Implementation and Application of APM Monitoring System under Big Data of Power Grid

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Abstract. With the rapid development of smart grid application system and the increasing complexity of information system, the difficulty and importance of data center operation and maintenance management are increasingly prominent. In order to further analyze the existing data under the big data of power grid, improve work efficiency and service quality, a set of scientific and efficient application performance management (APM) monitoring system is proposed. Through the real-time monitoring of power system performance, the latest information about the operation of software and hardware system can be ensured. With the performance data of the system under a series of activities and loads, users can define a performance baseline to represent the acceptable performance under typical operating conditions. This baseline provides a reference point for locating problems more easily. Through scoring system, the health degree of information system operation can be displayed intuitively. Once the score drops, the system is in a non-health state, and the location of the performance bottleneck can be roughly determined by the secondary score. The dispatcher can quickly contact the relevant operation and maintenance team to solve the performance problems, greatly reducing the response time of the performance problems.

1. Introduction

The electric power informatization started from the single machine one-way application in the 1990s, and now it has been applied in the whole network business. With the increase of the system traffic and the transformation of the surrounding environment, many application problems of power business system can not be found and solved in the first time by existing means; Meanwhile, due to the limited application monitoring means, application system cannot be monitored in real time. In addition, there is still no product comparable to foreign technology in the application performance monitoring, diagnosis, analysis and optimization technology in China, while IBM, Oracle and other research products in foreign countries do not provide localization services, cannot provide corresponding technical support and guarantee, and have high requirements for technical personnel and expensive product price and service fee. Therefore, it is urgent to build a set of scientific and efficient application performance management system to ensure the stable operation of power information system.

Different from the lagging mode of normal monitoring and post processing, power system performance monitoring can assist dispatching, operation and maintenance personnel to prevent performance bottlenecks and quickly locate performance problems, thus ensuring higher availability and stability of information systems. The research results are mainly used to deal with the performance evaluation, architecture optimization and code analysis diagnosis of business application system. It can bring certain benefits, such as reducing the demand of operation and maintenance personnel, saving

labor costs, establishing dashboard performance control, promoting business standardization, etc. In addition, the platform can also provide powerful and dynamic real-time performance monitoring interface and business data analysis interface for application systems of typical industries (such as banking and securities and other financial industries, aluminum electrolysis and other industrial control industries, transportation industry, government data center [1,2]). The big data generated by these industry application systems can be deeply mined and analyzed.

2. Requirement Analysis and Design of the System

Today's power business system is different from the traditional LAN application, which adopts a multi-layer technology architecture. It brings many challenges to the new generation of power business system. So we need to design a product to monitor the performance of the system in real time, to help the staff quickly locate the location of the problem, so as to quickly analyze and solve the problem.

2.1. System Design Requirements

In order to better monitor the performance status of power grid system, the main functions that the system hopes to achieve are as follows: (1) Real-time monitoring. It can achieve the millisecond interval to obtain performance data, real-time monitoring warning data and business code data. (2) JDBC monitoring. For fine-grained monitoring of resources, it can monitor the unreleased code of JDBC resources and exceptions in the process of database interaction. (3) Detailed monitoring of thread pool. For example, the number of threads, real-time thread execution, thread feedback, and the number of rows returned by the current data in the database; in addition, human intervention and thread release operations can be performed on zombie threads, interlocking threads, and threads occupying resources. (4) Monitoring of socket and I/O. (5) Professional monitoring large screen to ensure real-time display of all monitored data. (6) Customization of the monitoring range. .

2.2. Application Performance Management and Acquisition Technology

Gold application performance management (Gold APM) is the next generation of intelligent and easy-to-use application business performance management solution. Through the embedded collection method to achieve code level analysis, SQL scripts, services and other in-depth analysis, to achieve the end-to-end application performance monitoring for the real behavior of users from the user end to the service layer. The working principle of gold APM "application probe" is to analyze the "real production data" in the application. Operate the application from the front-end device, click the button to send the request, and the back-end server receives the request and processes it, such as calling the stack, database or accessing the third party and cache. "Application probe" is collected and processed uniformly, and uploaded to gold APM Data Center for processing display. The deployment mode of gold APM application performance management platform is shown in Fig.1.
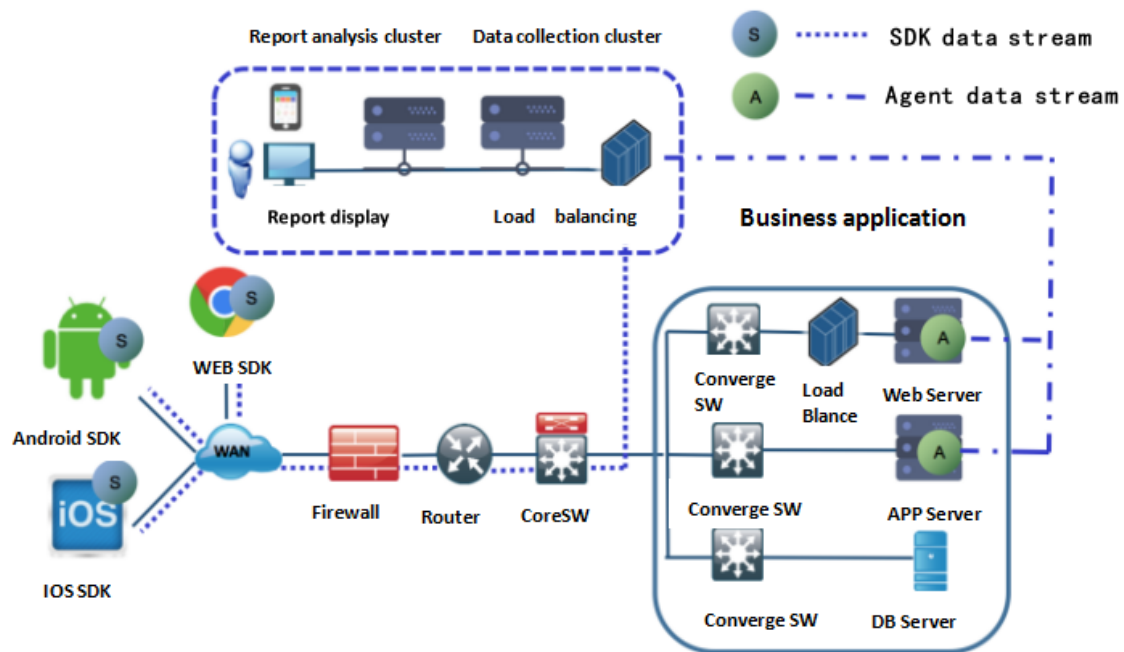
Figure 1. APM deployment mode.

Through APM technology, the data content of the whole life cycle of the application system can be collected, and the results can be achieved as follows: (1) Minimize downtime [3]; (2) Establish integrated dashboard performance control. APM's real-time integrated dashboard provides a powerful and dynamic real-time performance monitoring interface [4]; (3) Ensure the fault corresponding ability. Through continuous system performance monitoring, the possible dangers in the future can be predicted and prevented, and provide automatic alarm function in case of problems [5]; (4) Service satisfaction. The automatic load control (PLC) function can be used to ensure the stability of service, the minimization of downtime and the corresponding ability of failure, so as to realize a more stable and reliable 24-hour×365 day system operation[6]; (5) Reduce the overall cost. TCO can be reduced by minimizing downtime, ensuring fault response capability, optimizing application adjustment performance, maximizing IT resource efficiency and effectively using human resource applications; (6) Ensuring quantitative performance basis data. According to the quantitative data collection and statistical analysis of connected users and load, the system expansion and modification time can be predicted to ensure the quantitative basis data needed in addition and optimization [7,8].

3. Main Research Contents and Technical Solutions

Power application performance diagnosis, analysis and optimization monitoring system needs to provide excellent end-user experience monitoring and early warning, code level performance monitoring and fault handling, application performance bottleneck positioning, application performance problem root cause analysis, external things analysis, etc. Provide end-to-end solutions for end-user perception, application performance on the network and system operation health. Use probe technology to monitor, measure and detect application performance and abnormal conditions, provide detailed real-time view and historical record view, and provide visual reports on business transactions.

3.1. Main Research Contents

(1) Study the high-efficiency storage and reading technology of massive program code; (2) Study the application code collection technology in different operating environments; (3) Develop an efficient code data processing engine to optimize the application program in multi concurrent, distributed and cloud environments; (4) Study the code level program running state collection technology and non intrusive code monitoring technology; (5) Research on stack data tracking monitoring technology of

application system; (6) Research on dynamic link tracking technology; (7) Research on thread pool management tracking monitoring technology.

3.2. Implementation Plan and Technical Solution
The project mainly consists of four modules: data acquisition subsystem, data processing subsystem, data management subsystem and data analysis subsystem.

The data acquisition subsystem is composed of communication acquisition data module, profile data acquisition module [9], I/O data acquisition module, thread stack state acquisition module, JDBC data acquisition module [10, 11]; it is mainly developed by Java and C++ language, and data acquisition is mainly realized by C++ language in the bottom operation of the system. Data processing subsystem [12] consists of data acquisition interface, data integration module, data classification storage module and data preprocessing module. The standard deviation algorithm in statistics is used to process and classify the collected data, and to relate the scattered data. Big data algorithm is developed by C and C++ language, and mining algorithm function library is realized by C++ language in the form of dynamic link library. In the implementation of mining algorithm function library, STL basic container is used to evaluate the development efficiency and operation efficiency, and boost class library is used to provide basic data structure support. The data management subsystem consists of visualization module, warning module, authority management module, utility module and access control module. Be responsible for the management, task scheduling and control in the system, realize the dynamic display of application system operation status and behavior data, and present the analysis results of big data intuitively. Data analysis subsystem is the system architecture of data mining platform based on MapReduce, which is composed of regression analysis module, association analysis module, data classification module, data clustering module, text mining module and web mining module.

Java technology is mainly used to monitor the system operation status, application system behavior and application system business data, which is realized without modifying Java application source code. Some trace codes and profile information output codes used to collect performance data are inserted into Java application class through reflection and mapping technology, so as to realize data monitoring. In the aspect of I/O data and socket stack data monitoring, the method is to modify the program code to realize the output of specific stack information content, and use the Java virtual machine loading mechanism to realize the change of loading mode. In the aspect of profile information monitoring, by inheriting and overloading Java. Lang. object, Java. SQL.*, Java. Io. * and other system base classes, the base classes introduced by the application program will have code offset, so as to realize the corresponding data monitoring.

JDBC related data monitoring is based on the implementation of database link driven, and be divided into three types and makes corresponding configuration, including the connection pool mode, the native JDBC mode and the custom connection pool mode, so as to realize all the existing JDBC mode data monitoring. In the aspect of thread stack and queue status data monitoring, thread tracking identification technology is used. It is mainly used to monitor the thread class, uniquely identify each generated server thread, monitor and trace the thread throughout the process, identify its status, and extend some attributes of the thread, add thread response time factor to achieve the number of threads According to the monitoring of each state and the information of queue depth [13]. In terms of data storage, different storage methods are adopted for different types of data. For the behavioral data and profile data generated by the application system, the product uses the self-developed file data base for storage. The file database is developed based on the ISAM index sequential access method [14]. The index mode is very fast and can be used in the later data analysis and mining. The central integrated management mainly adopts the spring MVC architecture development, follows the MVC mode, and mainly uses H5 technology in visualization; for profile data, uses the transaction end time and the total response time to form a real-time scatter diagram, which can sense the situation of application server processing transactions in time through the shape of the diagram, and deal with the problems of insufficient resources and failures in time. In the aspect of trend display, line chart and column chart are used.

4. Implementation of APM Monitoring System

APM monitoring system is to establish an effective performance monitoring and fault response strategy, which is suitable for Java development application system. Based on the application layer, system performance data monitoring and code level data monitoring are realized, so as to quickly and accurately find the application system fault, and make the application system run more stably and efficiently.

4.1. Intelligent Alarm

One of the core capabilities of monitoring products is intelligent alarm. This section will introduce the intelligent alarm function of the system in detail, including the customized precise alarm and alarm real-time notification function.

4.1.1. Custom precision alarm

The alarm service supports the setting of service index and performance index alarm of a single service, and can also be set according to a class of service. At the same time, the alarm threshold can be set for the indicators of the whole business, and flexible alarm combination can be carried out, such as different indicator combination, different business combination, different alarm mode combination. First, lock the service request through the access path, server IP and message information, and then set the alarm threshold for the service request to achieve the real service alarm based, as shown in Fig.2. Second, the components of alarm strategy are modularized. Alarm monitoring index and threshold are designed as a module, alarm notification as a module, alarm name and enabling status as a module. Each module can be freely combined without mutual influence. This combination of alarm strategies can combine different alarm strategies according to alarm needs to meet the use of different services.

Business name	server	Route
successfully joined cart	192.168.132	/app/cart
get user information	192.168.132	/app/user/get-user
/app/category/list-with-product	192.168.132	/app/category/list-with-product

Figure 2. Business request location figure.

4.1.2. Real-time alarm notification

When the application is abnormal, it triggers the alarm strategy and sends a notice to the user. At the same time, it also records the application information and records the alarm information into the alarm database. The system has developed the client application. By installing the gold APM client, you can know the current status of the application in real time, receive the alarm notice of the application in time, and view the alarm information, as shown in Fig.3.
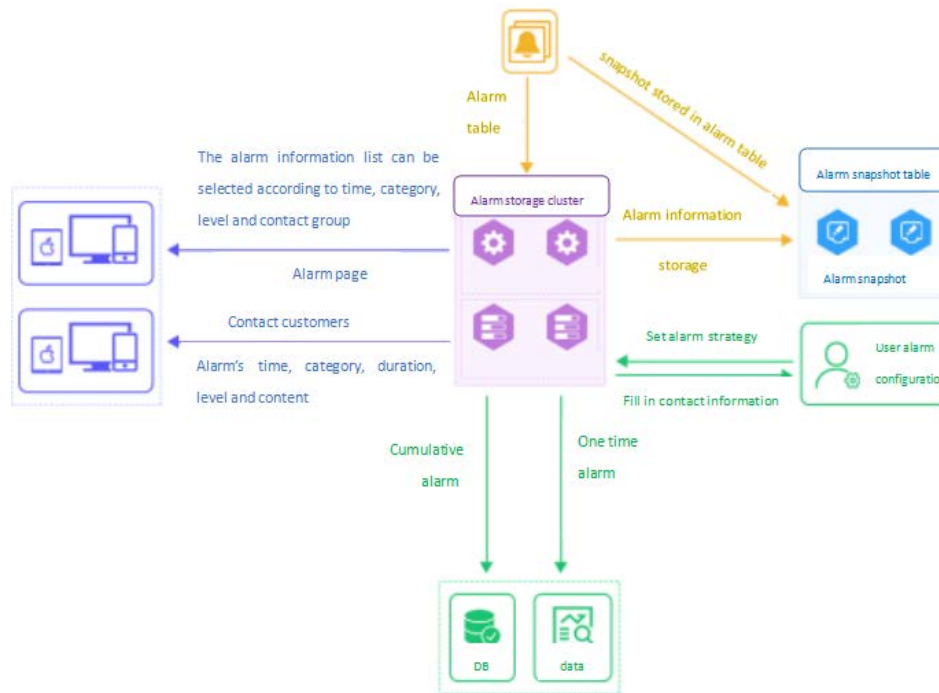
Figure 3. Real time alarm notification chart

After an alarm occurs, users can click the analysis button in the alarm list (both in the alarm overview and alarm details) to enter the alarm analysis page. In the alarm analysis page, the data of 20 minutes before and after the alarm is displayed, and the key indicators affecting the service request are graphically displayed, so that users can analyze the change of service request during the alarm.

4.2. Other Main Functions of the System

Start the server program by running startup.bat under the server installation directory. / bin. Then access the http://server addressr:7900, enter the the system home page. The system lists all commonly used custom monitoring parameters in the centralized monitoring page. For example, it displays the warning information of all monitored servers. The warnings are divided into four types: serious, error, warning and message, which are expressed in different colors. At the same time, the system also has a very professional real-time monitoring screen to ensure the real-time display of all monitored data.

Health score intuitively understands the health degree of the tested application. First, the application performance health index, second, the business health index and how the business performance is. The two indices represent the overall health status of the application. Set the weight of the core indicators of the application, and calculate the index score through the weight relationship, which can directly reflect the current health of the application. The full score is 100 points. Refresh every 5 minutes. The higher the score is, the healthier the application is. The border color of the score will change according to the score value. The platform also has the function of generating report books. By default, monitoring reports are generated on a weekly basis. After selecting the date range and time range, click query to generate a preview report, and print or export the report file.

5. Conclusion

In order to realize the real-time monitoring and early warning of power information system, quickly determine the application performance bottleneck position, and ensure the stable operation of power information system, We proposes a performance monitoring platform based on APM. The system uses probe technology to monitor, measure and detect application performance status and abnormal conditions; it provides the function of viewing detailed real-time and historical records, and generates visual application performance reports. This product is applicable to all mainstream operating systems and various Java versions (from version 1.4). Even a simple jar program without middleware can

achieve full function monitoring. In addition, the research results are also applicable to financial, industrial control, transportation, medical and other industries, as well as e-government and other government information business data centers.

6. Acknowledgments

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