds, for example, find the Kevlar reinforcing material of fiber cable jackets particularly appealing as nesting material, so they peck at the fiber cable jackets to utilize bits of that material. Beavers and other rodents use exposed fiber cable to sharpen their teeth and insects such as ants desire the plastic shielding in their diet, so they can often be found nibbling at the fiber optic cabling. Sharks have also been known to damage fiber optic cabling by chomping on it when laid underwater, especially at the repeating points. There is a plant called the Christmas tree plant that treats

fiber optic cable as a tree root and wraps itself around the cable so tightly that the light impulses traveling down the fiber are choked off.

5. Price - Even though the raw material for making optical fibers, sand, is abundant and cheap, optical fibers are still more expensive per metre than copper. Although, one fiber can carry many more signals than a single copper cable and the large transmission distances mean that fewer expensive repeaters are required.

6. Fragility - Optical fibers are more fragile than electrical wires.

7. Affected by chemicals - The glass can be affected by various chemicals including hydrogen gas (a problem in underwater cables.)

8. Opaqueness - Despite extensive military use it is known that most fiber become opaque when exposed to radiation.

9. Requires special skills - Optical fiber cannot be joined together as a easily as copper cable and requires additional training of personnel and expensive precision splicing and measurement equipment.

10. The joining of fiber optics cables need greater care because if the Joining is not correct; a lot of attenuation will produce in high Wave length.

11. As the fiber optics have no electrical conductivity, therefore additional Copper cable is not used with optical fiber to provide power supply to the repeaters.

12. The installation cost is very high as compare to the other types of T/N lines.

IV.CONCLUSION:

There are a number of essential points about fiber optics that have been mentioned throughout this paper.

Optical communication offer several advantages such as higher bandwidth, higher interconnection densities, and lower crosstalk, crosstalk which is independent of data rate, inherent parallelism and immunity from electromagnetic interference. These advantages mean that optical communication have the potential to exhibit higher data rate communication. The shortest interconnections however, will remain electrical ones, due in part to the inverse relationship between electrical interconnection length and power consumption, and to a length independent minimum latency time inherent to optical interconnections caused by the time delays required for electrical to optical to electrical conversions

As conclusion, fiber optic technology is a revolutionary technological departure from the traditional copper wires twisted-pair cable or coaxial cable. As we more forward in the

Information Technology age, the responsibility of moving extreme amounts of data must fall on the shoulders of this new technology. There is no doubt as to the vast opportunities that fiber optic technology can give and it should be continuously researched and expanded to cater for future demands.

ACKNOWLEDGMENT

Author is thankful to his father Dr. Kewal Kumar and mother Mrs. Veena Gambhir. Their inspiration and continuous support made me to complete this work successfully.

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