A way to improve the performance of the integrated maintenance system in new generation dispatching control system

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Abstract. As the structural complexity and application relevance of the new generation dispatching control system are increased due to the architecture changes, this paper analyses the actual requirements of integrated maintenance system of the control system and the performance problems in the data collection and analysis processes, introduces the application scenario of distributed memory technology in the integrated maintenance system of the new generation dispatching control system, presents an integrated solution to meet the maintenance performance requirements of the new generation dispatching control system.

1. Introduction
With the rapid development of UHV AC-DC hybrid power grid and clean energy, the characteristics of power system have undergone profound changes. The integration feature of power grid operation is becoming more and more complicated; the need for integrated monitoring, network control, and centralized decision-making is becoming more and more prominent. The reform of electricity marketization brings great pressure to power grid dispatching and operation [1-2]. In response to the above challenges, the dispatch center has organized the research and development of the new generation dispatching control system. New generation dispatching control system using cloud computing concept, adopted the "Physical-distributed and Logically-unified" architecture, grid monitoring function locally deployment, distribution network analysis and decision making deployment, at the same time a large number of application of cloud computing, artificial intelligence, and new technologies, such as large data analysis, makes the new generation dispatching control system different from the traditional dispatching control system [3-6]. The change of the architecture and the application of a large number of new technologies and the relevance of various applications of the new system is enhanced, the complexity of the application functions and structures is increased, and the scale of application data is expanding rapidly, so the workload of system operation and maintenance is increasing geometrically.

The design framework of the traditional dispatching control system is more considering the convenience of users, rarely consider the convenience and functionality optimization of the maintenance, it makes the operation of the maintenance complicated because of manual operation. With so many equipment and system process, the lack of unified automated maintenance tool, visualization technology and visual surveillance, problems can only be found by alarms, resulting in insufficient pre-control measures. When the system fails, there is a lack of integrated fault analysis tools to help the operation and maintenance personnel on duty to accurately locate and effectively
isolate the fault equipment. It mainly relies on the on-site treatment or remote telephone guidance from the technical support personnel of the manufacturer to delay the problem positioning and treatment. After the collection of operation and maintenance data, centralized storage is required to provide data input for early-warning analysis. The traditional method is to write data into relational database and calculate the pre-control method centrally. However, with the geometric growth of the amount of data collected, in order to quickly calculate the pre-control method, it is necessary to optimize the data storage and processing mode [7-11].

Based on the distributed memory technology, this paper describes the software architecture and related key technologies to improve the integrated maintenance capability of the new generation dispatching control system, and puts forward the overall solution to adapt to the integrated maintenance of the new generation dispatching control system, providing ideas for the construction and maintenance of the new generation dispatching control system.

2. The application of DSM in the maintenance of the new generation dispatching system

2.1. The maintenance in the new generation dispatching system

The analysis and decision center is unified construction, but the monitoring system is locally oriented and deployed separately in each control center. Combined with the architecture of the new generation dispatching control system, an integrated maintenance framework is constructed adapted to the architecture of “physical distribution and logical unify”. It realizes the two-level deployment of distributed maintenance system and centralized maintenance system, the operating status indicators of the control system online is monitored and collected, combined with the intelligent analysis of the operating status and the deep-level system defect mining and other technologies to ensure the reliable
maintenance of the new generation of dispatching control system. The integrated maintenance and support system of the new generation dispatching control system includes the following functions: system information data collection, system operation status integrated monitoring, system operation risk pre-warning, system fault diagnosis, system fault auxiliary decision making and system operation status evaluation. The software architecture is shown as Figure 1.

The new generation dispatching control system running status collection includes support platform (including commercial database, real-time database, communication bus, service management, etc.), business applications (including monitoring control, analysis, pre-warning, planning, decision-making, etc.), resource pool information (including physical machine, the virtual machine, container, storage devices, etc.) running information. The system operation monitoring and pre-warning technology realizes the uninterrupted panoramic visual monitoring and control of the running state of the new generation dispatching control system, and finds system abnormalities and operational risks timely through trend prediction. The system operation monitoring and warning technology consists of system operation status monitoring and control, data consistency monitoring and operation risk warning.

2.2. The DSM technology introduction
Distributed Shared memory is an important technology in the development of parallel processing. DSM provides programmers with a logically uniform address space that can be read and written directly by any processor. It has the advantages of expandability of distributed memory structure, generality of Shared memory structure, portability and ease of programming. The key technologies of distributed memory include replication problem, storage consistency model and so on. The implementation method of DSM includes three ways: hardware, software and combination of hardware and software. From an implementation point of view, there is no uniform global address space, data access is through message communication which is transparent to the programmer.

2.3. The application of DSM in the monitoring system of new generation dispatching control system
In order to show the running status of the dispatching system to the maintenance personnel, the data acquisition and processing of the maintenance related information should be provided with as little delay as possible, so as to provide the operation and maintenance personnel with early warning information and auxiliary decision-making information in the shortest time, and reduce the risk of systematic failure. In order to achieve this goal, this paper divides data into two categories. One is the operation and maintenance information data that needs to be persisted, which can be used for post-fault inversion. It will not have a great impact on the health state of the operating system. Operation and maintenance information collected in time, it only needs to participate in data calculation and generate early warning information and auxiliary decision-making information that are ultimately valuable to operation and maintenance personnel. In this paper, the following processing methods are designed for this scenario: store various collected operation and maintenance information directly into DSM, realize high speed access of data according to DSM, calculate and alarm directly based on DSM for various applications such as decision computation. The DSM is polled by the asynchronous library program, and the collected data and calculation results are stored in the relational database, and the temporary intermediate calculation data in the DSM is deleted. At this time, the DSM retains the result information of the previous round of auxiliary calculation, and meanwhile retains the warning information and auxiliary decision information of the latest calculation for the next analysis and calculation.

The information acquisition module, which can improve the performance and efficiency of the information acquisition module by writing the collected data directly into the DSM; Status assessment, fault diagnosis, risk warning, decision AIDS, and analysis and assessment all read data directly from the DSM and can write temporary intermediate data into the DSM if needed, which can improve the single machine memory and solve the problem of insufficient memory for the application to store intermediate data. Centralized monitoring can read calculated results directly from memory for graphics display, which can improve graphics refresh efficiency. For the data that needs persistent
storage, the collected data and calculated results are slowly written to the relational database through asynchronous write service, so as to improve the overall stability of the system. The general schematic diagram is shown as Figure 2:

![Figure 2. The general schema of the monitoring system.](image)

By adding time stamp to the data of various electrical models, the specific running data of the model at a certain moment can be represented. Figure 3 shows the schematic diagram of data storage.

![Figure 3. The storage of the monitoring status of the dispatching system.](image)

3. Prototype verification

At present the system information collection and system running status monitoring technology mentioned in this article has been deployment on the prototype system for test verification, after several rounds of test, have been incorporated into the new generation dispatching control support platform V1.0.

By comparing the time consumption of the original calculation method and the data reading method with DSM, the test results in Table 1 and Table 2 shows that DSM can effectively improve the overall efficiency of the monitoring system.

| Test case                | Relational DB(ms) | DSM(ms) |
|--------------------------|-------------------|---------|
| Table read(10,000 Records) | 721               | 84      |
| Read by Key(10,000 Times)  | 834               | 89      |

| Test case                | Direct against Relational DB(ms) | Asynchronous Write(ms) |
|--------------------------|----------------------------------|------------------------|
| Write (10,000 Records)   | 966                              | 985                    |
4. Conclusions
This paper introduces the architecture and key technology of the new generation dispatching control system, analyzed the complexity and the maintenance performance issues, introduces the technical characteristics of DSM and the application scenario and method in the new generation dispatching control system, and by the prototype test, explains that the DSM can improve the performance of the maintenance system of the new generation dispatching control system.

Acknowledgements
This work was financially supported by the project of “Research and Application of Key Technologies for Test Verification and Integrated Operation and Maintenance of Dispatch Control System” (No. SGJSDK00DWJS1800074) in China Electric Power Research Institute.

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