OPTICAL FIBER COMMUNICATION SYSTEM

Kilichov Jasur Ruzikulovich.
Muhammad al-Xorazmiy nomidagi Toshkent axborot texnologiyalari universiteti Samarqand filiali katta o‘qituvchisi
kilichovj1987@gmail.com
Erkinov G‘olibjon Xusniddin o‘g‘li
Muhammad al-Xorazmiy nomidagi Toshkent axborot texnologiyalari universiteti Samarqand filiali talabasi
golibjonerkinov05@gmail.com
Jalilov Nurmuhammad Jamshid o'g'li.
Muhammad al-Xorazmiy nomidagi Toshkent axborot texnologiyalari universiteti Samarqand filiali talabasi
jalilovnurmuhammad18@gmail.com
Almardonov Asliddin Faxriddin o‘g‘li.
Muhammad al-Xorazmiy nomidagi Toshkent axborot texnologiyalari universiteti Samarqand filiali 1-bosqich magistranti
aslialimardonov@gmail.com

Annotatsiya. *Ushbu maqolada optik tolali aloqa tizimlari haqida batafsil ma'lumot berilgan. Optik tolali tizimlar ma'lumotlarni uzoq masofalarga yuqori tezlikda va minimal yo'qotishlar bilan uzatishga imkon beruvchi texnologiya sifatida tasvirlangan. Maqolada optik aloqa tizimlarining tarixiy rivojlanishi, optik tolalarning tuzilishi, ularning afzalliklari va zamonaviy telekommunikatsiya sohasidagi o‘rni keng yoritilgan. Optik tolalar yuqori chastotali yorug‘lik to‘lqinlaridan foydalanib, katta hajmdagi ma'lumotlarni xavfsiz va samarali uzatish imkonini beradi. Maqolada, shuningdek, optik tolalarning mis kabellarga nisbatan afzalliklari, jumladan, past yo'qotishlar, elektromagnit ta'sirlarga chidamlilik va ma'lumotlarni tutib qolishning qiyinligi kabi jihatlar muhokama qilingan. Mis kabeldan optik tolaga o‘tish jarayonining afzalliklari O‘zbekiston misolida keltirib o‘tilgan.*

Kalit so‘zlar: *Optik tolalar,optik aloqa tizimlari elektromagnit ta'sirlar, ma'lumot uzatish, aloqa kabellari,yuqori chastotali yorug‘lik to‘lqinlari,mis kabellar, past yo'qotishlar.*

Abstract. *This article provides detailed information about fiber-optic communication systems. Fiber-optic systems are described as a technology that enables the transmission of information over long distances at high speeds with minimal loss. The article extensively covers the historical development of optical communication systems, the structure of optical fibers, their advantages, and their role in modern telecommunications. Optical fibers utilize high-frequency light waves , allowing them to transmit large amounts of data securely and efficiently.*

The article also discusses the advantages of optical fibers compared to copper cables, including low loss, resistance to electromagnetic interference, and the difficulty of intercepting transmitted data. The benefits of transitioning from copper cables to fiber-optic systems are highlighted using Uzbekistan as an example.

Key words: *Optical fibers, optical communication systems, electromagnetic interference, data transmission,high-frequency light waves, copper cables,low loss.*

Introduction

A communication system transmits information from one place to another, whether separated by a few kilometers or by transoceanic distances. Information is encoded onto an electromagnetic carrier wave, whose frequency can vary from a few megahertz to several hundred terahertz. Optical communication systems employ high frequencies (~200 THz) in the near-infrared region of the electromagnetic spectrum. These systems are also called lightwave systems to distinguish them from microwave systems, whose carrier frequency is typically smaller by five orders of magnitude (~1 GHz). Fiber-optic communication systems are a type of lightwave system that employ optical fibers for information transmission. Such systems have been deployed worldwide since the year 1980 and have revolutionized the field of telecommunications. Indeed, lightwave technology, together with microelectronics, led to the advent of the "information age" during the 1990s.

Historical Perspective

The use of light for communication purposes dates back to antiquity if we interpret optical communications in a broad sense[1]. Most civilizations used mirrors, fire beacons, or smoke signals to convey a single piece of information (such as victory in a war). Essentially the same idea was used up until the end of the eighteenth century through signaling lamps, flags, and other semaphore devices. This idea was extended further following a suggestion by Claude Chappe in 1792 to transmit mechanically coded messages over long distances (~100 km) by the use of intermediate relay stations[2],acting as regenerators or repeaters in modern-day terms. (Figure 1.1 schematically shows the inventor and his basic idea.) The first such "optical telegraph" was put into service between Paris and Lille (two French cities about 200 km apart) in July 1794. By 1830, the network had expanded throughout Europe. The role of light in such systems was simply to make the coded signals visible so they could be intercepted by the relay stations. However, the opto-mechanical communication systems of the nineteenth century were inherently slow. In modern-day terminology, the effective bit rate of such systems was less than 1 bit per second (B < 1 b/s

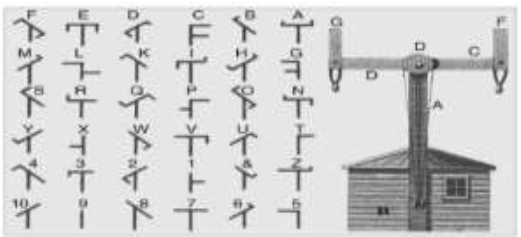

Figure 1.1: Claude Chappe, his coding scheme, and the mechanical device used for making optical telegraphs. Source: Agrawal [3].

Optical Fiber

An optical fibre or optical fibre is a flexible, transparent fibre made by drawing glass (silica) or plastic to a diameter slightly thicker than that of a human hair. Optical fibers are used most often as a means to transmit light between the two ends of the fibre and find wide usage in fibre-optic communications, where they permit transmission over longer distances and at higher bandwidths (data rates) than wire cables. Fibres are used instead of metal wires because signals travel along them with less loss; in addition, fibres are immune to electromagnetic interference, a problem from which metal wires suffer excessively. Fibres 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 fibrescope. Specially designed fibres are also used for a variety of other applications, some of them being fibre-optic sensors and fibre lasers.[4]

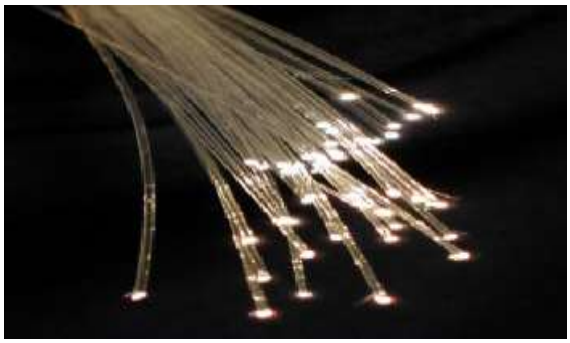

Figure 1.2 bundle of optical fibres

Figure 1.3 A TOSLINK fibre optic audio cable with red light being shown in one end transmits the light to the other end.

Basic Fibre Optical Communication System

The outlines of an optical communication system are given in Figure 1.4. The sound signals from different subscribers are multiplexed and converted into digital form by the ADC/ENCODER. The signal is then modulated using a pulse modulation technique and given to the Electrical-to-Optical (E-O) converter. This device produces modulated optical

signals. These signals are transmitted through an optical fibre to the desired destination. Optical fibres are used for the transmission of optical signals in the same manner as coaxial cables are used for radio wave transmission.

The main advantage of using optical frequencies as the carrier is that very high-density information transmission becomes possible at these frequencies. In addition to this, optical fibres also have an extremely low loss of nearly 0.2 dB/km, which permits larger repeater spacing. Other advantages of optical fibres include their much smaller size and lighter weight compared to coaxial cables. They require much less duct space and have lower transportation costs. Since they are made of dielectric materials, they are immune to electromagnetic interference, short circuits/ground loops, and are free from crosstalk. They are more tolerant to hostile temperature environments and are very cost-effective compared to other transmission media for a large volume of information traffic.[5]

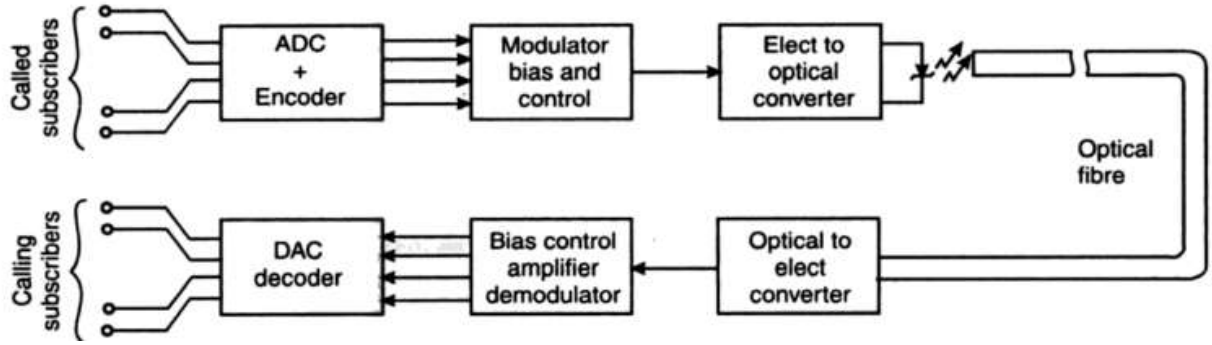

Figure. 1.4. Block diagram of a optical communication system.

Conclusion

My conclusion is that the most remarkable invention of the 21st century in the field of telecommunications is the fiber-optic communication system. Fiber optics transmit data quickly and securely, which further increases the demand for them.

Fiber optics offer high security: it is difficult to intercept or steal any information transmitted through fiber optics because they do not emit electromagnetic radiation. In Uzbekistan, the transition from copper cables to fiber-optic communication systems is also gaining momentum.

Of course, copper cables have their advantages as well. For example, equipment for copper cables is cheaper compared to fiber optics. Copper cables not only transmit data but can also carry electrical power. However, their main disadvantage is that data can be intercepted and stolen. This is why the transition to fiber-optic communication systems is taking place today.

Sources

[1] G. J. Holzmann and B. Pehrson. The Early History of Data Networks, Wiley, 2003.

[2] D. Koenig, "Telegraphs and Telegrams in Revolutionary France", Scientific Monthly, 431 (1944). See also Chap. 2 of Ref. [1].

[3] G. P. Agrawal, in Optics in Our Time, M. D. Al-Amri, M. El-Gomati, and M. S. Zubairy, Eds., Springer, 2016, Chap. 8.

[4] Edwin Conway. (2019) Optical fibre Communications Principles and Practice , Chap.5-8 .United Kingdom , EN9 1EJ Published by ED - Tech Press, 54 Sun Street , Waltham Abbey Essex

[5] Anokh Singh, A.K.Chhabra.(2006) Principles of Communication Engineering, Chap.505-506.

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