Analysis of Key Security Technologies for Power Dispatch Control System of Power Dispatch Support System

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Abstract. The scale of China's power grid is continuously expanding, the amount of collected data is increasing rapidly, and data processing and analysis services are developing towards clustering. Therefore, at present, task management in a stand-alone mode faces severe challenges in ensuring the high efficiency and reliability of distributed tasks. Information security risks in cyberspace can cause fatal threats to smart grid entities through the destruction of grid dispatching control systems and communication networks. Security check is one of the application functions of intelligent power dispatching control system. It is an important security defense line to ensure the stable operation of power grid and provides security check service for power grid dispatching plan and power grid operation. The existing operation and maintenance management mode of the power grid dispatching control system is distributed, and the data of each system and unit is not effectively integrated and connected, and lacks overall consideration. Based on the development history of power grid dispatching automation, this paper comprehensively analyzes the current status of the overall structure of the power grid dispatching system, and summarizes the key technology innovations and application effects.

1. Introduction

In the new era of rapid development and excessive development of China's UHV power grid, in order to effectively promote the safe and stable operation of China's power grid system, effective measures should be put forward to make certain adjustments to the structure and current flow of the grid [1]. Information security risks in cyberspace can cause fatal threats to smart grid entities through the destruction of grid dispatch control systems and communication networks. With the continuous expansion of the scale of the interconnected power grid, the electrical connections of the entire network are getting closer, the cross-section coupling relationship is more complicated, the shape and characteristics of the power grid are facing profound changes, and the level of security and stability are mutually restricted [2]. The concept of cyber security has evolved from traditional information system security protection to cyberspace confrontation. In fact, the network has become the fifth combat space after land, sea, sky and space. On the basis of integrated development, the regional line network constructed in China has clearly increased demand and exhibited differentiated usage characteristics. However, in actual construction, information and scale still do not fit the management model [3]. For distributed tasks, the current single-machine task management cannot manage such tasks across nodes, that is, tasks cannot be automatically deployed to multiple nodes, and computing performance cannot be improved by making full use of the resources of all nodes [4]. Security check is one of the application functions of smart grid dispatching and control system. It is an important security defense line to ensure
the stable operation of power grid and provides security check service for power grid dispatching plan and power grid operation [5].

Each specialized system of the dispatching control center has the application requirement of safety check, and the separate construction of safety check function in each specialized system will lead to waste of resources and difficulty in coordination [6]. Dispatching agencies at or above the provincial level shall set up automatic departments to undertake the operation, construction, maintenance and related technical management of the system [7]. The State Grid Corporation of China has carried out the construction and application of the smart grid dispatching and control system pilot project in dispatching and control centers above the provincial level. It has completed and put into operation the largest and most powerful grid dispatching and control system in the world, ensuring the safe operation of large power grids [8]. The operation and maintenance management mode of the existing power grid dispatching and control system is distributed and not centralized enough, and the data of each system and unit are not effectively integrated and linked, thus lacking overall consideration [9]. This paper analyzes the service bus and parallel computing service based on smart grid dispatching and control system to realize service-oriented security check service of power grid, which provides customizable and multi-task parallel security service for power grid service. So as to ensure the safety and reliability of power grid operation.

2. Analysis of Security Check Service Architecture

2.1 Security Check Service Based on Service Bus
With the improvement of automation level of power monitoring system, the enrichment of functions, the extension of coverage of dispatching data network and the increase of users, the sources of information security threats in power monitoring system are becoming more diversified. The power flow corresponding to the check section is formed for the maintenance plan of the power grid system function and the operation of the power grid, so that the safety check can be carried out for the faults and problems occurring in the operation of the power grid [10]. The information between the security check service process and each port is implemented interactively by means of interface functions, which can effectively meet the requirements of different application functions for the query and location services of the security check service. After the safety check of the system is completed, auxiliary decision-making and margin assessment calculations need to be carried out. This can effectively analyze the problems in the safety and stability of the power grid in the dispatch plan and operation, and propose correct judgments. The smart grid dispatch control system is gradually put into practical operation at all levels of dispatch agencies. In order to enable the smart grid dispatch control system to play a better supporting role in the dispatch business system, research and application of the smart grid dispatch control system operation and maintenance plan and key technologies are required. The grid system requires electrical energy to be balanced at all times, so the construction of smart grids is an inevitable choice for the current development of the power industry.

2.2 Parallel Computation of Dynamically Assigned Tasks.
Security check service uses grid dispatching control system to realize parallel computing service, and establishes effective connection between standard interface and cluster computing resources, thus realizing interaction between information resources. In the process of developing and researching the power grid dispatching control system, China has carried out brand-new reforms on the regulation of operating costs of various power grids and the realization of energy conservation and emission reduction. Security check calls the parallel computing service of smart grid dispatching control system, and realizes the interaction with cluster computing resources through standard interfaces. By receiving the optimized real-time data and equipment alarm information of the power grid and using tools such as remote browsing, the reliable operation monitoring of the system can be realized, and the safe and stable operation of the system can be guaranteed [11].
The database of the operation and maintenance service support platform adopts the combination of real-time database and relational database, and uses the real-time database to meet the requirement of providing fast real-time data access, and organically combines the real-time database and relational database [12]. Parallel computing service supports pre-allocation and dynamic allocation. The calculation amount of security check changes dynamically according to the application requirements, and dynamic allocation is adopted. After receiving the calculation request received by the service port, the security verification service terminal will select the calculation method according to the specific calculation content, and evaluate the accuracy of the calculation results[13]. As shown in Figure 1, the scanning speed modulation architecture of the power prediction model.

![Figure 1 Scanning speed modulation architecture of the power prediction model](image.png)

### 2.3 Requirements of Distributed Task Management in Power Grid Dispatching Control System

The connection between the electrical systems of the whole network is continuously strengthened, and the coupling relationship between the sections is becoming more complicated. The cross-security and stability of different levels of power grids are also receiving increasing attention, and their security problems are becoming increasingly prominent. Distributed task management is responsible for managing the entire life cycle of a job, from deployment, startup, run to exit. At present, single-machine task management can only manage the running status of task processes on this node, and cannot manage all tasks subordinate to the job across nodes. Distributed task management of power grid dispatching control system should be able to automatically deploy tasks to each node according to the system's resource usage, and ensure that tasks are evenly distributed according to node load. China's power grid has always adhered to the principles and standards of unified dispatching and hierarchical management during its operation. City and county-level power grids are responsible for the management and supervision of planning and safety check in the region[14].

The security check service system of the power dispatching system puts forward a unified model and a joint check scheme, which effectively ensures the safe and stable operation of the power grid. In addition, the implementation of the multi-level auxiliary dispatching plan plays a key role. In order to make full use of computing resources and improve the computing performance of tasks, distributed task management should monitor the resource usage of nodes in real time. The dynamic part of the unified information model mainly stores a message format template of real-time collected data by sensor nodes, and analyzes and updates the real-time collected data according to the template to form data consistent with the storage format of the data service system. The test preparation data for the delivery accuracy of screened power dispatching data, the delivery speed of power dispatching data, and the safety level detection of power dispatching data are shown in Table 1.
Table 1 System sampling analysis information

| Project                              | First time | Second time | Third time |
|--------------------------------------|------------|-------------|------------|
| Detection of power dispatching data  |            |             |            |
| security level                       | 36%        | 38%         | 40%        |
| Delivery accuracy of power dispatch  |            |             |            |
| data                                | 64%        | 62%         | 71%        |
| Power dispatch data delivery time    | 7          | 8           | 6          |

Since the power station does not need to consume fuel, the power company should first dispatch all the power[15]. The goal of dynamic economic dispatch of power system including power station is to minimize the generation cost of traditional generating units. The objective function can be written as follows:

\[
dR_i = \chi \cdot a(t) \cdot dt + \delta \cdot a(t) \cdot dw_i
\]  

(1)

Power balance constraint:

\[
R^s_i = x + \int \xi \cdot a(R^s) \cdot ds + \int \zeta \cdot a(R^s) \cdot dw_i - U^s_i
\]  

(2)

When the operation cost is not considered, based on the original startup and shutdown state, due to the randomness of wind power, the power generation cost of conventional units is also a random variable, so the objective function is the minimum expected value of power generation cost:

\[
dR^e_i = \xi \cdot a(t) dt + \zeta \cdot a(t) \cdot dw_i - dU^e_i
\]  

(3)

Like the two non-crossing guard rings of Figure 2, "2" on the link indicates that the link is composed of two fibers in opposite directions. When the working path of the service with bandwidth W passes through the link, the working link A or B belongs to only one ring network, and only one ring network protects the link of the service delivery node. If the service working link is a, the protection capacity w of the ring network 1a and the protection capacity of the ring network 1b are 0.

![Figure 2 Non-intersecting rings](image)

In the calculation of the power flow of the power dispatching plan, it should be considered that the power demand of the inter-regional tie lines and inter-provincial cross-section power needs is controlled within the planned value, and such considerations can effectively avoid internal plans formulated by different regional and provincial grids Power spreads out of balance. In distributed task management, in order to achieve the recovery of faulty tasks across nodes, one master and one standby redundant fault tolerance technology is used. In this technology, a backup task is configured for each main task on other...
nodes. When the main task fails, the backup task is immediately switched to the main task [16]. A distributed task management system needs to monitor the running status of each node in the system in real time. When a new node is found to be operational, tasks on a high-load node must be migrated to that node, making full use of idle resources to improve operating efficiency. The reactive power compensation measures shall be timely adjusted according to the node conditions in the specific report of power operation in the whole power grid dispatching control system, so as to ensure that the voltage of each hub node can be within the range specified by the planned value. With the continuous application of modern science and technology, the function of safety check service is continuously developing and improving, and is being promoted and applied in dispatching control centers at all levels. In order to ensure the reliability of the task management node, multiple backup machines are usually configured for the task management node[17]. When the host fails, the backup machine is immediately switched to the host to be responsible for task management.

3. Summary
According to the latest research results at home and abroad, the power grid dispatching control system should continuously improve its own safety check service function in the future development to ensure the safe and effective implementation of the power dispatching plan. With the rapid development of new energy power generation, its randomness and volatility have brought challenges to the dispatching and operation of the power grid, and the accuracy of planned power flow and safety check in some areas with surplus new energy resources have been greatly affected. The operation mode of the power network and the actual distribution of the power network are the keys to guide the dispatching and control technology of the power network and the dispatching and operation of the power network. In the future, the development technology of China's smart grid dispatch control system is mainly reflected in the technical optimization of multi-period and multi-level short-term power markets, self-description of system operation methods, and dynamic analytical development. Uncertainty theoretical analysis should be incorporated into the power grid security checking service to adapt to the security check service level of the power grid dispatching system in the context of the rapid development of new energy sources, so as to achieve the safe and stable operation of the entire power grid system in China. Only by fully understanding the development status of intelligent power network control and dispatching systems can we better develop and develop new types of future power grid dispatching technologies.

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