STUDY ON OPERATION AND MAINTENANCE RESOURCE SCHEDULING METHOD OF POWER GRID MARKETING SYSTEM BASED ON SENSITIVITY CLUSTERING

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Abstract: Aiming at the problem of low precision in operation and maintenance resource scheduling of traditional power grid marketing system, a method of operation and maintenance resource scheduling of power grid marketing system based on sensitivity clustering is proposed. Use operation and maintenance technology to collect key data of power grid, application operation state and online data of operation supporting environment, and integrate resources. On this basis, resource scheduling processing is carried out after analyzing resource scheduling requirements. The resource table and corresponding resource fields are selected to obtain the operation and maintenance resource scheduling set of the power grid marketing system, so as to realize the operation and maintenance resource scheduling of the power grid marketing system. The experimental results show that this method is more accurate than the traditional one and has practical application significance.

1.Introduction

In recent years, the domestic power demand has been growing rapidly with the rapid development of the national economy. The stable operation of the power system has an important impact on the development of the national economy. Power grid marketing system operation and maintenance resource scheduling is an important guarantee for the stable operation of power grid. For the safe operation of the VLHV interconnected large power grid, more efficient dispatching operation mechanism and more advanced technical support measures are needed. The coverage of power dispatch data network is relatively large, and it is also the key to the implementation of power grid, which plays a decisive role in the stable operation of power grid. The existing power grid dispatching system has been difficult to adapt to the development needs of the state grid. In order to ensure the safe operation of the uhv power grid, it is urgent for the power grid dispatching to improve the ability to control the large power grid and optimize the allocation of resources in a large range[1]. In order to ensure the safe and stable operation of the power grid, it is necessary to improve the operation and maintenance resource scheduling accuracy of the power grid marketing system, reduce transmission losses, ensure the safety and stability of the power grid, strengthen the operation and maintenance management, standardize the work of staff, avoid operational errors caused by human factors, and improve the stable operation of the power grid. With the development of computer network technology,

China's power grid has gradually developed into digital technology. The operation and maintenance resource scheduling of power grid marketing system is realized on the basis of computer technology. The operation and maintenance resource scheduling method of power grid marketing system is designed to improve the accuracy of power resource scheduling.

In order to enhance the precision of power grid operation and maintenance resources scheduling, a method of power grid marketing system operation and maintenance resources scheduling based on sensitivity clustering is proposed. Through the network marketing system operational resource scheduling method design, can improve the accuracy of resource scheduling, and can realize provide platform for scheduling of data transmission, capable of real-time information transmission and scheduling information in a timely manner, provide protection for electric power resource management, such as power generation, transmission, distribution and substation work, enables the power grid to the safe and stable operation.

2.Power grid marketing system operation and maintenance resource scheduling method design

2.1. Grid resource acquisition
According to the precision requirements of power grid marketing system resource scheduling, this paper proposes the use of operation and maintenance technology to collect the key data of the system[2], the application operation state and the online data of the operation supporting environment. Firstly, the database design language is analyzed and selected, and ADO.NET data is used for operation. Secondly, check the operating conditions of the nodes, monitor the CPU load, memory usage, disk space occupation rate, database space occupation rate and other operating indicators of the server and workstation, and conduct automatic collection of real-time operation data of the network equipment related to the scheduling data network and scheduling information network. Data acquisition is processed by horizontal isolation device, and the communication network operation and maintenance management system sends data to the communication resource management system. For example, when sending a request to read data of a communication resource, the communication network operation and maintenance management system initiates a non-tcp/IP connection to the isolation device. After the isolation device writes the stripped original data into its storage medium[2], it interrupts the connection with the communication network operation and maintenance management system and initiates the connection to the communication resource management system. The isolation device transfers the data in the storage medium to the data acquisition port. After receiving the data, it encapsulates the TCP/IP and application protocols and sends them to the power grid resource management system.

Detailed resource information such as starting and stopping stations, equipment, slots, ports, time slots and transmission segments should be provided for resource collection, as shown in the table:

Table 1. Table of detailed resource information

field	Field meaning	Field type	Field Length
WRTG	Application number	VARCHAR	24
DG	category	VARCHAR	7
DGTT	Channel type	VARCHAR	45
HERT	Starting point	VARCHAR	12
BFDJS	Starting equipment	DGHFHJN	55
GDER	Stop site	VARCHAR	74
HIO	Terminating equipment	ERRTGSS	54
TSXL	Channel name	GJFRTHD	77
ERWGH	Resource access	VARCHAR	2
TYY	Start port	FGHRDES	12

WRYY	Terminating port	BHTRFJH	52
HKB	Channel rate	SEFGBHD	56
FYHJ	Business number	EDGJNJJ	44
ETGER	Channel rate	FGHRDES	11
WERF	Contractor	EDGJNJJ	77
GY	Application number	EDGJNJJ	52

It can be seen from table 1 that there is a large amount of information in the dispatching of power grid marketing operation and maintenance resources. In order to ensure the smooth line operation and maintenance of power grid marketing system and prevent interruption, the line loss calculation of power grid system is carried out[3]. Line loss calculation of the system includes voltage distribution statistics and line distribution statistics. With lines and transformers as statistical units, the accumulations of power supply and sales are carried out. The power supply is subject to the incoming power of the 200KV line, and the power sales are subject to the outgoing power of the middle and low voltage side of the 200KV transformer. For losses of 110KV line and transformer, the line and transformer are used as statistical units to accumulate the power supply and sales[4]. The power supply shall be subject to the incoming power of 110KV line and the sales shall be subject to the outgoing power of the middle and low voltage side of 110KV transformer. Line loss of 35KV power grid: take lines and transformers as statistical units to accumulate the power supply and sales. The power supply shall be subject to the incoming power of 35KV line, and the power sold shall be subject to the outgoing power of the low-voltage side of 35KV transformer. Among them, the lossless electric quantity of the special line users is included in the electricity supply and electricity sales, and the statistics of the whole network are separately counted according to the line by line statistics. In this way, the operation and maintenance resource data collection of the power grid marketing system is realized, and the power grid data collection provides the data basis for determining the power grid data scheduling set.

2.2 Determine the grid resource scheduling set

Considering that the operation and maintenance resource data of the power grid marketing system are large, the wireless sensor network[5] composed of n nodes is placed in the power grid. Affected by the large data in the power grid, the network topology will change with the extension of time. Before the grid resource scheduling set is determined, resource processing is carried out after analyzing resource scheduling demand, and resource table and corresponding resource field are selected. Then use the repository operation technology to connect the corresponding database system. Finally, the structure and contents of the resource table are loaded into the resource handler with appropriate statements. After the resource selection, the resource is sorted out and the data loaded in the resource acquisition step is preprocessed. Then the data information and the structure of the database table are converted into a document (or a string)[6] and the user is provided with an interface to obtain the information. Realize cross-language and cross-platform data acquisition to provide seamless connection for data source acquisition during resource scheduling stage. After the above work is completed, the power grid resource scheduling set is determined. The following are the specific steps.

Assuming that each node in the network has the ability of time synchronization, the communication radius of sensor nodes is set as r. Then, according to the given mode of multi-channel in the network, the set of all resource nodes in the wireless sensor network is determined, and its function expression is:

$$A(n) = \frac{\left[r(n-1) + uc \right]}{2} \quad （1）$$

Where, $A(n)$ represents all power grid resource data sets in the wireless sensor network; u stands for resource noise; c stands for side path node.

According to the communication state of $A(n)$, the conflict relationship between each node is determined, and then the relevant scheduling matrix is established according to the conflict characteristics of resource data.

With the wireless sensor network center as the node center, when u communicates with neighboring nodes, affected by the communication noise, the resource data is bound to generate conflicting motion, and the form of conflict is shown in figure 1.
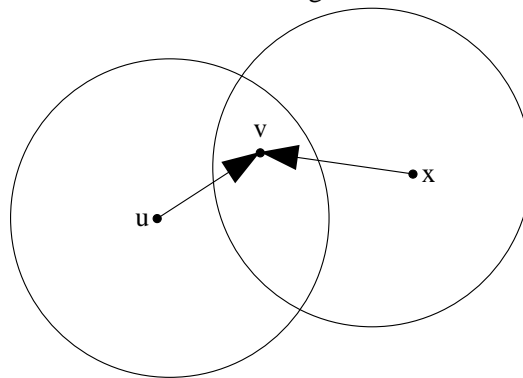
(a) First conflict
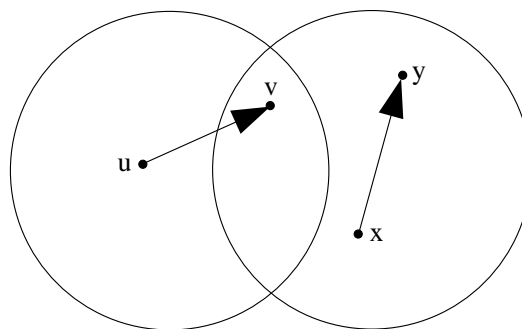
(b) Second conflict

Figure 1. Conflicting forms of grid data

In figure 1 (a), resource u points the conflict to v, and at the same time, the conflict of x also points to v, so u and x cannot receive resources at the same time. In figure 1 (b), resource u points the conflict to v, while x's conflict points to y, so the transmission of these two resources can be carried out simultaneously, forming a resource scheduling collection sequence, whose function expression is:

$$M = \left\{ A(n)_1, A(n)_2, \cdots, A(n)_k \right\} \quad (2)$$

Where, M represents the dynamic data scheduling set, and $M \le S_i$; S_i represents the non-conflicting state of any two transmitted data; $A(n)_k$ represents the k th network node.

After the above calculation, the resource scheduling set is obtained, and these resources are parsed and loaded into the target data source. In this paper, Base is used as the target data source, and the address[7], service method and other information of each data source are loaded into it. By distributing the information to different nodes, each node accesses different data sources according to the information received and obtains documents. These resources are then stored in the file system, along with information about these files (including storage addresses, file sizes, and so on) in the database for subsequent management of these files. When the grid resource scheduling set is determined, these

documents need to be parsed. Therefore, you need to look at the preface of these documents to understand how each document is stored, the format of the raw data, and so on, and then design the corresponding conversion rules and store them in the. And get the path from the database system and the corresponding conversion rules, and add to different nodes for processing, to determine the grid resource scheduling set. It can be seen that by defining the topology characteristics of a node through the network nodes of wireless sensors[8], its scheduling characteristics can be accurately collected to determine the operation and maintenance resource scheduling set of the power grid marketing system, which provides the basis for realizing the operation and maintenance resource scheduling of the power grid marketing system.

2.3 Realize the operation and maintenance resource scheduling of power grid marketing system based on sensitivity clustering

Based on the collection and determination of grid resource scheduling, the operation and maintenance resource scheduling of grid marketing system is realized. Considering the problem of resource scheduling accuracy, multi-objective optimization algorithm is used to make multiple scheduling objectives reach the optimal state and make multiple scheduling data tend to be optimal. The calculation formula is as follows:

$$\begin{cases} \min F(x) = \left[f_n(x) / \Delta d \right] \\ s.t. = \begin{cases} h_i(x) = 0, i = 1, 2, , I \\ g_j(x) \leq 0, j = 1, 2, , J \end{cases} \end{cases} \quad （3）$$

Where, $\min F(x)$ represents the minimum feature vector of operation and maintenance resources of power grid marketing system; $f_n(x)$ represents the decision vector and contains n decision variables. $s.t.$ is the optimal solution of the objective function and can be used for the calculation of scheduling rules; $h_i(x)$ represents the number of decision variables; $g_j(x)$ is the number of variables under inequality constraint.

After the optimization of the target scheduling data, A scheduling region including the scheduling target center A and the data source optimization B is formed, and then the wireless sensor network is used for the selection of the second round of resource scheduling. After calculation, the central coordinate of resource scheduling is obtained[9]. The central coordinates of resource scheduling are divided according to the communication form of nodes to prepare for the scheduling coefficient of resources.

The multi-channel scheduling coefficient of resources can be obtained by introducing $s.t.$ as a parameter, and the calculation formula is as follows:

$$\sigma = \frac{s.t.L_0^{\;2}}{s.t.L_y.\partial_s} \quad （4）$$

Where, σ represents the multi-channel scheduling coefficient and rules of resources; ∂_s represents the error parameter of resource scheduling, and $s.t.$ only introduces the optimal solution coefficient in the calculation process without any practical significance. L_0 is the target scheduling function; L_y is the optimal governing solution.

It can be seen from the operation and maintenance resource scheduling steps of the power grid marketing system that calculating the target scheduling resource is the most important task and also the most time-consuming step[10]. Since the membership degree of each target is independent, the parallel execution of this process can be considered, which provides a possibility for improving the accuracy of operation and maintenance resource scheduling of power grid marketing system.

After the above definition, the realization of network marketing system operational resource

scheduling, and through the algorithm described uncertain relationship between resource scheduling, self-learning, self-organization and adaptive characteristics, the algorithm is robust[11], suitable for parallel processing, and the method for power marketing system operational resource scheduling of high precision, has practical application significance.

3.Experimental demonstration

In order to verify the effectiveness and feasibility of the operation and maintenance resource scheduling method for power grid marketing system designed in this paper, a simulation platform was built and an experimental demonstration was conducted. Meanwhile, the algorithm is debugged in the context of cloud computing[12] to maximize the accuracy of experimental results. In order to ensure the rigor of the experiment, the traditional resource scheduling method was compared with the power grid marketing system operation and maintenance resource scheduling method designed in this paper. The comparison results are shown as follows:

3.1 Comparison of resource scheduling accuracy

In the realization of resource scheduling, this paper takes the sum of squares of errors as the condition of resource scheduling and extracts 1000 feature vectors from the operation and maintenance resources of the power grid marketing system. In order to reflect the effectiveness of the operation and maintenance resource scheduling method of the power grid marketing system and the traditional resource scheduling method in calculation, resource scheduling was conducted under the same cluster and the same resource set during the experiment to ensure the working environment and operating parameters of resource scheduling, as shown in table 2.

Table 2. Operation parameter setting

parameter	parameter values	Company	Explain
Resource scheduling time	0.5	h	
Service load	10.96	Pt/s	Including the energy consumption of the whole operation of the power system
power	362	kW	
sensor	4.5	$m.u/p.u$	Keep running

During the simulation experiment, the scheduling interval is set to 12 hours, and every 0.5 hours is taken as a time period for channel saturation detection. The experimental results are shown in figure 2.
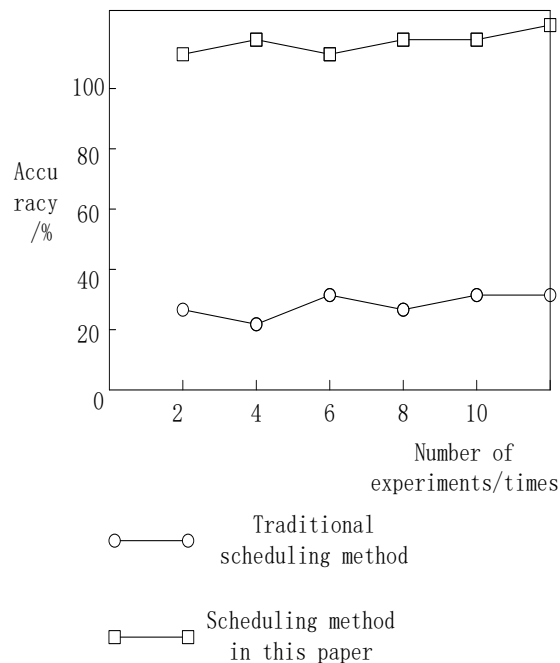
Figure 2. Resource scheduling accuracy comparison chart

3.2 Results analysis
As can be seen from the analysis of figure 2, when the operation and maintenance resource scheduling method of the power grid marketing system is designed in this paper, it has a high scheduling accuracy. With the increase of the number of experiments, the resource scheduling method still maintains a high degree of stability, while the traditional scheduling method has a low scheduling accuracy and a high error rate in the process of resource scheduling. Therefore, the above experiments can basically prove the effectiveness of the resource scheduling method designed in this paper, and the global optimization ability is good, and the resources to be scheduled can be accurately obtained, which has economic benefits and practical guiding value.

4.Conclusions
With the rapid development of computer network technology, power grid has become a development trend of power enterprises. Large-scale power grid operation needs the support of higher resource scheduling technology, so the operation and maintenance resource scheduling of power grid marketing system plays an important role in the power system. In order to ensure the safe and stable operation of power grid, it is of great significance to strengthen the operation and maintenance resource scheduling of power grid marketing system. Through the collection of power grid resources and the determination of power grid resource scheduling set, the power grid marketing system operation and maintenance resource scheduling method is designed and implemented. Finally, through experimental comparison, it is proved that the resource scheduling method designed in this paper has higher accuracy, much higher precision than the traditional scheduling method, and higher stability. To a certain extent, it has practical application significance. It is hoped that the design of this paper can provide some help for the operation and maintenance resource scheduling of power grid marketing system.

References
[1] Huang Fei, Song Zhongyou, Yu Hongxin, et al. Research on operation and maintenance technology of power dispatching automation system based on ITIL [J]. Automation and instrumentation, 2017 ， 23(11): 44-55.

[2] Zhang Weiliang, Huang Bin, Lin Changsong, et al. Applied research on operation management and control platform based on power intelligent optical distribution network [J]. Automation and instrumentation, 2017，45 (12): 209-211.

[3] Xu Ping, Zeng Chunhong, Liang Haipeng. Application of Android-based mobile terminal in power optical cable revenue [J]. Automation technology and application, 2017, 36,23 (2): 89-91.

[4] Xu Hongqiang, Yao Jianguo, Yu Yijun, et al. [J]. Architecture and key technologies of dispatch control system supporting integrated large power grid [J]. Power system automation, 2018, 42 (6):34-55.

[5] Xu Jiayan, Song Fuhai, Lu Hazel. Design and Implementation of Visualization and One-button Operating System for Secondary Maintenance and Safety Measures of Intelligent Station [J]. Power System Protection and Control, 2017, 45 (16): 136-144.

[6] Anonymous. Research on Fast Return Application Based on Long Connection of Mobile Wireless Network [J]. Computer and Digital Engineering, 2018, 46 (12): 2590-2594.

[7] Sun Qiao, Fu Lanmei, Pei Xubin, etc. Reliability enhancement method of resource operation and maintenance management based on distributed system [J]. Computer application, 2017, 37 (s1): 243-245.

[8] He Jianfeng, Luoyu, Li Jun'e, et al. Modeling of power dispatching data network simulation and impact of routing protocol attacks [J].Journal of Wuhan University: Science Edition, 2017, 63 (2): 163-171.

[9] Zhang Xun, Zhang Chengyu, Wei Jinwu. Design and implementation of a resource operation and maintenance system based on container layout technology [J].Telecommunications Science, 2018, v.34(6): 168-176.

[10] Jiang Ning, Zhang Pan, Wang Yuqian, et al. Construction of core indicators of dispatching control system for intelligent distribution network [J].Journal of Power Systems and Automation, 2018, v.30; No.172 (05): 90-95.

[11] Liu Jun, Zhang Guangxing, Zeng Shaohua. Design and implementation of end-to-end network active measurement system for power data communication network [J]. Computing technology and automation, 2017, 36 (3): 60-77.

[12] Zhu Shuangwei, Xiong Xiaofu, Liu Shanfeng, et al. Short-term risk assessment of Power Grid Considering Transmission Line Galloping prediction [J]. Power system protection and control, 2018, 46 (9): 86-93.