Fiber optics essay

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Thesis: Some of the important features of the fiber optics that we are interested are discussed below. Now a days we are using copper wires as they are the most cost effective and reliable interconnect in parallel machines. However as machines grow more powerful, wire density becomes critical making fiber possible alternatives because of their small wire size. Fiber optics are used mainly to use effectively its high bandwidth. On a single fiber lots of information/data can be transmitted concurrently and in parallel. Over 1000 high bandwidth (100-200 Mb/s) independant channels or busses can be supported on a single optical fiber. Furthermore multiple buses can co-exist on a single fiber. Fiber links allow a number of high speed serial links to replace a large number of electrical lines. The use of fiber is thus space saving. The input and output properties of the fiber are very important. They give us an idea about the nature and working of fiber materials. The fiber cables can transport light signals from one place to another place just similar to the way the metallic conductors transport electric signals. The fiber cables guide light around bends and they are able to carry light for very long distances with very little attenuation. But the transmission characteristics of the fiber are not complete and completely efficient. The fiber cables introduce loss of light and smearing of the modulation imposed on the light signals to represent information. These affects of delay distortion and attenuation limit the distances that can be spanned without electro-optic repeaters and thus limit the information rates which can be carried over long distances as well. Make of fiber optic cables.

Turns out they can be made of just glass, glass plus polymers, or just polymers (“ plastic optical fibers” -POF-). The most basic optical fiber consist of: a) An inner cylinder with high refractive index, called the core. b) Middle cylinder with a lower refractive index, called the cladding. c) An outer protective polymer layer (usually polyurethane or PVC) called the jacket. For glass optical fibers, the diameter of the core ranges between 10-600 microns, the cladding thickness is between 125-630 microns, and that of the jacket varies between 250-1040 microns. For POF all diameters range between 750-2000 microns. As can be seen, one of the main differences between glass and plastic optical fibers is their diameter. This makes POF easier to handle. The material used for currently commercialized fibers (core and cladding) include pure glass (SiO_2), plastic, or a combination of both. The use of one or the other material will be determined by such factors as quality and economics. Plastic optical fibers (POF) have the advantage of being made of cheaper materials than glass and to operate in the visible range of the spectrum. However, they show a high loss, and for that reason their applications are confined to short distance transmission. In spite of this, POF is widely used for medical and industrial instruments, and currently research is carried out about using POF as a replacement of copper wiring for data transmission in automobiles. If you use silica glass for the core, it must be high purity in order to allow the light to be transmitted along the core with minimal loss. Some of the advantages associated with the use of fiber optic cables are: 1) Immunity to Electromagnetic Interference Although fiber optics can solve data communications problems, they are not needed everywhere. Most computer data goes over ordinary wires. Most data is sent over short distances at low speed. In ordinary environments, it is not practical to use fiber optics to transmit data between personal computers and printers as it's too costly. Electromagnetic Interference is a common type of noise that originates with one of the basic properties of electromagnetism. Magnetic field lines generate an electrical current as they cut across conductors. The flow of electrons in a conductor generates a magnetic field that changes with the current flow. Electromagnetic Interference does occur in coaxial cables, since current does cut across the conductor. Fiber optics are immune to this EMI since signals are transmitted as light instead of current. Thus, they can carry signals through places where EMI would block transmission. 2) Data Security Magnetic fields and current induction work in two ways. They don't just generate noise in signal carrying conductors; they also let the information on the conductor to be leaked out. Fluctuations in the induced magnetic field outside a conductor carry the same information as the current passing through the conductor. Shielding the wire, as in coaxial cables can reduce the problem, but sometimes shielding can allow enough signal leak to allow tapping, which is exactly what we wouldn't want. There are no radiated magnetic fields around optical fibers; the electromagnetic fields are confined within the fiber. That makes it impossible to tap the signal being transmitted through a fiber without cutting into the fiber. Since fiber optics do not radiate electromagnetic energy, emissions cannot be intercepted and physically tapping the fiber takes great skill to do undetected. Thus, the fiber is the most secure medium available for carrying sensitive data. 3) Non Conductive Cables Metal cables can encounter other signal transmission problems because of subtle variations in electrical potential. Electronic designers assume that ground is a uniform potential. That is reasonable if ground is a single metal chassis, and it's not too bad if ground is a good conductor that extends through a small building. However, the nominal ground potential can differ by several volts if cables run between different buildings or sometimes even different parts of the same building. Signal levels in semiconductor circuits are just a few volts, creating a problem known as ground loop. When the difference in ground potential at two ends of a wire gets comparable to the signal level, stray currents begin to cause noise. If the differences grow large enough, they can even damage components. Electric utilities have the biggest problems because their switching stations and power plants may have large potential differences. A serious concern with outdoor cables in certain computer networks is that they can be hit by lightning, causing destruction to wires and other cables that are involved in the network. Certain computer companies are aware of this problem and trying to solve it by having protective devices for wire circuits to block current and voltage surges. Any conductive cables can carry power surges or ground loops. Fiber optic cables can be made non-conductive by avoiding metal in their design. These kinds of cables are economical and standard for many indoor applications. Outdoor versions are more expensive since they require special strength members, but they can still be valuable in eliminating ground loops and protecting electronic equipment from surge damage. 4) Eliminating Spark Hazards In some cases, transmitting signals electrically can be extremely dangerous. Most electric potentials create small sparks. The sparks ordinarily pose no danger, but can be really bad in a chemical plant or oil refinery where the air is contaminated with potentially explosive vapours. One tiny spark can create a big explosion. potential spark hazards seriously hinder data and communication in such facilities. Fiber optic cables do not produce sparks since they do not carry current. 5) Ease Of Installation Increasing transmission capacity of wire cables generally makes them thicker and more rigid. Such thick cables can be difficult to install in existing buildings where they must go through walls and cable ducts. Fiber cables are easier to install since they are smaller and more flexible. They can also run along the same routes as electric cables without picking up excessive noise. One way to simplify installation in existing buildings is to run cables through ventilation ducts. However, fire codes require that such plenum cables be made of costly fire retardant materials that emit little smoke. The advantage of fiber types is that they are smaller and hence require less of the costly fire retardant materials. The small size, lightweight and flexibility of fiber optic cables also make them easier to be used in temporary or portable installations. 6) High Bandwidth Over Long Distances Fiber optics have a large capacity to carry high speed signals over longer distances without repeaters than other types of cables. The information carrying capacity increases with frequency. This however, doesn't mean that optical fiber has infinit bandwidth, but it's certainly greater than coaxial cables. Generally, coaxial cables have a bandwidth parameter of a few MHz/km, where else the fiber optic cable has a bandwidth of 400MHz/km. (These figures are just approximations and do vary from cable to cable!) This is an important factor that leads to the choice of fiber for data communications. Fiber can be added to a wire network so it can reach terminals outside its normal range. Some fo the problems associated with the use of fiber optic cables: 1) System Reconfiguration Although fiber optics are renowned for their efficiencies and loads of advantages, there are a few drawbacks in them and one of them is system reconfiguration. Converting existing hardware and software for the use of fiber optics does take a lot of time and money which also reduces the turnover for any profit making firm in the market. Sometimes it may be more convenient to transmit high speed computer data serially (one bit after another) than sending several bits at a time in parallel over separate wires. This changeover requires modification in both hardware and software. Minor differences can cause old programs to crash and make data in old files unreadable. Even though the need for such modifications can be reduced by designing fiber optic systems with interfaces that look just like electric ones, it would not make most efficient use of fiber transmission capacity and would increase costs. 2) Limitations in Local Area Networks In Local Area Networks, fiber optics is not used as widely as one would expect. One reason is the implementation requires great deal of changes in current networks and systems. This requires a lot of time and effort which the management is not willing to sacrifice. People are comfortable with what they have and don't want to change. Although most problems regarding program changing can be solved, the solutions to it will take much longer than expected. Thus, any new program has to be a big improvement over the old one to justify a significant change (although the great improvement usually means that the old program does not work). Another fundamental problem in fiber optic LANs is the change in technology. The hardware and software to make LAN run efficiently add up to an expensive package. If many terminals in a building must be in constant touch with each other and a variety of other hardware, such as printers and storage devices, LAN will be cost efficient. However, if the real need is to keep the terminals in touch with a mainframe computer, it would be cheaper to run cables between them and the mainframe. If the terminals need to talk to each other, ordinary telephone lines could very well be used as telephone lines are much cheaper than fiber optics. 3) Economic Evaluation The major practical problem with fiber optics is that it usually costs more than ordinary wires. All costs elements involved in economic evaluation can be grouped into two main classes; which are investment costs and operation costs. The investment costs usually includes expenditures related to acquiring and owning properties and plants, in this case changing wires to fiber optic cables. All investment costs should be considered, such as those incurred for equipment and materials (also including storage and handling costs), engineering costs and miscellaneous costs. Operation costs include the usage of fiber optics and the wear and tear of it. The higher costs of fiber is often not by itself. Fiber optic cables are much cheaper than coaxial cables. The main difference comes when all the other components of fiber optics add up, such as transmitters, receivers, couplers and connectors. Fiber systems require separate transmitters and receivers because they cannot directly use the electrical output of computer devices; that signal must be converted into optical form and then converted back into electrical form. Fiber optic connectors and couplers are more expensive than any other electrical components. These costs are the ones that add up and form the major disadvantage of fiber optics. Conclusion: Fiber optic transmission has found a vast array of applications in computer systems. Some design considerations depend largely on the application. For certain terminal to terminal application, crucial factors including maximising transmission speed and distance and minimising fiber and splice loss. By contrast, connector loss becomes important in local area networks that operate within buildings. In other systems, it is important to minimise the cost of cable, with the intention of reducing the cost of terminal equipment.

These system considerations make design and construction of practical fiber optic systems a difficult task. Guidelines appropriate for one system is usually not suitable for another system. There are a number of essential points about fiber optics that have been mentioned throughout this report. As we move towards a more sophisticated and modern future, the uses of fiber optics are going to grow in all computer systems as well as telecommunication networks. Modern information systems handle ever-increasing data loads which strain the data throughput ability of information systems. Designers have made significant progress in increasing processor speeds, however progress in the design of high-speed interconnection networks has lagged so much so that the most significant bottleneck in today's information systems is the low speed of communications between integrated chips. These low speed communications networks consume increasing amounts of power in an effort to keep up with the faster processors. The slow communications speed is brought on by the small bandwidth available to existing communications networks based on the propagation of electrical signals through metallic lines. Optical interconnections offer several advantages over metallic interconnections, they include: higher bandwidth; higher interconnection densities; lower crosstalk; crosstalk which is independent of data rate; inherent parallelism; immunity from electromagnetic interference and ground loops; the ability to exploit the third dimension; lower clock and signal skew; and a higher fan-in/fan-out capability. These advantages mean that optical interconnections have the potential to exhibit higher data rate communication, higher densities of interconnections with lower crosstalk, and lower power consumption. 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 conversion. Agrawal, G. P. (1992). Fiber-optic communication systems. New York: Wiley. This source provides details pertaining to my research. It provides details regarding the selection of fiber parameters. It says about the process by which the fiber parameters are selected. It tells about the impact of the parameters on factors like cost of fiber, fiber attenuation, ease of cabling, and connection loss. This factors helps in determining the type of fiber cables we should use. Bonadedo, N. H. (1995). Fiber Optics theory and practice. New York: McGraw- Hill. This source provides details about the input-output characteristics of the fiber. 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