Analysis of centralized control system for safety production and operation of distribution network

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Abstract. In the construction and development of modern society, the distribution network as an effective connection of power supply equipment and electricity customers of the power transmission system, during the production and operation of whether the safety and reliability, directly affect the power supply equipment and electricity equipment efficiency and quality. Therefore, how to build a centralized management system of big data is an important research topic put forward by electric power enterprises under the background of the comprehensive development of work, and also an effective means for enterprises to achieve scientific management and improve work efficiency. On the basis of understanding the production and operation status of distribution network, this paper focuses on the structure and application effects of power centralized management system based on Spark, according to the study status of Chinese big data management and power enterprise information integrated management. The final experimental results show that the overall system design can further improve the throughput of the system and provide users with high-quality service functions.

Keywords: Distribution network; Electric power engineering; Safe production; Big data; Centralized control.

1. Introducion

In the rapid development of social economy and science and technology, with the continuous reform and innovation of power supply technical equipment in our country, the construction level of power grid has become higher and higher, and the construction technology of urban power grid has become more and more perfect. The construction scale and application quality of existing distribution network has been improved comprehensively. However, the traditional distribution network production and operation management mode problems become more obvious, which directly limits the distribution network production efficiency and reform and innovation. Especially after entering the era of big data, along with the application scale of distribution network in our country has continued to expand, the number of urban users and user types more and more, resulting in the original distribution network management mode and management concept has been unable to meet the time business demand, often there will be problems such as inadequate management and untimely management. Therefore, some scholars proposed to build and promote the big data centralized control system according to the safety production and operation requirements of power distribution network engineering. From the perspective of long-term development, the big data centralized management and control system plays a unique role in the safety production of power distribution network engineering, which is reflected in the following aspects: On the one hand, it helps to improve the production and operation efficiency and quality of the distribution network. The concept of big data first appeared in the field of consulting, and now it has been widely used in many industries. It is an important basis for the innovation and exploration of technical theories. [1-3]If we can deeply dig the massive information data in a certain field, we can master more valuable information resources from it. Therefore, at present, the safety production and operation of Chinese distribution power engineering pay more attention to the study and application of large data centralized control system, which can master more valuable information resources and comprehensively improve internal management efficiency; On the other hand, it is helpful to improve the comprehensive ability of market competition of electric power enterprises. In the continuous improvement of the market economic system, the rapid development of the Internet

economy and the trend of global economic integration have changed the traditional market operation mode. In order to occupy an important position in the increasingly competitive market environment, power enterprises should put forward effective countermeasures according to specific problems. For example, when establishing a regional distribution network, they should first use the centralized control system of big data. Collect various information of local electricity customers, and then improve the service function of the existing platform according to the information. In this way, it can not only give full play to its own unique advantages, but also meet the consumption demand of local electricity customers.[4-6]

In the context of the era of big data, the data information produced by power enterprises shows an explosive growth trend, but the phenomenon of information island still exists among some business systems. This is because the sharing degree between different information departments is low, and the application value of data information cannot be shown in the process of production and operation. Therefore, at present, in view of the basic requirements of safe operation of power distribution network, scholars in various fields have proposed to use software-defined network to build the centralized control mode of power big data link network, and some scholars have also proposed the power grid big data processing platform with cloud computing as the core. These application effects can prove that the centralized control of big data plays an important role in the construction and management of power distribution network. Therefore, after understanding the current situation of safety production and operation of power distribution network engineering, this paper mainly explores the design structure of big data centralized management and control system with Spark technology as the core according to the application value of big data centralized management and control system, and defines the system application performance and effective measures by combining practical cases.[7-9]

2. Methods

2.1 Overall Architecture

Spark is a data interaction mode of distributed computing based on data models of the RDD type. RDD represents data sets and can be directly stored in the system. Compared with the traditional way of disk data exchange used by Hadoop, it can effectively improve the system computing level. In addition, Spark provides diversified operation types, which is suitable for managing large data in a centralized manner. Shark is a data warehouse tool based on Spark. It provides SQL interfaces for system running and can transform any SQL query into a distributed query. In Shark, a table can be used to represent a directory in the HDFS, and the files in the directory are the data in the table. Shark supports partitions. Each partition is a subdirectory in the table directory. Spark runs in three modes. The following figure shows the overall running architecture:

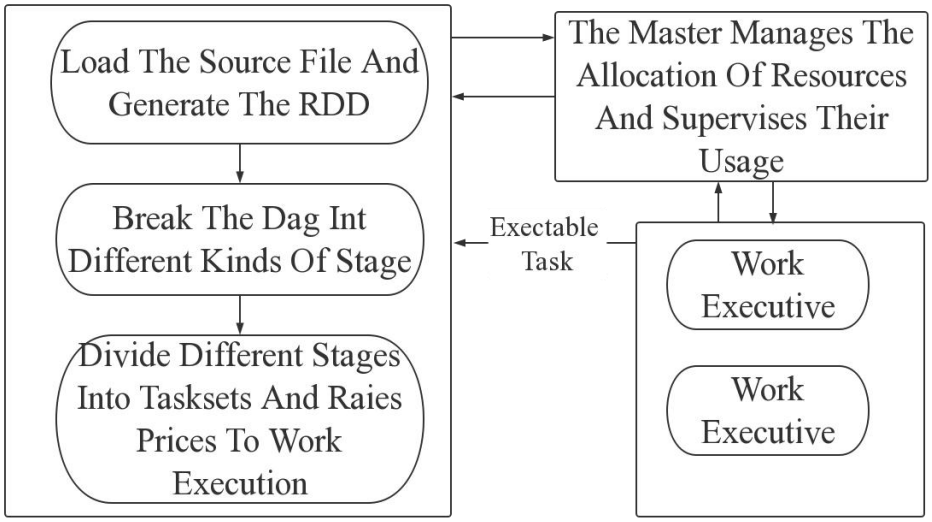

Figure 1 Running architecture diagram of Spark technology

2.2 System Requirements

On the one hand, scalability. This performance refers to the ability to self-regulate the system computation and processing performance with minimal system impact. At present, the production and operation of power distribution network engineering involves multiple links. Coupling design is carried out between different levels to ensure that the system has independent external service performance and can better meet the needs of system expansion. On the other hand, usability. Availability refers to the ability of a system to efficiently access or continuously provide services. Generally speaking, the formula for calculating the availability index of the system is as follows:

$$G = (1 - T_u/T_a).100\%$$

In the above formula, G represents the degree of availability of system cycles, Tu represents the time of unavailability, and Ta represents the total time of system operation.

The system architecture studied in this paper is mainly divided into three layers, as shown in Figure 2 below:[10-13]

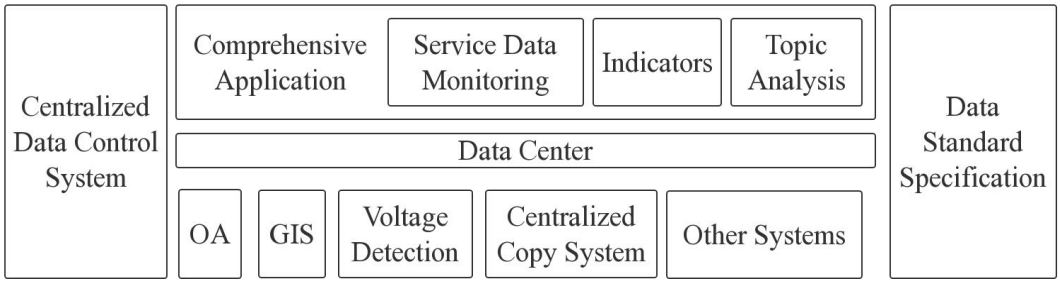

Figure 2 System architecture diagram

Based on the above analysis, it can be seen that the first is the support platform for business operation, the second is the index data center, and the last is the comprehensive application.

The data center structure of the system is shown in Figure 3 below:

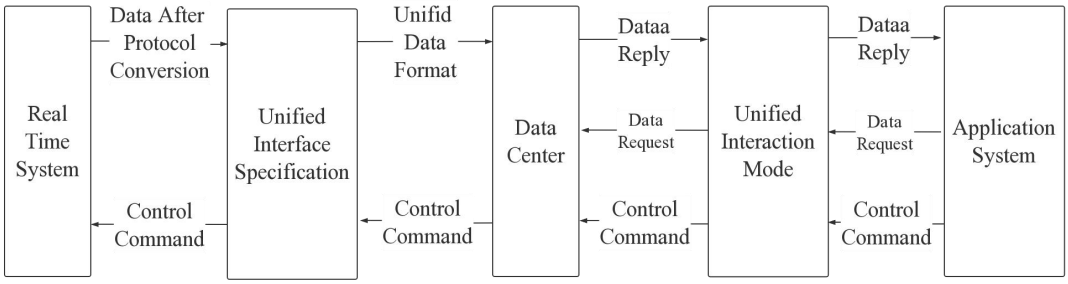

Figure 3 Data center architecture

Based on the analysis of the above figure, we can see that the application system will put forward data request and control command based on the unified interaction mode, and the unified interaction mode will transmit these two contents to the data center, and the data center will put forward control command to the unified interface specification, and finally apply it in the real-time system. The real-time system will ensure that the data information has a unified format in the unified interface specification of the transfer protocol interface, and then through the data center and the unified interaction mode, and finally stored in the application system. From the perspective of overall system operation, data information should be synchronized to the database by means of interface service and data sharing. The overall operating environment is shown in Table 1 below:[14-15]

Table 1 Environment analysis of system operation

data source	data type	Interface synchronization frequency
Centralized data management and control	Spatial coordinate data of related facilities and three-dimensional and two-dimensional influence	Synchronize once every morning.
	Substation, distribution room and transmission line	
	Business request	one minute
	Monitoring according to inspection points	once a day
large screen	Accurate positioning of integrated GIS system	It depends on the situation

2.3 System Functions

According to the above analysis of the system design structure, diversified functional modules should be designed and promoted according to the safety production and working requirements of the power distribution network engineering, which mainly include power data quality assessment, power load management, comprehensive service analysis, etc., which can truly achieve the basic objectives of visual management and information integration. Convenient real-time monitoring and orderly management of the whole process of customer service.

For example, in the load service management and comprehensive service analysis module, the overall system design should have the basic functions of power anomaly analysis, line damage analysis, voltage monitoring, etc., mainly to provide the technical means of effective analysis for the power management personnel, and truly achieve the basic goal of power management. At the same time, the core data of different businesses should be integrated and analyzed, power data operation should be controlled from different perspectives, and diversified means of information query should be provided. Common services include the following contents: First, self-service payment. The system functions can be effectively connected with GIS, which is convenient for

electricity customers to pay fees independently. The whole business process is completed independently by users, which can effectively reduce the working pressure of the business hall. Second, automatic transfer to human services. If the user does not get the expected goal in the voice service, then he can directly enter the manual service by means of case or voice. Third, Internet business. Users can log in relevant web pages on the network platform to quickly get business information and processing results. From the perspective of practical application and comprehensive service analysis, to provide security and reliability for the operation of the power supply system, the fixed connection method should be used to deal with electrical equipment and transmission lines. The actual system control scope is shown in Figure 4 below:

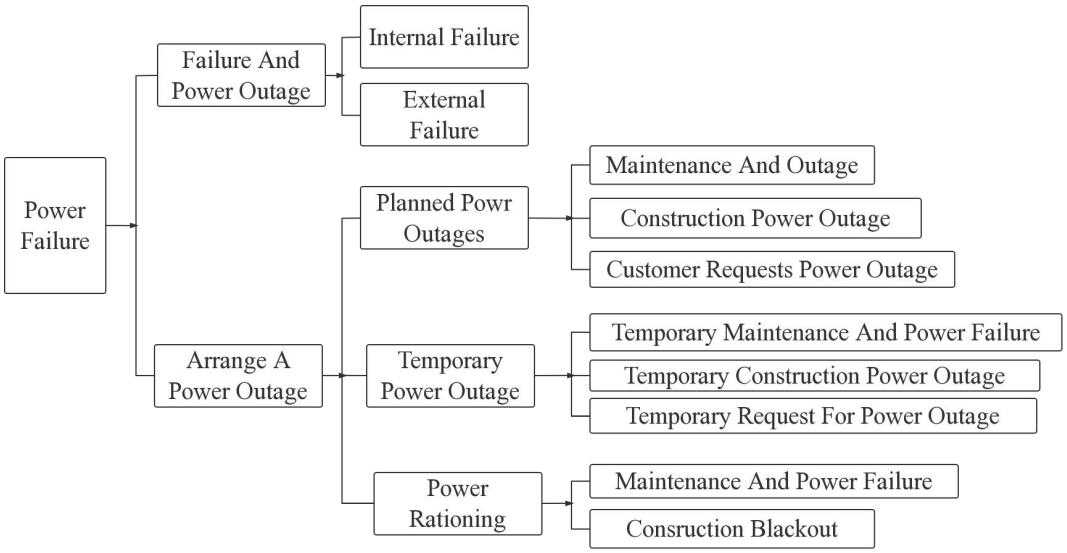

Figure 4 Scope structure diagram of system control

3. Result analysis

In order to verify the application performance of the big data centralized management and control system studied by me, and judge its application role in the safety production and operation of power distribution network engineering, simulation and comparative analysis are carried out according to the requirements of experimental work. The final results show that with the continuous increase of physical nodes, the transformation trend of the system studied in this paper basically presents a linear change. Compared with the traditional big data centralized management and control system structure, Spark technology can effectively improve the computing performance of the system, and can quickly analyze data information based on different fault types, which is convenient for managers to formulate effective solutions as soon as possible. At the same time, with the continuous expansion of the scale of management data, the delay of the system studied in this paper will slowly rise, but it has obvious advantages compared with other systems. This is because the system can comprehensively analyze the quality of power big data, quickly screen out redundant data, effectively avoid unnecessary interference caused by useless data, and comprehensively reduce the security risk of network congestion.

In modern social construction and development, scientific research scholars in our country begin to extensively study big data centralized control system. Effective management measures will be put forward according to the safe production and operation needs of power distribution project in the new period: on the one hand, distribution data center should be established to improve the production and management level of the system. The application of the big data analysis platform during the operation of the distribution network system can facilitate enterprises to fully implement the requirements put forward by the government departments, truly achieve the work objectives of the distribution network management, gradually break through the restrictions between the

marketing system and the production management system, and integrate the processing of the production, scheduling, marketing and other business systems of the distribution network of power enterprises. On the other hand, the function of data platform should be optimized to improve the efficiency and quality of production and operation of electric power enterprises. In order to comprehensively optimize the perfection and real-time performance of information under the operation state of distribution network, enterprises should develop and design the real-time function of distribution network operation state and early warning information release while applying the big data centralized management platform, which can not only facilitate enterprise managers to quickly grasp the hidden security risks, but also provide effective basis for subsequent operation and management. Therefore, on the basis of integrating and studying the safety production and operation status of power engineering in distribution network, Chinese scientific research scholars have integrated and studied the big data centralized management and control system platform based on advanced technology theories such as artificial intelligence, Internet of Things, big data and cloud architecture, which provides an effective basis for the innovation of power enterprises in the new era.

4. Conclusion

To sum up, the operation efficiency of distribution network directly determines the production and operation quality of electric power engineering. Therefore, scholars propose to apply the big data centralized management and control service platform to scientifically solve the problems faced by the operation of traditional electric power engineering system, comprehensively improve the market competitiveness and economic benefits of electric power enterprises, and provide technical support for the innovative development of electric power industry in the new era. After clarifying the design structure and application function of the big data centralized management and control system, this paper focuses on discussing its application value in the development of the electric power industry. Although the overall design and application has reached the initial requirements, there are still many problems in the relevant technical theories. Therefore, scholars in various fields need to continue to study and discuss the application of the big data centralized management and control platform in electric power engineering.

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