Research on Key Technologies of Performance Monitoring and Operation and Maintenance of Optical Fiber Transmission Network Driven by Big Data

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Abstract. The traditional network operation and maintenance technology is that the administrator passively waits for the network fault to report and then carries on the emergency treatment. This method lacks active mechanism and has many disadvantages in dealing with network communication failure. The low timeliness of operation and maintenance reduces the reliability of network communication operation and maintenance to a certain extent, so it is particularly urgent to explore the research of network communication operation and maintenance technology driven by big data. This article describes the difference between several different transmission modes in the field of optical fiber communication, and discusses the related factors that restrict the reliability and timeliness of the optical fiber transmission network. On this basis, this paper analyses the possibility of integration of big data technology and the optical fiber network, and lists the typical application of big data technology in the optical fiber network, which provides a new thinking direction for the performance monitoring and operation maintenance of the optical fiber network.

Keywords: Optical Fiber Communication, Big Data, Automatic Operation and Maintenance

1. Introduction

Optical fiber communication is different from traditional telecommunication communication, and there are essential differences between them. Optical fiber communication technology achieves the purpose of information transmission by taking optical fiber composed of optical fiber as the carrier of information transmission. Telecommunication technology uses the high frequency light wave as the carrier to transmit information. Optical fiber communication mode has incomparable advantages in the transmission frequency band and communication capacity, which makes it deeply integrated with all aspects of human production and life.

2. Overview of optical fiber communication

2.1. The principle of optical fiber communication
As the name implies, optical fiber communication is a kind of information transmission method which uses light as the communication medium \[2\]. It transforms the electrical signal and sound signal that people want to transmit into optical signal through professional instruments and equipment. Then, the signal is transmitted through the arranged optical cable to the destination to be transmitted. Finally, the signal is analysed by some professional equipment and instruments, and transformed into the information that people can receive directly. From the working principle of optical fiber communication technology, one of the advantages of optical fiber communication can be seen, that is, the extremely fast propagation speed. In addition, the propagation process of optical fiber communication depends on the transmission of the optical signal in the optical cable laid underground, so it has good anti-interference performance.

2.2. Development status of optical fiber communication

(1) Ordinary single-mode fiber optic cable fiber communication. The optical cable used in ordinary optical fiber communication is the most common single-mode optical cable \[3\]. This single-mode optical cable does not have enough communication distance in the early stage of development. Once the communication distance is long, the signal in the optical cable may be lost and disturbed, which will affect the accuracy of data transmission. In the early stage, the problem of the single-mode fiber optic cable lies in its channel capacity, which cannot meet a large number of signal transmission. Therefore, in order to adapt to the scale of signal transmission, the transmission distance and channel capacity of single-mode optical cable have been optimized in recent years.

(2) Dielectric optical fiber communication. The optical cables used in optical fiber communication are not all made of metal materials, and the most ideal communication line is a kind of dielectric. This kind of dielectric fiber optic cable has no metal component, and its excellent communication effect makes it a popular product for signal transmission. The only defect of this kind of optical cable lies in its high cost and needs to be imported from abroad. Although the domestic research and development of this kind of optical cable has started in recent years, there are still some differences between the performance of this kind of optical cable and that of the imported optical cable, which needs to be improved in the future development.

3. The restricting factors of the development of optical fiber communication at present

3.1. Outdated monitoring and management system

The information monitoring and management system of communication network in most enterprises is relatively backward, which leads to the failure of enterprises to form an integrated information business platform. At present, the information platform support of communication network operation and maintenance management of many telecommunication enterprises mainly adopts the deployment management mode promoted by national network and provincial network, among which IMS, ISS and other network monitoring and security monitoring systems for the communication network operation and maintenance management mainly adopt the platform deployed by the national network and provincial network \[4\]. At the same time, the main business management software is deployed based on the two-level mode, which cannot penetrate into the business system of the prefecture level power supply company. In addition, the telecom enterprises lack of a special integrated centralized communication network operation monitoring platform. In the supervision system, all management work can only be implemented by the operation and maintenance personnel in their respective terminal hosts, which leads to the lack of business management overall view.

3.2. Unreasonable resource scheduling

The existing communication network resource allocation and supporting working mechanism can not meet the requirements of the company's refined management mode. At present, the operation and maintenance management mode of most telecommunication enterprises mainly relies on the telephone duty management of maintenance personnel and other management personnel. At the same time, part
of the work adopts the part-time information communication coordination mechanism. With the continuous expansion of the scale of telecommunications companies' communication networks and the increase in the complexity of management services, problems such as poor timeliness of operation monitoring, low timeliness of fault handling, and insufficient scheduling capabilities in the above management modes have become more obvious. This model not only affects the quality of the operation and maintenance management of the communication network, but also reduces the company's overall service capabilities.

4. Integration of big data and optical fiber network

4.1. New technology for the maintenance of optical cable transmission line

This paper presents a new fault handling system for optical fiber communication network. Through the communication network resource management module, the system can build the network resource database of the optical cable communication network and generate the network model of the optical cable communication network based on the network design, construction data and other network information on the geographic information platform. At the same time, the system can update the network resource base dynamically according to the network changes in the maintenance process.

(1) The fault signal filtering and analysis module

According to the network model and the model-based association method, the module can analyse the massive alarm signals and identify the fault source and fault type.

(2) The network fault location module

The module can determine the fault type and identify the fault equipment according to the network model and alarm signal filtering results.

(3) The network fault handling module

According to the fault type and location, the module can call the expert system to generate the fault handling scheme. At the same time, it can send the fault handling scheme to relevant personnel through mobile Internet and mobile application. In addition, the module can generate the electronic map marked with the location of the fault point according to the geographical location of the fault point. Figure 1 shows the architecture of the intelligent fiber failure analysis platform.

![Figure 1. The architecture of the intelligent fiber failure analysis platform](image)

4.2. Using big data technology to build communication data integration platform

In the operation and maintenance process of network communication, it is necessary to classify the data in the network communication system and establish a global model [5]. In this way, each classified data source is mapped to the global pattern, so that the heterogeneity of data can be masked. In the process of network communication data integration, first of all, the storage format and information meaning of all data should be analysed completely. According to the analysis results, the global operation and maintenance mode should be established, and the global operation and maintenance mode should be used as the basis for the exchange of network communication data. In the integrated platform, the data layer provides all kinds of data for the network communication operation and
maintenance, the relational database and spatial data file of the data layer are used to store the network communication data, and the mobile terminal is responsible for reporting the fault data in the operation and maintenance process. For the dynamic data of network communication reported by the mobile terminal, considering its efficiency, the wrapper will encapsulate the dynamic data into the data format transmitted to the interest management module, and then the task of transforming it into the global mode will be completed by the interest management module.

4.3. Using big data technology to analyse and evaluate the performance of communication network
Communication network operation and maintenance technology can comprehensively evaluate the performance of communication network by statistical analysis of data information in data packets. Network performance analysis is to analyse the time of data packets entering and leaving the device at both ends of the network communication equipment, so as to obtain the delay of the network communication equipment \[6\]. At the same time, it can also analyse the number of data packets entering and leaving the network communication device to obtain the packet loss of the network communication device. However, the flow of network communication is accumulated by a large number of data packets, so the utilization rate and operation of network communication can be accurately analysed through the integrated platform. Figure 2 shows an example of analysing the accuracy of communication network fault detection based on big data technology.

![Figure 2. Accuracy analysis of communication network fault detection](image)

5. Conclusion
In the process of optical fiber line maintenance management, the most important link is the performance monitoring and maintenance link of the optical fiber cable line. If there is a problem with the optical fiber cable line, the entire communication network will be seriously affected. In the era of deep integration of big data and communication technology, the scale of the communication network will be larger and larger, and performance monitoring and maintenance management of optical fiber lines will be more important. Therefore, communication enterprises should not only keep updating in technology level, but also change in maintenance mode. In short, modern telecommunications companies should integrate advanced management concepts and technologies into operation and management of optical fiber networks, so that optical fiber technology can contribute unique strength to the transformation and upgrade of the national economic structure.

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