

Current Situation of Operation and Maintenance of Railway Communication Network and Equipment

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Abstract

With the rapid development of China's railways, communication network has been widely used in railway construction, and communication network equipment has also been widely used, resulting in increasing network failures year by year. This paper analyses the current situation of railway communication development at home and abroad, the maintenance technology of communication network, network failure and management mode, and summarizes the application of new technology in maintenance of railway maintenance department and some improvement schemes. This paper uses theoretical knowledge to analyze and optimize the implementation of the transformation. In the aspect of communication network management mode, the reform of management mode and the adjustment of organization structure are put forward. A comprehensive evaluation system was established. The relevant measures and methods to solve the problems of railway communication network are put forward.

Keywords

Communication Network; Network Failure; Network Management; Comprehensive Evaluation System.

1. Introduction

With the rapid development of railway transportation and the arrival of data era, the speed of traditional communication network can not meet the needs of the public. With the increasing demand of railway communication network, higher requirements are put forward for communication technology. Railway communication system is an important project of urban construction, and also an important symbol to test the level of urban construction and development. It is an important task for railway construction and safe operation to optimize the management of railway communication equipment, to be familiar with the application technology of railway communication and to establish a scientific management system of railway communication network. In different times, the equipment and communication technology of railway communication network are also different, and the maintenance of railway communication network is also developing continuously. In order to realize better operation of modern railway communication network, this paper carries out equipment maintenance and fault analysis of railway communication network, and puts forward suggestions on strengthening network maintenance, upgrading and optimization, and establishing comprehensive management system [1-3].

There are two main purposes in Establishing Railway Communication system. On the one hand, it is convenient for the personnel inside and outside the railway to communicate in train operation, obstacle maintenance, power supply, safety assurance, passenger service and information maintenance, and to provide voice and data information exchange for the railway department on duty, train driver and maintenance personnel. Provide accurate time information for the normal operation of the railway; on the other hand, provide reliable transmission through different network systems in railway transportation [4].

Nowadays, the world is expanding the scale of the network, and the number, type and specification of online devices are also increasing, which improves the complexity of the whole network, and the problems of manufacturers are becoming increasingly prominent. Because developers of different

operators adopt independent R&D technology and their own management system, incompatible network protocols will inevitably be brought, management information can not communicate with each other, and there are loopholes in the whole network management.

1.1 Research status in China and abroad

Since the establishment of China Telecom, Mobile and Unicom, scholars at home and abroad have studied and discussed its development direction, and put forward many views. At present, the three major domestic operators are facing many difficulties, and there is still a lack of substantive research on the operation and maintenance of railway communication network. For the subject of how to use scientific methods to establish an effective railway communication network solution, starting with the research on the use and development of foreign railway communication network, this paper studies the use of foreign railway communication network based on the maintenance technology of communication network, drawing on the theory of domestic experts and the actual results of network. Based on the close relationship between the network operation system of Railway Communication Company and the network operation system of domestic telecom operators, this paper studies the subject and puts forward solutions [5-6].

1.2 Overview of the problem

With the development of economy, communication network has been integrated into all aspects of social life, and the requirements for communication network are also increasing. Communication network is stable, fast, simple and convenient, so that the network transmission efficiency can adapt to different levels of social activities in time. Railway, as a transportation hub between cities, plays an increasingly important role in economic development. Therefore, the requirements of railway departments for communication networks have been further improved. Due to the diversity and complexity of the communication network, there is a huge conflict between the traditional maintenance mode of the railway communication network and the maintenance mode of the railway communication network in the new era. Operators try to explore the original railway communication network equipment maintenance technology. However, there are no substantive suggestions on equipment technology and network operation of railway communication network in the world, and the operation of the whole railway network is still at a standstill. Therefore, it takes quite a long time to establish construction specifications according to network management standards.

1.3 primary coverage

This topic mainly studies the status quo analysis of railway communication network equipment and the deficiencies in network maintenance, finds out the key points of network equipment failure need to be maintained, and puts forward the fault analysis scheme. In network operation and maintenance management, it is proposed that we should be familiar with improving communication technology, optimizing and reforming communication network, transforming organizational structure, and establishing accurate management maintenance mode. First, network technology maintenance, including PTN technology, access network technology, GMS-R technology, GIS technology; second, network equipment, fault detection, fault analysis and solutions; third, network upgrading, optimization and transformation. Aiming at the maintenance mode of railway communication network equipment, a new idea is put forward. According to the characteristics of railway communication network equipment, the original maintenance system has been reformed and adjusted.

2. Research on Equipment Maintenance and Technology

The construction of urban railway makes people's life more convenient. With the increasing number of communication network users, railway departments have encountered various problems on the basis of communication network equipment maintenance technology. With the development of modern technology, the railway system has gradually separated from the traditional communication technology and adopted more new network technology.

2.1 Application of PTN Technology

With the increase of railway communication users, traditional SDH communication technology can not adapt to the development of the new era, seriously affecting the development of railway business, so PTN technology was born.

Compared with SDH technology, PTN technology has many advantages: PTN technology uses statistical multiplexing of packet switching and hierarchical QOS computing, which improves the efficiency of statistical multiplexing of data services and realizes the rigid bearing experience of key value services. PTN belongs to the technology of wide bandwidth. Single port can realize 100GE and 400GE. The protection power of PTN can reach 50ms, which improves the security of communication system. It can effectively solve the connection problem and realize other complex transmission services.

In PTN technology, all of its service bearer implementations are grouped tunnels. On the basis of tunnel and simulation, this technology can meet the needs of service transmission in the process of network evolution, and improve the effective configuration of multi-service and the operation and maintenance of network. PTN technology has the following advantages [7-9].

Tunnel and simulation

With the continuous development of communication network, services such as TDM and IP will coexist in the communication network system. PTN technology is a kind of grouping tunnel. It can not only effectively protect investment, but also accurately meet the needs of the continuous development of railway communication system, improve the effective configuration of services and network operation and maintenance.

Connected Tunneling Technology

Railway communication network system is mainly oriented to traffic command, dispatch management, train operation and other information systems, which need high quality service transmission level. In PTN technology, tunnels are constructed and dismantled for all enterprises according to the concept of simulated load-bearing of tunnels. The realization of centralized control plane needs complete face-to-face connection. When connected to the forwarding node, only the initial specified operation is performed, not the lookup table and the addressing operation of each hop, which can reduce unexpected errors and packet loss. In addition, it reduces the practice on the transmission path, effectively prevents the jitter caused by data errors, and finally guarantees the quality of service transmission.

2.2 Access Network Technology and Railway Communication

Access network technology is the most basic component of railway communication network. Access network technology in railway communication network mainly includes two aspects: special application and public application. Among them, the special contents of railway special communication mainly include: interval telephone, blockade telephone, special telephone, inter-station telephone, dispatch telephone, etc. Access network has the following applications in railway communication.

Wireless Access Network

With the rapid development of railway communication network, the speed of train operation is gradually accelerating. Therefore, in order to adapt to its development, it is very important to adopt wireless or mobile access network technology. Wireless access technology mainly includes mobile satellite communication, WiFi and so on, as shown in Table 3-1. Wireless access network is usually divided into fixed wireless and mobile wireless. SDH optical synchronous digital transmission technology is more effective for communication and interaction between fixed stations or devices. Within the framework of the whole network system, master the combination of new technologies such as ATM switching and IP network communication, and create a backbone communication network. For example, the dual-fiber unidirectional ring access mode has the advantages of high cost

performance, high speed, high efficiency, high security, strong self-healing ability and good reliability.

Table 3-1 Wireless Access Network Technology

Access Technology	Downlink transmission rate	mobility	Maturity	Transmission cost
Mobile Satellite Communication	2Mbps	Low	Mature	High
WiFi(IEEE802.11)	300Mbps	Medium	Mature	Low
WiMAX(IEEE802.16e)	70Mbps	Medium	Mature	Low
3G	WCDMA: 7.2Mbps	Medium	Mature	High
	CDMA2000: 3.1Mbps			
	TD-SCDMA: 2.8Mbps			
LTE	100Mbps	High	Mature	High
4G	1Gbps	High	Immature	High

Cable Access Network

In railway system, the traditional train dispatching, freight dispatching or dispatching systems all adopt line dispatching mode, and the core is cable ring structure. Switches used in digital scheduling can not only work independently, but also cooperate with switches. By using this method, the dispatch can be extended to ordinary telephone users, and the fan can be extracted from each station by using access network technology to realize the point-to-point communication interaction between extension and switch. In the railway station, the dispatching extension interface of each station is combined with the telephone subscriber extension through optical fiber line to realize the communication function.

Hotlines or blockades

Telephone systems in railway systems include hotlines and blockade phones. Shielded telephones can also be called station-to-station drive telephones. It is mainly suitable for point-to-point communication between adjacent stations in railway train centralized dispatching system. The railway communication network system realizes the exchange and exchange of network information through access network technology, and realizes the interactive mode between the upper and lower stations, including the sub-disc settings of detection circuit and ringing circuit. In railway communication network system, pairs of common disks and total disks are usually needed, and telephone total disks are realized by using shared disks through access network technology. When the call circuit in the railway communication network is convective, a direct current circuit is formed in the access network, so that the loop current can excite the whole main disk. The final ring circuit triggers the sound, and the worker can connect the call.

Collinear telephone dispatching system

The telephone dispatching system of railway communication line is composed of extension, transmission channel and dispatcher. The public line telephone dispatching system links the extension and the switch in parallel to complete the communication between the extension and the switch, but the communication between the extension and the extension is not possible. Generally speaking, collinear systems are not a group. Extension number is about 20-25. There are about 15-25 calls in this group. Other railway communication systems, such as electric power survey system, freight transportation system and train system, adopt independent transmission network. Telephone communication is realized through collinear series connection and carrier loop or solid-state channel.

In order to improve the safety of train operation, voice of railway communication network can not be superimposed on OLT point, which avoids OLT point failure and the collapse of the whole network.

2.3 Application of GMS-R Technology

GMS-R system is a railway dedicated digital mobile communication system based on GSM technology. The frequency band of GMS-R technology is 9000MHZ, which not only increases the function of mobile communication, but also applies to the communication work in high-speed motion environment.

GMS-R system network is a communication network based on Internet interaction technology. GMS-R communication network of Internet interaction technology includes intelligent network and switching energy. GMS-R communication network does not belong to a special area or railway network, but covers the whole country through Internet interactive technology. Digital GMS-R communication network in railway system is the combination of traditional fixed communication network and integrated digital mobile network, which improves the flexibility and convenience of railway communication network and makes GMS-R communication network run well in high-speed motion environment [10-11].

When the railway department adopts GMS-R technology, in order to ensure the safety of GMS-R communication network operation and reduce the construction cost of communication system, relevant construction departments should deeply study the relationship between the equipment provided by different manufacturers and the reliability of GMS-R communication. Firstly, promoting interconnection and on-site testing is conducive to the formation of a healthy market competition, which greatly reduces the risk of communication system construction. Secondly, to ensure the normal operation of GMS-R communication network is conducive to better service for railway communications. Considering the long-term development of GMS-R network in the future, according to the goal of communication network construction planning, the overall benefit of communication network can be maximized. By facilitating interconnection and field testing, it is possible to ensure that the major network components of different manufacturers' equipment can be exchanged.

2.4 Application of GIS Technology

The GIS system is based on geospatial database and uses the method of geographic model analysis to support all kinds of spatial and dynamic geographic information, as well as the computer technology system of geographic research and geographic decision service. Today's Ministry of Railways Geographic Information System is only in use in 2009. The main purpose of the system is to establish the database of the frequency of on-board equipment and the switching of working system all over the world to ensure the safe operation of trains. The system centralizes the geographic information used by train communication equipment, formulates a unified version of geographic information data for the whole road, provides standardized data for train dispatching, and realizes automatic frequency switching of the whole road.

System Composition

Railway GIS system is divided into railway company and railway sub-bureau. Headquarters level includes headquarters data management server and headquarters database server. Railway sub-bureau includes railway station data management server, data acquisition and data acquisition terminal.

Technical improvement plan

Relatively few methods are used in the railway system of GIS. The database is only available for custom CIR devices. Its software and hardware expansion capacity is limited and cannot meet business requirements. With the development of railway, the demand of GIS system application is increasing. Experts have studied and found that the database, software and hardware of some GIS systems can be improved.

The database structure of the existing GIS system is relatively single. All kinds of data information in the system are concentrated in the database, which is not conducive to the expansion of the system application. Therefore, it is suggested that different data should be classified, hierarchical

management should be carried out for different levels of users, and multi-level decentralized management should be established. This is not only conducive to the expansion and upgrading of the system database, but also conducive to protecting various data information and improving the security of the system.

With the development of science and technology, hardware and software technology is also developing continuously. The improvement schemes of GIS system include database capacity upgrading, data acquisition equipment upgrading, data management equipment hardware upgrading, supporting incremental updating of basic data and wireless updating. At the same time, the system supports customized terminals for various applications, breaking through the existing CIR communication equipment. The standardized geographic information data interface of the system can be connected with other communication information systems to realize business interoperability and resource sharing. The upgraded GIS system will make better use of GIS technology and provide a solid technical foundation and reliable guarantee for the maintenance and management of railway communication.

3. Fault Analysis and Maintenance Reform

With the gradual increase of railway traffic, the fault of railway communication network increases year by year. Therefore, how to analyze the network fault, debug the related communication equipment, upgrade the communication network has become a key problem.

3.1 Fault Analysis of Communication Network Equipment

At present, there are various problems in the transformation of the communication network in railway departments of our country. For example, communication equipment performance is low, network bandwidth is small, equipment debugging failure rate is high, poor network security, etc., the following will be specific analysis and solution of various faults.

Line fault analysis

During the debugging of railway data communication network equipment, the frequency of switch connection fault is very high. When this failure occurs, it can slow down the server and prevent platform workers from accessing the internal server. In this case, the server of the road station will be cut off. Secondly, it misleads the accuracy of data and affects the transmission of information. Accordingly, relevant department should discover and deal with in time.

When the switch is disconnected, the server's network speed will slow down. There are four reasons for this failure: one is the transmission errors of installed devices; the other is the configuration errors of routers in the network; the third is the network problems of two routers or switches used to connect computers; and the fourth is the quality problems of the switches used. In the actual investigation process, the staff can use the exclusion method to eliminate the causes of the above-mentioned failures one by one, find out the real causes of the failures, and solve the problems.

Fault Analysis of Equipment Debugging

In the process of debugging communication equipment, railway departments will inevitably encounter some technical problems, which will lead to some faults. Therefore, in order to avoid the frequent occurrence of faults, it is urgent to take appropriate measures to deal with these faults in order to prevent these faults from occurring again in the future network operation and ensure the normal operation of railway communication network. In view of the failure situation, the following measures can be taken: First of all, you can lay the network cable by way of labeling to remind; Secondly, the configuration of parameters is given priority. Thirdly, strengthen the check of network Settings.

Network State Fault Analysis

There are many factors leading to network instability, including network problems or devices used in switch connections. When this happens, the above reasons should be examined one by one. If there is no such reason, it may be directly related to the protector. The main reason is that the data

transmission range of some protection devices in the configuration process is very limited. When the data transmission exceeds the scope of use, the loss of the protector will further increase, which will affect the data reception and transmission, and reduce the network speed.

In the debugging process of communication equipment, the protector is prone to produce greater attenuation, which is the main reason leading to abnormal network connection or disconnection. The main performance is that when the stability of the network is not good, it will seriously affect the normal operation of the railway data communication network, not conducive to the use of the network by users, not conducive to the normal operation of the railway data communication network, and the related work is heavy.

3.2 Maintenance and optimization

Considering the particularity of railway, its communication network must be able to achieve deep coverage to ensure the quality and efficiency of communication network. According to the quality standard of communication network provided by railway company, if the coverage efficiency can reach enough coverage, the signal intensity of switching enough areas and boundary parts needs to be adjusted. Establish new base stations with wide coverage. For frequently switched components, the optical fiber should be vertical. Distributed signal coverage is achieved by long-distance cell coverage, which reduces the number of handoffs. Due to the chaos of local signals caused by weak signals, it is necessary to add base stations directly to cover complementary functions.

3.3 Network upgrading and transformation

Railway communication engineering is still in the stage of construction and development. In the process of construction and operation, there are many problems and shortcomings. Make rational use of modern technology to promote the upgrading and transformation of railway transportation. At present, there are some problems in data transmission of communication network, such as slow transmission speed, low accuracy and low efficiency. Railway communication network upgrading and transformation mainly includes the following contents:

Data collection

The upgrading of railway communication network is based on data acquisition. Staff go to the construction site for investigation and detection, do a good job of data collection, improve work efficiency, provide a strong reference for network engineering construction, reduce the burden of construction personnel.

Data classification module

After the collection is completed, the data are selected and classified to eliminate some data information which has little influence on the network operation. Data classification module is to effectively classify the collected data, extract useful information from it, and ensure the rational use of data information. For example, the classification module is set up in the computer system to divide the information, input the relevant data of railway engineering survey into the information system, and classify the scientific classification data of the classification module, including geography, hydrology and meteorology, so as to facilitate the transmission of information.

Data processing module

The processing module mainly processes data and completes the automatic processing of data information. Its operation directly affects the level of railway communication data processing. Therefore, according to the configuration characteristics of computer system hardware and software, the key is to control the memory size and running state of the server.

4. Reform of Management Model

In addition to maintenance technology, the railway communication network also needs to reform the maintenance system. Guided by the authenticity theory and assisted by modern technology, it improves the maintenance layout, improves the maintenance process, optimizes the quality of service,

optimizes the quality of equipment use, and reduces the adverse effects of maintenance on communication services.

The following is mainly about the reform of maintenance methods and organizational structure.

4.1 Maintenance Mode and Maintenance System

Railway communication management departments take network management as the leading role, monitor and assist at any time, pay attention to daily maintenance and timely response, attach importance to equipment and communication network management resources, theory and practice management, and effectively maintain communication network. Do the following.

Establishing the Basic Framework

Railway communication network units manage and use communication equipment. Within the prescribed scope of electric power implementation, according to the actual situation of current work and the operation status of railway network, the independent and reasonable allocation of personnel and the control of expenditure are combined to explore the concealment ability of communication network equipment and improve the utilization efficiency of communication network equipment. Reform and innovation of maintenance technology will be carried out to maximize the application ability of network equipment and realize three-step development of funds, quality and efficiency.

Establish basic steps

Information management uses a variety of digital frameworks and a large amount of data to timely infer the best solution to relevant problems, to assist managers at all levels in decision-making, to make rational use of staff and information resources, and to achieve higher information benefits. People-oriented, the use of network communication equipment for network data collection, transmission, storage, update and maintenance, improve the efficiency of the communication network. The information management system can truly reflect the operation status of operators, help decision-making, control behavior and achieve planning objectives from the overall perspective of operators.

Service management system needs to cross all levels of management, selectively share service management information; cover up the implementation details of various parts of the network system through diversified information; and provide mechanism guarantee. At the same time, by selectively partitioning the data within the prescribed operating range, we can provide superior communication network service level for customers with different service levels.

One is to tap the potential capacity of communication network equipment; the other is to allocate personnel reasonably and effectively; and the third is meeting the needs of different levels of network users.

Establish maintenance team

At present, Railway Communication maintenance personnel account for 42% of the whole department, accounting for 1/2 of the railway company. Maintenance personnel and managers are more inclined to face this diversified and complex network equipment fault judgment rate and solving ability. Employees should learn to break the original professional knowledge and maintenance, improve the practical application ability of technology, keep up with the pace of reform, and carry out new maintenance work. In daily life, real-time monitoring, timely inspection of network operation, pay attention to the maintenance of communication equipment, to ensure the normal operation of railway communication network.

4.2 Adjustment of organizational structure

Dispatch and Command System

Railway traffic in the inner layer of the country gradually set up by the headquarters (management of TMSC1), then to the provincial branch (management of TMSC1), and finally set up a branch in the urban area, "separation of powers". Take the head office as the center, the province, the city as the auxiliary, exercises the management authority independently, checks and balances mutually. Companies at all levels should earnestly establish network management departments suitable for the

operation of the regional railway network. Railway communication network system is also divided into two major technical support, one is the technical support of the head office, which is the main technical support; the other is the technical support of provinces and municipalities, which is the secondary technical support.

Management Hierarchy System

Railway network departments should always follow the evolution of communication technology and changes in customer needs, constantly improve the operation process and strengthen network management. In the process of management, one is to maintain communication equipment and network, the other is to excavate potential resources in equipment maintenance, and the third is whether the improvement of these two aspects can improve the transmission rate of communication network and better meet the needs of customers. The following three levels are analyzed:

Maintenance level: Railway communication network operation and maintenance should start from three levels. The first is to monitor the communication network at any time and find the errors in the network operation in time; the second is the technical support of maintenance personnel, familiar with the use of various communication network equipment, and can achieve rapid support; the third is to maintain the communication network to achieve fast, timely and accurate, shorten the maintenance time, restore network communication and ensure the operation of railway communication.

Resource Level: Resource is the core of the whole network system. Railway administrative departments should make full use of hidden resources and combine them with existing resources to make accurate and effective use of hidden resources. Such as communication network equipment, communication cable, optical cable transmission capacity equipment resources, customer resources to expand the scale of users, human resources reasonably allocated by managers, adequate communication network equipment and other network resources.

Service Level: Considering the different requirements of customers for communication network, the level of service is different. Enterprises strive for diversified and complex network needs, formulate plans to ensure appropriate quality. Provide customers with a variety of ways to meet customer needs and improve business efficiency.

Emergency response system

Railway communication departments have reduced the occurrence of network failures and the damage of communication equipment components, and prevented the smooth operation of the network, or even the occurrence of network failures. Therefore, it is of great significance to establish and improve the emergency system for railway communication network maintenance. The implementation of network emergency system is to send decision-making information to local railway companies when network failures occur, and notify maintenance personnel to deal with abnormal situations. Second, there is no staff in the branch to handle network anomalies or to thoroughly handle anomalies, so the system transmits them to the head office to report the situation. Step by step until the fault is completely eliminated. Emergency system can also install intelligent systems to assist maintenance personnel and speed up troubleshooting.

4.3 Establishing a Scientific Comprehensive Evaluation System

Before the reform, the railway department only cared about the evaluation of communication equipment technology, but on the one hand, the railway department could not adapt to the competitive market of network operators in the new century and could not meet the needs of the public. Speed up the reform of existing evaluation methods and network operation and maintenance quality, and establish a scientific and comprehensive maintenance and evaluation system as soon as possible, in order to provide a basic telecommunications network and network operation and maintenance quality of social evaluation of operation status. High-precision maintenance positioning is one of the important systems for building a new type of maintenance work. According to the current situation of network maintenance and network service demand, railway network maintenance evaluation

system should be divided into three indicators: communication maintenance quality, maintenance service quality and operation and maintenance efficiency.

The quality of communication maintenance is embodied in mechanical equipment failure, network transmission, obstacle occurrence, obstacle repair, average obstacle duration, longest obstacle duration, etc. The quality of maintenance service is embodied in the level of service facilities, service environment, service personnel quality level, service level and so on. Service mechanism and system level, service identification and image, the efficiency of operation and maintenance is reflected in the organization operation and maintenance.

5. Conclusion

With the rapid development of science and technology, the development speed of information technology is also gradually accelerating. Railway has become an indispensable part of social development. Railway transportation is in all directions. Understanding and improving railway communication technology and analyzing communication network faults are of great significance to railway transportation and construction. With the integration of communication network into all sectors of society, strengthening the maintenance of railway communication network is an important part of railway development.

This paper takes communication network equipment and communication technology as the research object. Based on the analysis of the development status of railway communication, the obstacles in the operation and maintenance of railway communication network are put forward. Through the analysis of the influencing factors, it is found that only by ensuring the stability and reliability of the railway communication system, can the safety of the railway train operation be guaranteed to the greatest extent. From the perspective of network operation and maintenance, this paper makes a comprehensive analysis and Research on the establishment of a new network operation and maintenance system, trying to analyze the impact of the rapid development of digital information on the reform of railway communication network operation and maintenance management. At the same time, based on the research and analysis of the background of railway communication network, a scientific comprehensive evaluation system is established. At the same time, it is pointed out that the communication network must be optimized and reformed to improve communication efficiency, support railway development and improve the level of railway communication in China.

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