FUTURE TRENDS IN OPTICAL FIBRE COMMUNICATION

Smita Kumari ¹, Bachan Prasad ², Mukesh Kumar ³

¹Department of Electronics & Communication Engineering
RVS College of Engineering & Technology Jamshedpur, India

ABSTRACT:

In communication system, transmission and reception of a signal is the most important thing that needs to be performed. There are wide range of technology that can performs this. For today world we used a wide range of bandwidth transmission in very less time. Here, in this paper we have fiber optics. Light pulses are the transmitted data through fiber optics cable provide 21 times bandwidth efficiency than present communication system. The first fiber optic communication systems developed in 1978 were able to transmit signals at 100 Mb/s using multimode fiber. This paper gives overview fiber optic communication systems including their key word technologies, and also discusses their technological trend towards the next generation. Remarkable developments can be seen in the field of optical fibre communication in the last decade.

Keywords: optical Fiber, Dispersion, Electromagnetic Interference, Modified Method

[1] INTRODUCTION

The Optical fiber communications have changed our lives in many ways over the last four decades there is no doubt that low-loss optical transmission fibers have been critical to the enormous success of optical communications technology. There is no doubt that low loss optical transmission fibers have been critical to the enormous success of optical communications technology. Fiber optic data transmission systems send information over fiber by turning electronic signals into light. Light refers to more than the portion of the electromagnetic spectrum that is near to what is visible to the human eye.

The electromagnetic spectrum is composed of visible and near-infrared light like that transmitted by fiber, and all other wavelengths used to transmit signals such as AM and FM radio and television. Fibre optic communication is a communication technology that uses light pulses to transfer information from one point to another through an optical fibre. The information transmitted is essentially digital information generated by telephone systems, cable television companies, and computer systems. A desirable feature for these future optical networks would be the ability to process information directly in the optical domain for purposes of multiplexing, demultiplexing, filtering, amplification, and correlation. Optical signal processing would be advantageous because potentially it can be much faster than electrical signal photon-electron-photon conversions.
[2] OPTICAL FIBRE

An optical fiber is a cylindrical dielectric waveguide made of low-loss materials, usually fused silica glass of high chemical purity. The core of the waveguide has a refractive index slightly higher than that of the outer medium, the cladding, so that light is guided along the fiber axis by total internal reflection. Fibre optics (optical fibres) are about the size of a human hair. They are arranged in bundles called optical cables and used to transmit signals over long distances. (fig1)

![Fig1: fiber optics](image1)

Fibre optic communication is a communication technology that uses light pulses to transfer information from one point to another through an optical fiber. The light forms an electromagnetic carrier wave that is modulated to carry information. The major driving force behind the widespread use of fibre optics communication is the high and rapidly increasing demand for more telecommunication capacity and internet services. Fibre optic technology is capable of providing the required information capacity.

A basic fiber optic system consists of a transmitting device that converts an electrical signal into a light signal, an optical fiber cable that carries the light, and a receiver that accepts the light signal and converts it back into an electrical signal. (fig:2)

![Fig 2: Basic fiber optic communication system](image2)

**INFORMATION SOURCE:** Information source provides an electrical signal to a transmitter comprising an electrical stage which drives an optical source to give modulation of the light wave carrier.

**OPTICAL SOURCE:** The optical source which provides the electrical–optical conversion may be either a semiconductor laser or light-emitting diode (LED).
OPTICAL FIBRE CABLE: The transmission medium consists of an optical fibre cable and the receiver consists of an optical detector which drives a further electrical stage and hence provides demodulation of the optical carrier. Photodiodes ($p-n$, $p-i-n$ or avalanche) and, in some instances, phototransistors and photoconductors are utilized for the detection of the optical signal and the optical–electrical conversion.

Although often simpler to implement, analog modulation with an optical fibre communication system is less efficient, requiring a far higher signal-to-noise ratio at the receiver than digital modulation. Also, the linearity needed for analog modulation is not always provided by semiconductor optical sources, especially at high modulation frequencies. For these reasons, analog optical fiber communication links are generally limited to shorter distances and lower bandwidth operation than digital.

[3] TYPES OF FIBRE OPTIC

1. Step index fibre optic
2. Graded index fibre optic

**Step index:** The step index cable refers to cable in which there is a step change in the refractive index between the core and the cladding. This type is the more commonly used. The other type as indicated by the name changes more gradually over the diameter of the fibre. Using this type of cable the light is refracted towards the centre of the cable. Optical fibres or optical fibers can also be split into single mode fibre and multimode fibre.

The disadvantage of single mode fibre is that it requires high tolerance to be manufactured and this increases its cost. Against this the fact that it offers superior performance. Especially for long runs means that much development of single mode fiber has been undertaken to reduce the costs.

**Graded index fibre:** This form of fibre has a greater diameter than single mode fibre. Being typically around 50 micrometer and this makes them easier to manufacture than the single mode fibres.

As it has a wider diameter than single mode fibre it can capture light from the light source and pass it to the receiver with a high level of efficiency. As a result it can be used with low cost light emitting diodes. In addition to this the greater diameter means that high precision connectors are not required. However this form of optical fibre cabling suffers from a higher level of loss than single mode fibre and in view of this its use is more costly than might be expected at first sight. It also suffers from multi-mode modal dispersion and this severely limits the usable bandwidth. As a result it has not been widely used since the mid 19805. Single mode fiber cable is the preferred type.
1) All optical communication networks: Fibre optic communication is envisioned to be completely in the optical domain where all signals will be processed in the optical domain, without any form of electrical manipulation. The optical electrical conversion, and vice versa, adds a delay in the network and a limitation to achieving very high data rates. Another benefit of all optical networks is that there will not be any need to replace the electronics when data rate increases, since all signal processing and routing occur in the optical domain.

2) Multi-terabit optical networks: Dense wave Division multiplexing (DWDM) paves the way for multi-terabit transmission. The need for increased bandwidth availability has led to the interest in developing multi-terabit optical networks. Researchers are looking at achieving higher bandwidth with 100 GB/s. With the continuous reduction in the cost of fiber optic components, the availability of much greater bandwidth in the future is possible.

3) Intelligent optical transmission network: Traditional optical networks are unable to adapt to the rapid growth of data services due to the unpredictability of dynamic allocation of bandwidth, they rely mainly on manual configuration of network connectivity, which is time consuming, and unable to fully adapt to the demands of the modern network.

4) Polymer optical fibre: Polymer optical fibers offer many benefits when compared to other data communication solutions such as copper cables, wireless communication systems. And glass fibers in comparison with glass optical fibers, polymer optical fibers provide easy and less expensive processing of optical signals, and are more flexible.

5) Improvement in optical amplification technology: Erbium Doped Fibre Amplifier (EDFA) is one of the critical technologies used in optical fiber communication systems. To achieve higher output power, high power pumping lasers with excellent optical amplification characteristics, and very low noise figure are envisioned to exist in the nearest future.
6) Improvement in glass fibre design and component miniaturization: - Various impurities are added or removed from the glass fiber to change its light transmitting characteristics. The miniaturization of optical fiber communication components is another trend that is most likely to continue in the Future.

7) In the area of ultra-long haul optical transmission, the limitations imposed due to imperfections in the transmission medium are subject for research. Canoe/lotion of dispersion effect has prompted researchers to study the potential benefits of soliton propagation.

[5] ADVANTAGES

1. Long life - The life of fiber is longer than copper wire.
2. Handling & installation costs nominal - Handling and installation costs of optical fiber is very nominal.
3. Unaffected by electromagnetic interference - It is unaffected with electromagnetic interference.
4. Lower attenuation - Attenuation in optical fiber is lower than coaxial cable or twisted pair.
5. Signal security - The light from optical fiber does not radiate significantly and therefore they provide a high degree of signal security. This feature is attractive for military, banking and general data transmission i.e. computer networks application.
6. Electrical Isolation: Optical fibers which are fabricated from glass or sometimes a plastic polymer are electrical insulators and unlike their metallic counterpart, they do not exhibit earth loop or interface problems. This property makes optical fiber transmission ideally suited for communication in electrically hazardous environments as fiber created no arcing or spark hazard at abrasion or short circuits.
7. Potential low cost: The glass which provides the optical fiber transmission medium is made from sand. So, in comparison to copper conductors, optical fiber offers the potential for low cost line communication.

[6] DISADVANTAGES

1. It requires a higher initial cost in installation
2. Although the fiber cost is low, the connector and interfacing between the fiber optic costs a lot.
3. Fiber optic requires specialized and sophisticated tools for maintenance and repairing
FUTURE TRENDS IN OPTICAL FIBRE COMMUNICATION

[7] APPLICATION

1. Flexible digital camera
2. Mechanical imaging
3. Medical imaging ex-endoscopes & laparoscopes
4. For sea communication
5. In military applications ex-tanks, aircrafts etc
6. For nuclear testing
7. Public service organization ex-TV transmission railways
8. In telecommunication ex-data network message service

[8] CONCLUSION

The fibre optics communications industry is an ever evolving one. The growth experienced by the industry has been enormous and there is still much work to be done to support the need for faster data rates, advanced switching techniques and more intelligent network architectures that can automatically change in response to traffic patterns and at the sometime be cost efficient. The trend is expected to continue in the future leading to a new generation in fiber optics communication. The different types of fiber and their applications, light sources and detectors, couplers, splitters, wavelength division multiplexers, and state-of-the-art devices used in the latest high-bandwidth communication systems have been presented.

REFERENCES

[7] G. Keiser, optical