Load Balancing Scheduling of Power Network in Cloud Computing Environment

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Abstract. In the traditional cloud computing environment, the power network load balancing scheduling method cannot adaptively track the time-varying coupling characteristics of load data, and the power data center is not efficient in processing massive data, so it is increasingly unable to meet the multi-service quality requirements of power users. The purpose of this paper is to improve the load balancing of power network, improve the efficiency of power network balance scheduling and power resource balance allocation in cloud computing environment. At the research method level, this paper analyzes the application status of data center and cloud computing task scheduling, and starts from the task scheduling demand analysis of cloud computing data center to determine load balancing and QoS as the technical goals of task scheduling. According to the parallel model framework of MapReduce, the task execution process is studied, and the design scheme of power cloud data center is given in view of the problems of low resource utilization, poor scalability and high energy consumption cost faced by the existing power data center. The experimental results show that the network load balancing scheduling method proposed in this paper can meet the multi-qos demand of power users to the maximum extent, effectively improve the efficiency of power data center operation, and achieve better load balancing effect than the traditional scheme.

Keywords: Cloud Computing, Power Network, Load Balancing Scheduling, Power Resource Allocation

1. Introduction

The continuous development of cloud computing technology not only makes the study of electric power, machinery and other related industrial extends to electric power network in data management, and also more and more obvious shows the establishing integration information platform as the basis of through the smart grid six links support platform, is the development trend of electric power enterprise informatization construction. The core technologies of cloud computing are large scale cheap server cluster, virtualization technology, mass distributed data processing technology and parallel programming model, which can better meet the construction needs of smart grid data center platform. Cloud computing technology is just a metaphor, and its important characteristic is fuzziness.
It can improve the effectiveness of power system and power resource management by combining cloud computing technology with autonomous learning technology.

In previous studies, the research on power load balancing scheduling methods under cloud computing network was all carried out in the way of physical model [1]. Among them, domestic researchers proposed a method to analyze the load balancing algorithm of large power networks based on cloud computing grid time scale to improve the cloud storage and data scheduling performance of large electrical data in the database [2]. However, the algorithm has some problems, such as the waste of power network load database storage resources and the uneven distribution of grid space in cloud computing. Some researchers have also proposed a power data equilibrium scheduling model based on random scheduling of virtual information resources in the cloud computing environment, aiming to achieve task balancing and scheduling through cloud computing and improve the operation efficiency of power network [3-4]. However, this algorithm has some disadvantages such as large time delay and complicated calculation. Foreign researches in the field of cloud computing have a relatively mature history compared with domestic ones, and the research results are more reliable, flexible and scalable, large data processing capacity and high utilization rate of equipment [5]. Foreign research focus is generally focused on the utilization of resources and task scheduling mechanism, in the center of the quality of cloud computing services and data resource utilization has great relationship and data center resources utilization between high and low and the relationship between the task scheduling mechanism made a lot of work, problem to be solved at present is to use what kind of task scheduling mechanism to improve resource utilization [6-7].

In view of the shortcomings of existing studies and research topics, this paper proposes a cyclic iterative control of power network load balancing scheduling algorithm [8]. First, the power network load data stack storage model under the cloud computing environment was constructed, and the network topology of the power network environment under the cloud computing was divided into three layers. Based on this, fuzzy cyclic iterative control was carried out on the characteristic values to improve the balanced scheduling algorithm [9-10]. In the process of feature analysis, the time-scale features of power network load data flow are extracted, and the performance of the algorithm is simulated [11]. These studies highlight the superior performance of the algorithm in this paper in improving the scheduling capability of load data balancing in power network, and in improving the balanced allocation and management efficiency of power resources [12].

2. Method

2.1 Load Balancing
The concept of load balancing is proposed in order to improve the overall performance of the system, improve the utilization of resources, and reasonably distribute the request tasks among multiple server nodes, so that the load of each node is basically balanced. This form of sharing is often called load balancing. At present, with the development of cluster system, load balancing strategy has been widely studied and constantly improved. However, due to the flexibility of application in cloud computing environment, this makes cloud computing more typical cluster system is somewhat different. Therefore, appropriate load balancing strategies need to be applied to the cloud computing environment to improve its overall performance and meet the user's service level agreement.

As the core of the load balancing strategy, the performance of the load balancing algorithm directly affects the overall performance of the system. According to the different timing, the load balancing strategy can occur in two phases. One is to call the load balancing algorithm when the request task arrives, and assign the task to the appropriate node according to the algorithm. The other is that when the cluster node is in the working state, if a node is overloaded, the load balancing algorithm is started to transfer the tasks on the overloaded node to the node with light load for processing. A load balancing algorithm can include both phases or consider only one of the two phases at design time. The dynamic load balancing algorithm only considers the first stage of the trigger algorithm, that is, when the request task arrives, the appropriate node is selected for processing by the load balancing
2.2 Load Balancing Scheduling Algorithm

Under the environment supported by cloud computing, power network data can balance the load of power network through reasonable scheduling. Reasonable scheduling method can improve the efficiency of balanced allocation and management of power resources. Fuzzy cyclic iterative control algorithm is a data equalization algorithm based on iterative calculation and control algorithm. On the basis of data feature extraction, fuzzy cyclic iterative control is carried out. The algorithm principle is as follows: suppose that the data set forms a new mapping relationship in the stack space in the form of vector control. At this time, a time span of data operation is denoted as:

\[ h(\vec{n}, t) = \sum_{j=1}^{N} a_j(t) e^{i \theta_j} \theta(t - \vec{n}) \]  

(1)

Let R be the trust relationship containing quaternion (Ei,Ej,d,t) data, construct the data weight distribution mechanism, calculate the orthogonal weighted constraint equilibrium ratio, and evaluate the weight of classification attributes. Given the efficiency function of data task E(I, j), for any point ai on data set A, its equilibrium calculation parameters are:

\[ R = w_1 C_i + w_2 D_i + w_3 M_i + w_4 N_i \]  

(2)

Where, W is the weight; C is the weighted constraint equilibrium ratio; D is the time parameter; M is the time sampling period. Under the action of interference and noise, the information becomes unbalanced. In this case, it is necessary to control the directional fuzzy distance between A and B as follows:

\[ h(A, B) = \frac{1}{N_A} \sum_{i \in A} ||x_i^a - x_i^b, y_i^a - y_i^b|| \]  

(3)

In the process of equilibrium iterative control, the hierarchical algorithm of data aggregation tree is adopted to reduce the value of data scheduling set x by 1. If x=0, its state is set to RY state. Fuzzy cyclic iterative control is adopted, and the control process conforms to the normal distribution probability.

3. Power Network Load Balancing Scheduling Steps

Step 1. Considering the design of the input and output of the grid equalization regulation parameters, time-scale characteristic parameters, information flow parameters, time-delay response parameters and corresponding load output units can be established according to the fuzzy equalization iterative algorithm. In this process, fuzzy iterative equalization is adopted. In order to ensure the effect of balanced dispatching, this paper preprocesses the power data, normalizes the original grid data, and distributes the normalized data in the forward interval.

Step 2. Select and determine the fixed flow input node and output node in the power network. The information collected from the input node is the physical quantization information, while the computational node and target output based on the fuzzy iterative loop control use the digital quantity. Set the error correction function. In the cyclic iterative algorithm, there is always an iterative relation approximation that can be used for cyclic calculation for any given input function and specified target output error accuracy. According to the given equilibrium adjustment objective function, the existing power load sequence, the maximum load, the minimum load and other influencing factors are targeted as input data, and the fixed power load value is obtained through fuzzy cycle iteration.

Step 3. According to the error and the requirements of the objective function, consider whether to carry out the next iteration.
4. Discuss

4.1 Analysis of Simulation Results
In order to test the actual performance of the proposed power network load balancing scheduling method, this paper carries out load balancing scheduling test in the cloud computing environment. Experiment of the communist party of China has a number of units of 120 computers is involved in the experimental data acquisition, and became a big power network through these machines, these cabinets in the broadband is about 17 gb/s, the power network in the 15 degrees of fixed parameter setting, built 120 tasks of a large database of power network load cloud storage resource scheduling sets and 700 network nodes. The load data of the entire power network is divided into 15 virtual reduction detection cells in the fuzzy stack control. Based on this, data collection and signal model construction are carried out. The simulation results of the collected load data of the power network are shown in figure 1 below.

![Simulation results of power network load data](image)

**Figure 1.** Simulation results of power network load data

As can be seen from the figure above, after adopting the load balancing scheduling algorithm proposed in this paper, the response spectrum peak of load balancing scheduling in power network is relatively obvious, indicating that the algorithm proposed in this paper has strong response capacity of balancing scheduling and improves the scheduling efficiency of power network load. Further quantitative analysis was carried out, and the fuzzy cycle iterative scheduling model designed in this paper was used to construct the load information flow and balance scheduling of power network. Parameters such as fusion rate and standard difference of scheduling were taken as test indexes, and the balance fusion results of load data were obtained as shown in table 1 below.

| Power network node number | 1  | 2  | 3  | 4  | 5  | 6  | Stack |
|----------------------------|----|----|----|----|----|----|-------|
| Fusion rate (%)            | 28.3 | 21.4 | 20.6 | 31.2 | 29.3 | 27.7 | 33.5   |
| Average data               | 5.09 | 4.82 | 5.14 | 5.02 | 4.93 | 4.98 | 5.02   |
| Standard deviation         | 0.162 | 0.137 | 0.189 | 0.083 | 0.095 | 1.17 | 0.097  |
| Minimum fusion threshold   | 4.668 | 4.552 | 4.642 | 4.753 | 4.374 | 4.836 | 4.175  |
| Maximum fusion threshold   | 5.068 | 5.284 | 5.177 | 5.094 | 5.385 | 5.162 | 5.226  |
By analyzing the results in table 1, it can be concluded that the design of fuzzy cyclic iterative control and balanced scheduling can effectively eliminate the incoherent data in the cluster, improve the load balancing of power network, and improve the efficiency of balanced integrated scheduling and balanced allocation ability of power network in cloud computing.

4.2 Analysis of Advantages of Cloud Computing in Power Network Scheduling Applications
Cloud computing contains a lot of technical content, including the core of mass distributed data storage and management technology, parallel programming model, etc., which can better meet the needs of the construction of power cloud data center, has many advantages, which can be simply described as the following aspects.

(1) Large amount of data
Power data includes a large number of state monitoring data, state assessment data, load prediction data, etc. The collection amount of these data is huge, and cloud computing has obvious advantages in processing massive data.

(2) There are many types of data
Cloud computing adopts large distributed file system and distributed data management system, which is conducive to improving the reliability and management efficiency of mass operation data storage.

(3) Large amount of calculation
Power data center processing data types, large data, the corresponding need to process a huge amount of computation. The specialty of cloud computing is parallel computing, and the use of the corresponding scheduling algorithm can improve the efficiency of the data center.

5. Conclusion
Data management based on cloud computing is an important part of the construction of integrated information platform of smart grid, and it is also the development trend of smart grid in the future. Therefore, more and more researchers attach importance to designing more efficient task scheduling strategies to adapt power system to different business and business objectives. This paper analyzes the design scheme of power cloud data center, studies the task scheduling strategy of cloud computing, and combines the characteristics of power cloud data center to give a scheduling algorithm based on load balancing. Experimental simulation results show that the proposed scheduling scheme can effectively improve the efficiency of power resource balance allocation and management.

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