Research on The Current Situation and Development Trend of Optical Fiber Communication technology

Bingjie Yuan\(^1\), Han Cai\(^2\)

\(^1\) Department, University of South China, Hengyang, Hunan Province, 421001, China
\(^2\) Department, University of South China, Hengyang, Hunan Province, 421001, China
\(^*\) Corresponding author’s e-mail: yuanbingjie@yyy1003.onexmail.com

Abstract. The technology uses light wave as carrier and optical fiber as transmission medium to realize the function of transmitting information from one end to the other. Optical fiber communication technology has become one of the important means of information transmission in today’s era. It can be imagined that in the near future, optical fiber technology will have more rapid development and application. This paper briefly introduces the principle and characteristics of optical fiber communication technology, analyzes its current application fields, and discusses the future development trend of this technology, so as to let more people understand this technology.

1. Introduction

With the increasing consumption level and demand for communication, the traditional cable communication technology has been unable to meet people’s needs\(^[1]\). Now optical fiber communication engineering technology has become a major way of information transmission in China. As a product of information age, optical fiber communication technology has multiple advantages such as strong anti-electromagnetic interference ability, less resource consumption and fast transmission speed. Therefore, under the background of the continuous progress and development of China’s Internet information technology, the technology will develop rapidly in the future.

2. Brief Introduction of Optical Fiber Communication Technology

2.1. The principle of optical fiber communication

The fiber is usually composed of three parts, as shown in Figure 1. The outer layer to the inner layer are the core, cladding and coating, respectively. The coating protects the optical fiber from the erosion of water vapor, and at the same time enhances the flexibility of the optical fiber, which can protect the optical fiber to a certain extent\(^[2]\) and prolong the service life of the optical fiber. The core part of the fiber is the cladding and core, where the loss of light in the core is lower than that in the cladding, so the light wave is mainly transmitted in the core.
Optical fiber communication is a kind of communication mode that uses light wave as carrier and light in special optical fiber as transmission medium to transmit information, which is called 'wired' optical communication.

At the transmitter, the information signal transmitted by the data (such as voice signal) is transformed into an electrical signal to modulate the light wave technology emitted by the light source so that the intensity of the light varies with the amplitude (frequency) of the electrical signal and then is sent out with the optical fiber network. At the receiving end, the optical signal transmitted by the fiber or cable is converted into electrical signal by the optical radio through the optical detector, and then the weak electrical signal is amplified to a sufficient level through the amplifier circuit to generate the original transmission signal. Its structure is shown in Figure 2, in which the repeater is used to compensate the attenuation of the optical signal when it is transmitted in the the near-line pulse shaping of the waveform distortion [3-4].

2.2. The characteristics of optical fiber communication technology

2.2.1. Anti-em interference capability.
Quartz is generally used as the raw material of insulating material for optical fiber materials, which has good insulation and can effectively protect the optical fiber. Therefore, in the process of information transmission, optical fiber network communication has stronger anti-electromagnetic interference ability than traditional cable communication. Even in thunderstorm weather and even extremely harsh natural environment, the quality and speed of information transmission are well guaranteed. At the same time, due to the strong sensitivity of this insulation material to the special acoustic signal, the optical fiber communication technology is also given higher accuracy[5].
2.2.2. **Wide frequency band and large communication capacity**

The optical fiber communication uses invisible light with wavelengths of 850 nm and 1310 nm, and the frequency is very high. Therefore, the communication capacity is very large, and the information transmission rate is also significantly improved compared with the traditional copper wire.

2.2.3. **Low loss and cost savings**

At present, silicon dioxide is widely used as the raw material of fiber in communication system, and the loss of fiber can be effectively reduced by improving the purity of glass fiber. Because of the decrease of optical fiber loss, the distance between relay stations can be lengthened, which can effectively reduce production costs and improve the quality of information and communication services.

2.2.4. **Good confidentiality**

Since optical fiber communication mainly uses optical wave to transmit signals, the structure of optical signal limited to optical wave guidance is completely bound to propagate in the fiber core, while other leaked light is absorbed by the cladding outside the fiber line, which will not cause electromagnetic radiation, so as to achieve the purpose of not crosstalk and leakage[6]. The general electromagnetic radiation spectrum is far away from the light spectrum, and it is difficult to enter the fiber core to affect the transmission of light signals. Therefore, optical fiber communication technology has the confidentiality that general cable communication cannot compare.

2.2.5. **Rich raw material resources**

All forms of electronic communication, whether wired or wireless, need to use a large number of non-ferrous metals, but glass silica used in the manufacture of optical fibers is rich in resources on the earth and difficult to draw materials.

2.2.6. **Light weight and small size**

The diameter of the fiber is very small, only about 50 micron, which is only equivalent to human hair[7]. Therefore, whether in packaging or transportation, it is very convenient and can be completed when laid alone. Light weight, small size, free bending, plastic sheath surface can be made of flexible, tough cable, can be laid on various terrain communication lines, installation is very convenient.

3. **Application of Optical Fiber Communication Technology**

3.1. **Application of Optical Fiber Communication Technology in Military Field**

Traditional military communication network technology can not meet the needs of modern China 's military and economic development. Optical fiber communication engineering technology can be applied to military communication, which can adapt to the complex environmental conditions of various social problems and greatly improve the command and combat capability of the people 's army[9]. At present, optical fiber communication technology has been widely used in the military fields of all countries in the world. For example, in the underwater anti-submarine task, the use of optical fiber communication can not only complete the work of mine cleaning, but also establish an underwater anti-submarine network system for real-time monitoring of underwater by using optical fiber communication technology. In short, the application of this technology in the military field provides strong technical support for the information construction of weapon air defense.

3.2. **Application of Optical Fiber Communication Technology in Railway Communication**

Optical fiber communication technology can not only ensure the stability of information transmission, but also accelerate the speed of information transmission. In China, the application of optical fiber communication technology in railway transmission is not long, but it has great application value. For example, wavelength division multiplexing technology is often used. The railway department mainly
applies it in low-level loss area to ensure signal continuity. Because wavelength division multiplexing can broaden communication channels, passengers can better enjoy online life[10].

3.3. Application of Optical Fiber Communication Technology in Power Communication
In recent years, the competition in the power enterprise industry has become increasingly aware of the most important role that optical fiber communication information technology can play in power system communication, and then through the continuous application of this technology in power communication, power communication can continue to develop in the direction of network[11]. Optical fiber is widely used in departments other than substations and national grid. Ensure the timeliness of power supply. In addition, the application of optical fiber technology also reduces the external influence on power communication and helps to reduce the occurrence of power accidents.

3.4. Application of Optical Fiber Communication Technology in Radio and Television
Optical fiber communication technology has been widely promoted in the television industry, especially in network television. On the one hand, optical fiber communication technology is applied to radio and television in the form of carrier, which is used as a reliable platform for network transmission to ensure the orderly transmission of broadcast information. In the broadcast information processing, through the effective processing of radio and television audio, video and other information, in order to make it present high quality picture quality and sound, and then improve the high level of radio and television services for the audience. On the other hand, the application of optical fiber communication technology in radio and television can effectively promote the construction of radio and television network platform, protect radio and television signals from interference by the external environment, and thus effectively broaden the channels of radio and television information dissemination.

4. The Future Development Trend of Optical Fiber Communication Technology
At present, optical fiber communication technology has become an important research and development direction in the field of science and technology, and its technical equipment level has been continuously improved. Next, based on the level of self-awareness, this paper analyzes the future development trend of optical fiber communication from the overall situation of optical fiber communication technology.

4.1. Achieve ultra high capacity information transmission
With the increasing demand for communication networks, existing technologies will be difficult to meet future information storage requirements. Therefore, optical fiber communication will further strengthen technical updates and improve transmission rate in terms of ultra-large capacity, which is one of the future development directions. In terms of information transmission volume, it is necessary to create new transmission waves and combine them with multi-purpose wave division to realize the development and application of single wavelength to multi-wavelength, so that multi-signals can be merged and separated. In addition, the storage capacity of information needs to be continuously improved in terms of storage[12].

4.2. Achieving Ultra-large capacity WDM
The development potential of the system with time division multiplexing technology is exhausted. However, the resource management of 200 nm available bandwidth through optical fiber only uses less than 1 %, and 99 % of the resource problem remains to be explored. The basic idea of wavelength division multiplexing ( WDM ) is that if multiple light source signals with appropriate staggering transmission wavelengths are transmitted simultaneously on a polar fiber, the information transmission capacity of the fiber can be greatly improved. The combination of optical time division multiplexing technology and WDM system can broaden the transmission channel of information, increase the transmission capacity and improve the transmission speed[13].
4.3. Optical device integration
Optical device integration is the goal of the development of optoelectronic devices. The integration of laser, detector, modulator and other dispersed chips into a single chip is the goal of optical device integration. The integration of optical devices is very important for the realization of all-optical networks, and it is one of the core enterprise technical issues.

5. Conclusion
This paper briefly introduces some principles and characteristics of optical fiber communication technology. After readers have a general understanding of this technology, this paper briefly analyzes the application of technology in some fields, and finally expounds its future development trend according to their own cognition.[14]. With the rapid development of optical fiber communication technology, it will become an important pillar of global information infrastructure in the future.

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