

Fiber Optical Communication Systems, Modulation Techniques and Its Applications

S.Jabeen Begum ¹, K Thamhina ²,

¹Asst.Professor of Physics, Ashoka Women's Engineering College, Kurnool, Andhra Pradesh India. Jabeenbegum777@gmail.com

²Asst.Professor of Physics, Ashoka Women's Engineering College, Kurnool, Andhra Pradesh. India.

Article Info

Page Number: 430-434

Publication Issue:

Vol. 71 No. 2 (2022)

Article History

Article Received: 24 January 2022

Revised: 26 February 2022

Accepted: 18 March 2022

Publication: 20 April 2022

Abstract

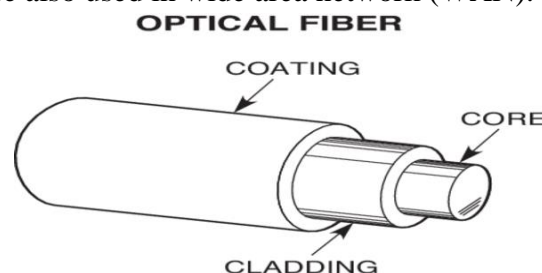
Fiber optic communication has expanded significantly in the fields of data transmission and communication engineering in the modern communication environment. Wave propagation is guided by optical fibres. It is made up of wired parts. Compared to twisted pair and coaxial cable, it has a greater bandwidth efficiency. This essay attempts to describe recent developments in fiber-optic communication, various modulation techniques used in contemporary systems, and wireless technology applications.

Keywords: optical fiber, LED, WAN, ASK, FSK, PSK, WDM

Introduction

Fiber optic communication, which involves the transmission of data via long fibres often composed of plastic or glass and propagating light pulses, is one of the rapidly evolving technologies in the modern period. Metal wires are utilised for optical fibre communication's transmission. Fibers consist of three primary components: the core, cladding, and coating. Either Light Emitting Diodes (LEDs) or Laser Diodes serve as the light source in optical fibres. Optic fibres provide a far higher bandwidth than coaxial and twisted pair wires.

Optical fibers are forms the application for broadband transmission where several channels are handled parallel manner. Free Space communications in optical domain is implemented by transmission of visible and infrared (IR) beams through the atmosphere to obtain optical communications. They are also used in wide area network (WAN).

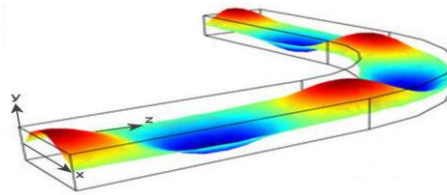


The fiber's light transmission section, which might be made of glass or plastic, is its essential component. More light would be transferred into the fiber if the core were larger. In order for reflection to take place inside the core and allow light waves to go through the fibre, cladding offers a lower refractive index at the core interface. Coatings are made up of many plastic layers that are applied to safeguard the fibre strength and add additional fibre protection. Between 250 and 900 microns are the available sizes for these buffer coatings. Interference from magnetic and electric fields has no effect on optical fibres. The operation of optical

fibres is underpinned by the theory of total internal reflection. According to their refractive index and mode of propagation, optical fibres are categorized. They are categorized according on the refractive index.

Optical Waveguides

a structure that directs a light beam by preventing it from taking a particular desired path. The optical guiding of light can be explained by total internal reflection if the transverse dimensions of the guide are significantly larger than the wavelength of the guided light. When light strikes a dielectric contact at a larger angle than the critical angle c ,



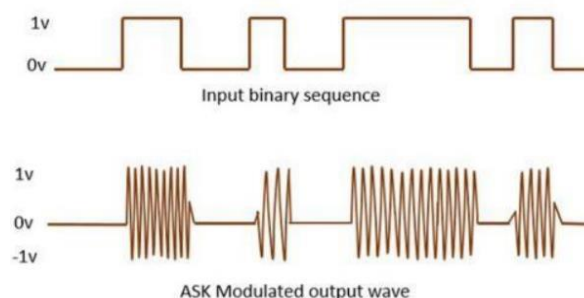
A wave guide directs light by surrounding a guiding region known as the core, made from a material with index of refraction $n(\text{core})$. Most waveguides are non-planar.

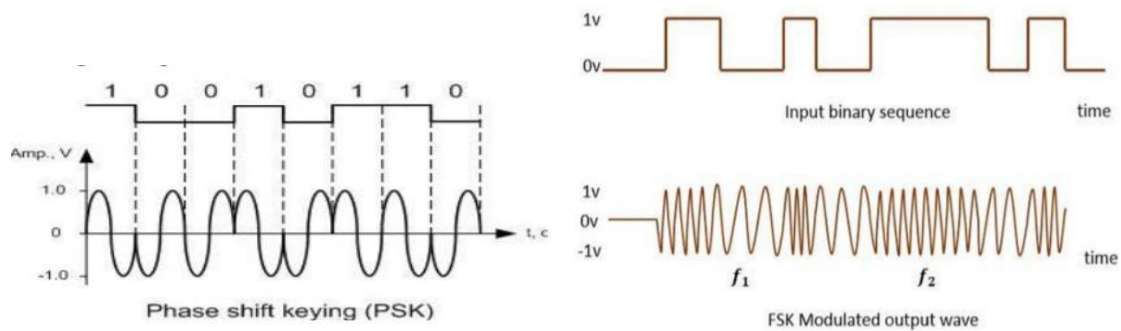
Light can be guided using different types of waveguides like rectangular, planar or circular. In optical wave guiding, light does not escape through the sides of the fiber.

Digital Modulation Schemes For Optical Fibres

Modulation is the process of changing the properties of a modulating signal with respect to the carrier signal, such as amplitude, frequency, and phase. Both the analogue and digital domains support the use of modulation. The signal in analogue communication is severely weakened, subject to distortion, and offers inferior data security. We get less attenuated, less distorted, high information capacity, and high data speeds when we communicate digitally.

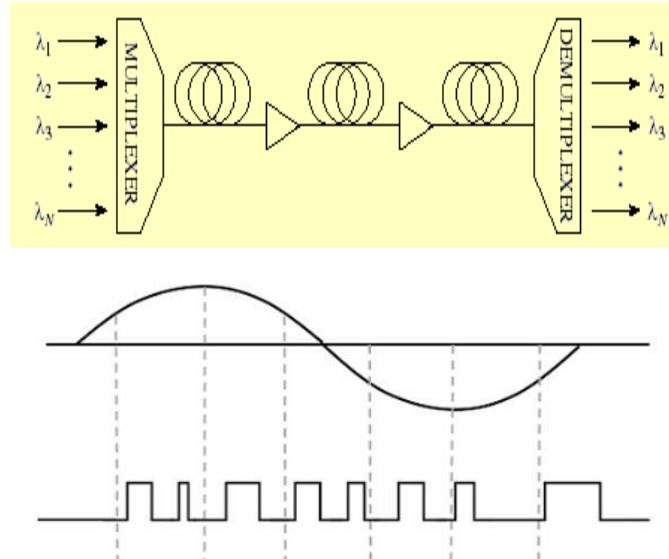
In digital communication, there are methods such as ASK, FSK and PSK that are analogous to AM, FM and PM in analog communication. With Amplitude Shift Keying (ASK), the carrier amplitude is adjusted based on the data bit. Likewise, in Frequency shift keying, the frequency of the output signal will change between high and low depending on the data bits present. In phase shift keying, there are various forms such as 2-PSK, QPSK, 8-PSK and 16-PSK.





In optical modulation, the commonly used modulation technique is the ON-OFF keying technique. It has a rectangular pulse duration of $(1/R)$ where $R = \text{bit rate}$ and the intensity level is $= 2 \cdot P$ ($P = \text{transmitting power}$). This implies that 1 = High intensity level and 0 = No bits present. An alternative approach to pulse position modulation, we have a technique known as digital pulse interval modulation. Here, high transmission capability is performed followed by eradication of all the unused slots. In this technique, there is no necessity for synchronization since each symbol is initiated with a pulse. Data is encoded in discrete intervals of time.

Pulse code modulation is used in optical fibres in which digital pulse coded signal is coupled into a fiber. The end of the fiber is controlled by a connector to maximize the input power. Semiconductor lasers like In GaAsP are used mainly in fiber-optic communication system. The commonly used diodes in this modulation include PIN Diode, avalanche diode which are used as optical detectors.



communication of information having data rate higher than 10 Gbit/s is achieved using a popular technique which is known as wavelength division multiplexing (WDM). Several signals with different wavelength are sent through the same optical fiber using this technique.

Here, both the multiplexer and demultiplexer has optical diffraction grating. The wavelengths varies from 2 to over 100. The separation distance between wavelengths, varies between from 0.4 to 3.2 nm.

Comparison Between Guided Transmission Media

Type	Type Sub Type	Maximum Segment Length	Bandwidth Supported	Installation	Cost	Interference
Twisted Pair Cable	UTP	100 mts	100 Mbps	easy	cheapest	high
	STP	100 mts	500 Mbps	moderate	moderate	moderate
Coaxial Cable	Thinnet	185 mts	10 Mbps	easy	cheap	moderate
	Thicknet	500 mts	10 Mbps	hard	moderate	low
Fibre Optic Cable	Multinode	2 kms	100 Mbps	very hard	expensive	none
	Singlenode	100 kms	2 Gbps	very hard	expensive	none

Here, in optical fibers, the data transmission characteristics are better than coaxial cable and twisted pair cables. Optical fibers supports very high bandwidth, suitable for worst environmental conditions, provides secured transmission of data with high capacity. In contrast to this, optical fibers are difficult to install. connection losses, soldering problems, noise immunity are some of the most common demerits which occurs in the case of optical fiber communication. Light can reach the receiver out of phase and quite expensive. Wavelength division multiplexing(WDM) is used in optical fibers which supports data rates greater than 10Gbps.

Applications Of Optical Fibers

Optical fibers have major applications in telecommunication, military, metropolitan area networks, satellite communication and Image processing.

- Due to its low bit error rates and less weight it is used in aircraft applications. Due to the presence of dielectric inside the fibers, it makes them immune from electromagnetic interferences.
- Optical fibers also supports data secured transmission. They also have applications in Rayleigh scattering where the scattering is inversely proportional to the fourth power of wavelength.
- Optical fibers are used in wiring of television cables used in our homes. They are used in imaging tools and as lasers for surgeries in hospitals which comes under medical applications.

Conclusion

This research looks into the different digital modulation strategies employed in current optical communication systems.

In everyday life, optical fibers are widely used for a variety of purposes such as medical, military, and networking. Optical fibers are commonly used with LED and LASER technology. An examination of the pros, cons and comparison between guided transmission has been conducted.

References

- [1] M. Sushma Sri , Dr. A. Venkata Ramana ,”Free space optical communication” (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 3, Issue 5, May 2013)

- [2] Prachi Sharma, Rohit Kumar Arora, Suraj Pardeshi, Mandeep Singh, “Fiber Optic communication: An overview” (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume3, Issue5, May2013)
- [3] Ghafour Amouzad Mahdiraji, Edmond Zahedi ,”Comparison of Selected Digital Modulation schemes (OOK, PPM and DPIM) for Wireless Optical Communications”.
- [4] Smruti Goswami, Ravi Patel, “Under water optical wireless communication”, Volume: 04 Issue: 02 ,Feb - 2017,e-ISSN:2395-0056 Dwaipayan Biswas, “ Modern optical fiber, communication splitter transmitter.