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Optical Fiber Communication

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Abstract–

Fiber optic systems are important telecommunication infrastructure for worldwide broadband networks. Wide bandwidth signal transmission with low delay is a key requirement in present day applications. Optical fibers provide enormous and unsurpassed transmission bandwidth with negligible latency, and are now the transmission medium of choice for long distance and high data rate transmission in telecommunication networks. This paper gives an overview of fiber optic communication systems including their key technologies, and discusses their technological trend towards the next generation.

Introduction

An optical fiber is a flexible, transparent fiber made by glass (silica) or plastic to a diameter slightly thicker than that of a human hair.[1] Optical fibers are used most often as a means to transmit light between the two ends and find wide usage in fiber-optic communications, where they permit transmission over longer distances and at higher bandwidths (data rates) than wire cables. Instead of metal wires Fibbers are used because signals travel along them with lesser amounts of loss; in addition, fibers are also immune to electromagnetic interference, a problem from which metal wires suffer excessively.[2] Fibers are also used for illumination, and are wrapped in bundles so that they may be used to carry images, thus allowing viewing in confined spaces, as in the case of a fiberscope.[3] Specially designed fibers are also used for a variety of other applications, some of them being fiber optic sensors and fiber lasers.[4]

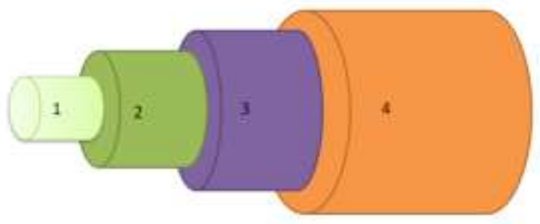


Fig.1 : Optical Fiber Cable

Optic filaments generally include a transparent core girdled by a transparent cladding material with a lower indicator of refraction. Light is kept in the core by the miracle of total internal reflection which causes the fiber to act as a waveguide.(5) filaments that support numerous propagation paths or transverse modes are calledmulti-mode filaments (MMF), while those that support single mode are called single- mode filaments (SMF). Multi-mode filaments generally have a wider core periphery and are used for short-distance communication links and for operations must be Single-mode for longer than transmitted. Fibers are used communication links 1,000 meters (3,300ft).

Review of Literature

Guiding of light by refraction, the principle that makes fiber optics possible, was first demonstrated by Daniel Colladon and Jacques Babinetin Paris in early 1840. John Tyndall included a demonstration of it in his public lecture in London, 12 years latter.

Tyndall also wrote about the property of total internal reflection in an introductory book about the nature of light in 1879 when the light passes from air into water; the refracted shaft is fraudulent towards the vertical. When the shaft passed from water to state it is fraudulent from the perpendicular. However the shaft will not quit the water at each it will be completely reflected at the fact, if the angle which the shaft in water enclosed with the vertical to the face be lesser than 48^0. The ray will not quit the water at all it will be totally reflected at the surface.

The angle which marks the limit where total reflection begins is called the limiting angle of the medium. For were this is called the limiting angle of the medium, for medium, for water this angle in $48^0$27’ for flint glass it’s $38^0$41’, while for diamond it is 23°42 .

In the late 19th and early 20th centuries light was guided through fraudulent glass roads to illuminate body depressions. Practical operations similar as close internal illumination during dentistry appeared early in the twentieth century. Image transmission through tubes was demonstrated singly by the radio researcher Clarence Hansell and the TV colonist Johan Logie Barid in the 1920’s. In 1930’s Heinrich Lamm showed that one could transmit images through a pack of bottomless optic filaments and used it for internal medical examinations, but his work was largely forgotten. IN 1953 Dutch scientist Bramvan Heel first demonstrated image transmission through packets of optic filaments with transparent cladding . That same time Harold Hopkins and Narinder Singh Kapany at Imperical College in London succeeded in making image transmitting packets with over 10000 filaments and latterly achieved image transmission through a 75cm long pack which combines several thousand filaments. Their composition named a flexible fiberscope using static scanning was published in the journal Nature in 1954 .

The first practical fiber optical semi flexible gastroscopy was patented by Basil Hirschowitz C. Wilbur Peters and Lawrence E. Curtiss experimenters at the University of Curriss produced the first glass sheathe filaments former optic filaments had reckoned on air or impracticable canvases and waxes as the low indicator cladding material. A variety of other image transmission operations soon followed. Kapany chased the term fiber optics in an wrote the first book about the new field.

The first working fiber optic data transmission system was demonstrated by German physicist Manfred Borner at Telefunken Reswarch Labs in Ulm in 1965, which was followed by the first patent operation for this technology in 1966. NASA used fiber optics in the TV cameras that were transferred to the moon.

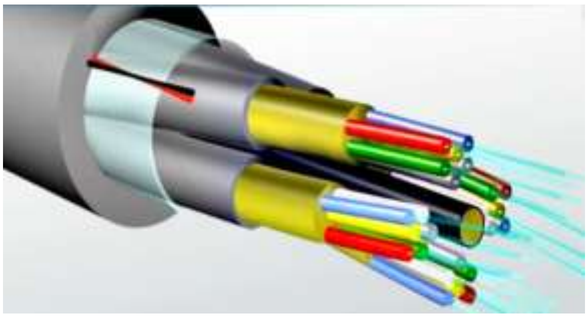
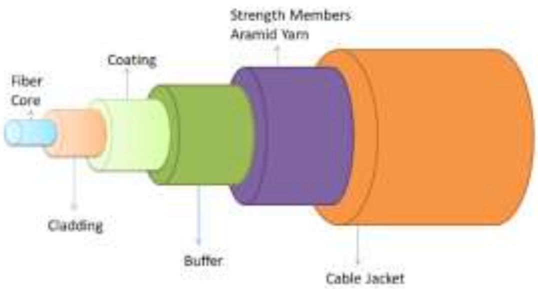


Fig 2: Construction of optical fiber cable by Geometric Parameters

At the time the use in the camera was classified non-public and workers handling the cameras had to be supervised by someone with an applicable security concurrence. Charles K. Kao and George Hockham of the British company Standard Telephones and lines (STC) were the first in 1965 to promote the idea that the attenuation in optic filaments could be reduced below 20 desibles per km (dB/km) making filaments a practical communication medium. They proposed that the attenuation in filaments available at the time was caused by contaminations that could be removed, rather than by abecedarian physical goods similar as scattering. They right material to use for similar filaments silica glass with high chastity. This discovery earned Kao the Nobel Prize in Physics in 2009. The pivotal attenuation limit of 20dB/km was first achieved in 1970 by experimenters Robert D. Maurer, Donald Keck, Peter C. Schultz and Frank Zimar working for American glass maker Corning Glass Works. They demonstrated a fiber with 17 dB/km attenuation by answer Silica glass with Titanium. A many times latterly they produced a fiber with only 4db/km attenuation using Germanium dioxide as the core dopant. In 1982 General Electric produced fused quartz beams that could be drawn into beaches 25 long hauls 40km long .

Originally high quality optic filaments could only be manufactured at 2 measures per second. Chemical mastermind



Thomas Mensah Joined Corning in 183 increased the speed of manufacture to over 50 measures per second making optic fiber lines cheaper than traditional bobby bones. These inventions steered in the period of optic fiber Italian exploration centre CSELT worked with Corning to develop practical optic fiber line performing in the first metropolitan fiber optic string being stationed in Troino in 1977 CSELT also developed an early fashion for splicing optic filaments, called Spring rove. Attenuation electrical bobby lines leading to long haul fiber connections with repeater distances of 70-150km (43-93mit). The erbium unravel fiber amplifier, which reduced the cost of long distance fiber system by reducing or barring optic-electrical-optic repeaters Wosco developed by brigades led by David N. Payne of the University of Southampton and Emmanuel Desurvire at Bell Labs in 1986.

Construction Parameters

Indeed with the important further flexible and robust bend asleep kinds optic fiber is still glass and requires both skill and knowledge to install Fiber can be either single-mode (SM) or multimode (MM) fiber sizes are expressed by using two figures e.g. 9/125. The first number refers to the core size in microns and the alternate number refers to the core and cladding size combination in microns. It is insolvable to separate between SM and MM fiber with the naked eye. These is no difference in the outside appearances both are 125 microns in size only the core size differs.

Core-The optic core is the light carrying element at the center and is generally made up of a combination of Silica and Germanium.

Cladding-The cladding girding the core is made of pure Silica and has a slightly lower indicator of refraction than the core. This lower refractive indicator causes the light in the core to reflect when encountering the cladding and remain trapped within the core.

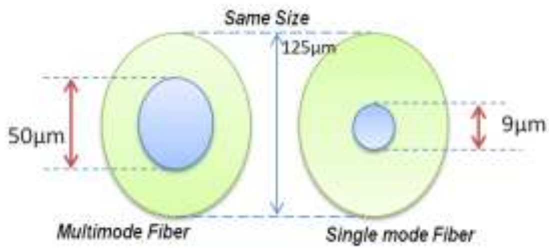
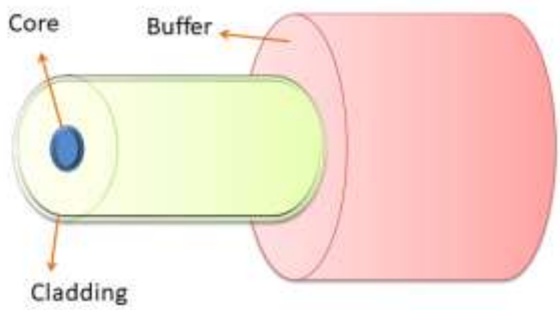
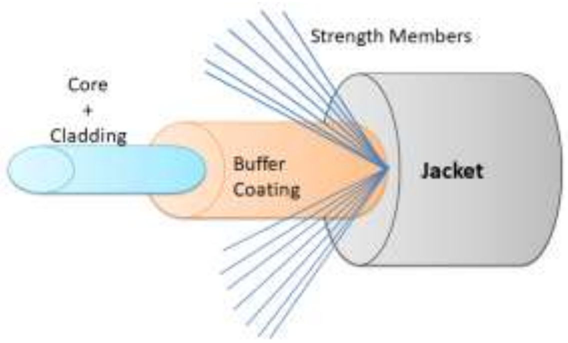


FIG 3..Geometric Parameters of Fiber

Buffer- Buffer coating this is removed during stripping for splicing or connectorization and acts as a shock absorber to cover the core and cladding from damage.



Cable Jacket- Polyethylene (PE) is the material of choice for use as an outside factory (OSP) string jacket. The performance of raw PE can degrade fleetly through exposure to sum. For this purpose Carbon Black is combined with the PE is used to absorb the UV light and latterly dissipates .The jacket colours other than black are used for reasons of enhancing identification.



Cable jackets shall be marked with manufacturer's name month and number of fiber's along with a telecommunication handset symbol. Lines without these markings will not pass examination and should not be installed.

Advantages:

Bandwidth- fiber optical lines have a much bandwidth than essence line. The quantum of information that can be transmitted per unit time of fiber over other transmission media is its most significant advantage. With the high performance single mode string used by telephone diligence for long distance telecommunication, the bandwidths surpasses the requirements of moment's operations and gives room for growth hereafter.

Low power loss- An optic fiber offers low power loss. This allows for longer transmission distances. In comparison to bobby in a network the longest recommended bobby distance is 100m while with fiber it's 2000m hindrance fiber optic lines are vulnerable to electromagnetic hindrance.IT can also be run in electrical noise will not affect fiber.

Size- In comparison to bobby a fiber optic string has nearly 4.5 times as important capacity as the line string has and a cross-sectional area that is 30 times lower.

Weight- Fiber optical lines are important thinner and lighter than essence cables. They also enthral less space with line of lighter weight makes fiber easier to install. Lighter weight makes fiber easier to install.

Safety- Since the fiber is a dielectric it does not present a spark hazard.

Security- Optic fibers are delicate to tap. As they do not radiate electromagnetic energy, emigration cannot be interdicted. As physically tapping the fiber takes great skill to do undetected fiber is the most secure medium available for carrying sensitive data.

Inflexibility- An optic fiber has lesser tensile strength than bobby or sword fibers of the same.

Disadvantages:

Cost- Lines are precious to install but last longer than bobby lines.

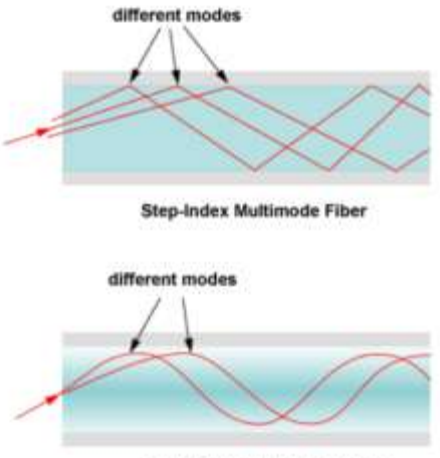
Transmission- Transmission on optic fiber requires repeating at distance intervals.

Fragile- Fibers can be broken or have transmission loss when wrapped around angles of only a many centimetres compass still by boxing fiber in a plastic jacket, its delicate to bend the string into a small enough compass to break the fiber .

Protection- Optical fibers bear further protection around the string compared to bobby.

Operation of Optical fiber

The use and demand for optic fiber has grown extensively and optic fiber operation is multitudinous. Telecommunication operations are wide ranging from global network to desktop computers. These involve the transmission of voice, data or videotape over distances of lower than a cadence to hundreds of kilometres using one of a many standard fiber designs in one of several string designs. Carriers use optic fiber to carry plain old telephone service (POTS) across their civil networks. Original exchange carriers (LEC's) use fiber to carry this same service between central office switches at original situations
and

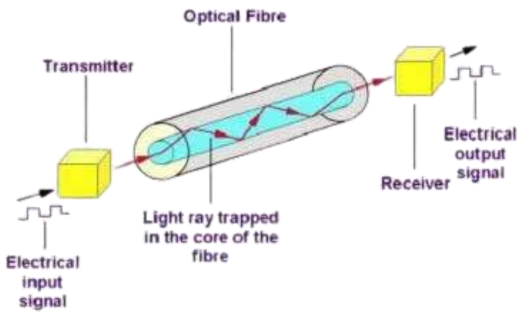


occasionally as far as the neighbourhood or individual home fiber to the home (FTTH) optic fiber is also used considerably for transmission of data transnational enterprises need secure dependable systems to transfer data and fiscal information between structures to the desktop outstations or computers and to transfer data around the word. Cable TV companies also use fiber for delivery of digital videotape and data services. The high bandwidth handed by fiber makes it the perfect choice for transmitting broadband signals, similar as high description TV (HDTV) telecasts. Intelligent transportation system, similar as smart roadways with intelligent business lights automated tollbooths and changeable communication signs also use fiber optic grounded telemetry systems.

Another important operation for optic fiber is the biomedical assiduity. Fiber optic system are used in utmost ultramodern telemedicine bias for transmission of digital individual images. Other operation for optic fiber include space, service, automotive and the artificial sector.

Optical Fiber Communication

The fiber optical technology has been developed substantially for use in communication. Fiber optical communication is transmitting information from one place to another by transferring beats of light through an optical fiber a technology that used glass or vestments to transmit data an introductory fiber optic system consists of a transmitting device that converts an electrical signal into a light signal, an optical fiber accepts the light signal and converts it back into an electrical signal. Fiber optical is a particulate popular technology for original area network.



Fiber Optic Transmitters and Receivers

Transmitters: – The most commonly used optical transmitters are semiconductor devices such as light-emitting diodes (LEDs) and laser diodes.

Receivers: – The main component of an optical receiver is a photo detector, which converts light into electricity using the photoelectric effect.

Fiber optics are long, thin strands of very pure glass about the size of a human hair. They are arranged in bundles called optical cables and used to transmit signals over long distances.

Optical fiber types

There are two major categories:

Step index fiber optic cabling

Graded index fiber optic cabling

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