

A NoSql-Based Data Sharing Capability Mechanism in Smart Grid

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Abstract—Based on the data interaction mechanism between NoSql database and relational database, this paper proposes a new solution to the real-time and effectiveness of cross-platform data interaction. Develop a middleware for NoSql and relational database synchronization data. By actively requesting GIS services, the GIS service accepts the request and returns the request data.

Keywords— NoSq, database, interaction mechanism, GIS

I. INTRODUCTION

The current grid GIS (Geographic Information System) platform realizes the integrated maintenance of graphics, topology and account of full-voltage grade grid equipment facilities. In the promotion process, there is a large amount of data, business application pressure, performance is not ideal, the main reason is that the business application and query analysis applications are not physically isolated, resulting in database IO performance is not ideal. At the same time, the performance requirements of various graphic application scenarios are relatively high, and relational data needs to be reassembled for each type of graph, which has a great impact on performance.

The early information management system mostly adopted the C/S architecture. The data storage method mainly uses the relational database. The system research and development mainly carries out secondary development on the existing platform [1]. The software modules have strong coupling and low reusability [2]. With the development and popularization of Internet technology and Web service technology, the information management system architecture has evolved from a single C/S model to a B/S model, and has gradually evolved into a service-oriented architecture (SOA) [3]. In addition, Web services technology can solve data sharing and interoperability problems, providing new ideas for metadata sharing [4].

This paper adopts the data mart structure which is composed of the business system and the auxiliary analysis intermediate library and the special decision database. The business library is mainly applied to the process control of the addition, deletion and transformation and the graphic generation review. The auxiliary analysis intermediate

library is applied to the resource data. The query of graphical data is published; the thematic decision-making library is mainly applied to big data mining and analysis, so that services at all levels are specialized and reduced in quantification.

II. IMPLEMENTATION OF GIS PLATFORM ARCHITECTURE SEPARATION TECHNOLOGY

In terms of performance improvement of the grid GIS platform, some advanced technologies such as integrated machine, real-time discrete data integration, HANNA architecture and other technologies can be used in the promotion process. Since NoSQL databases are inherently distributed, NoSQL databases typically have multiple services [5]. The computational complexity of the graphics computing service itself has high performance requirements. The overall design of the system is shown in Figure 1:

The large computational complexity of the graphics computing service itself has high performance requirements. How to optimize the architecture, introduce new technologies, and provide a simplified and dedicated service interface for specific application scenarios to improve response speed is the key point. The module not only needs to support the processing of massive data, but also needs to specifically distinguish the business system to which the information belongs, without increasing the computing load of the functional subsystem such as the data recognition engine and the system storage space [6].

A. Read-only library construction

Through OTG or other advanced database replication technology to build a read-only library, preliminary analysis of business and data relationships, partitioning, classification control read-only database data synchronization frequency, and based on existing applications for comparative testing and performance demonstration.

B. Data writing

Define the scope and frequency of data transfer according to business characteristics, and sacrifice real-time performance in exchange for read performance, and

introduce ETL process and related mechanisms to improve data write performance.

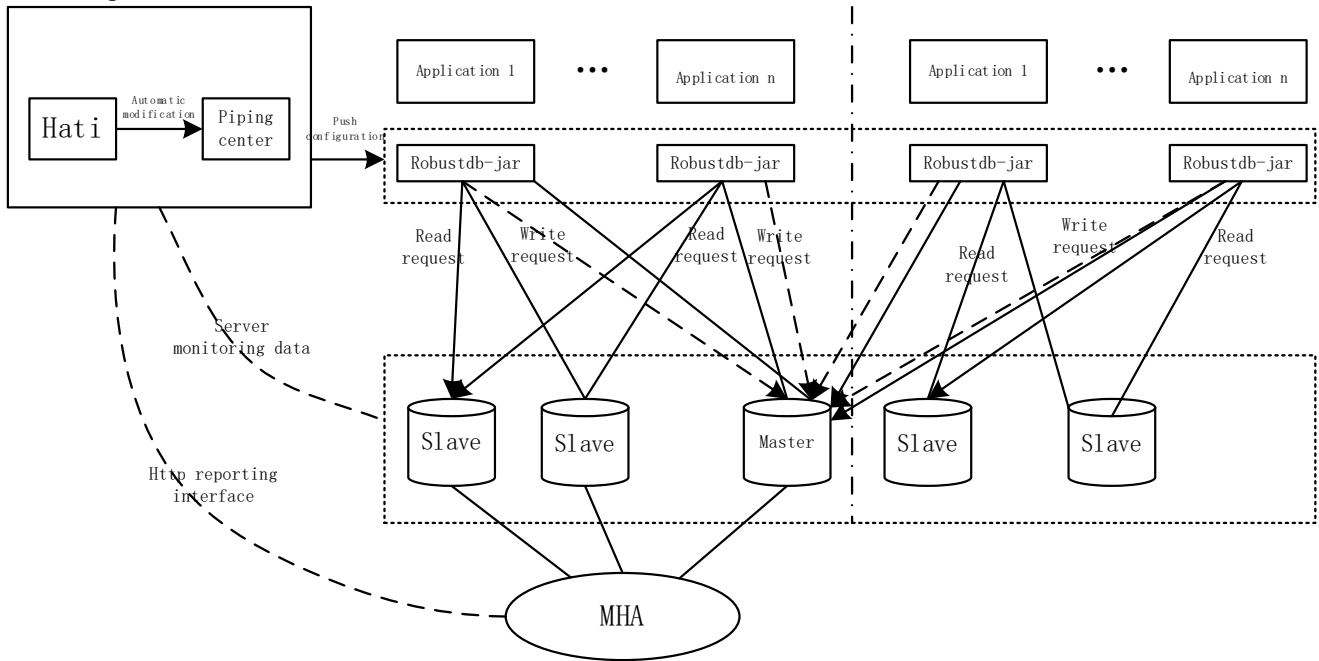


Figure 1 System architecture

C. Data reading

Research HANA in-memory database technology, Hadoop distributed technology architecture and other technologies, and integrate into GIS platform to improve data

read performance. The read-write separation verification work includes the effect of data synchronization and the impact of the synchronization process on the performance of the main library.

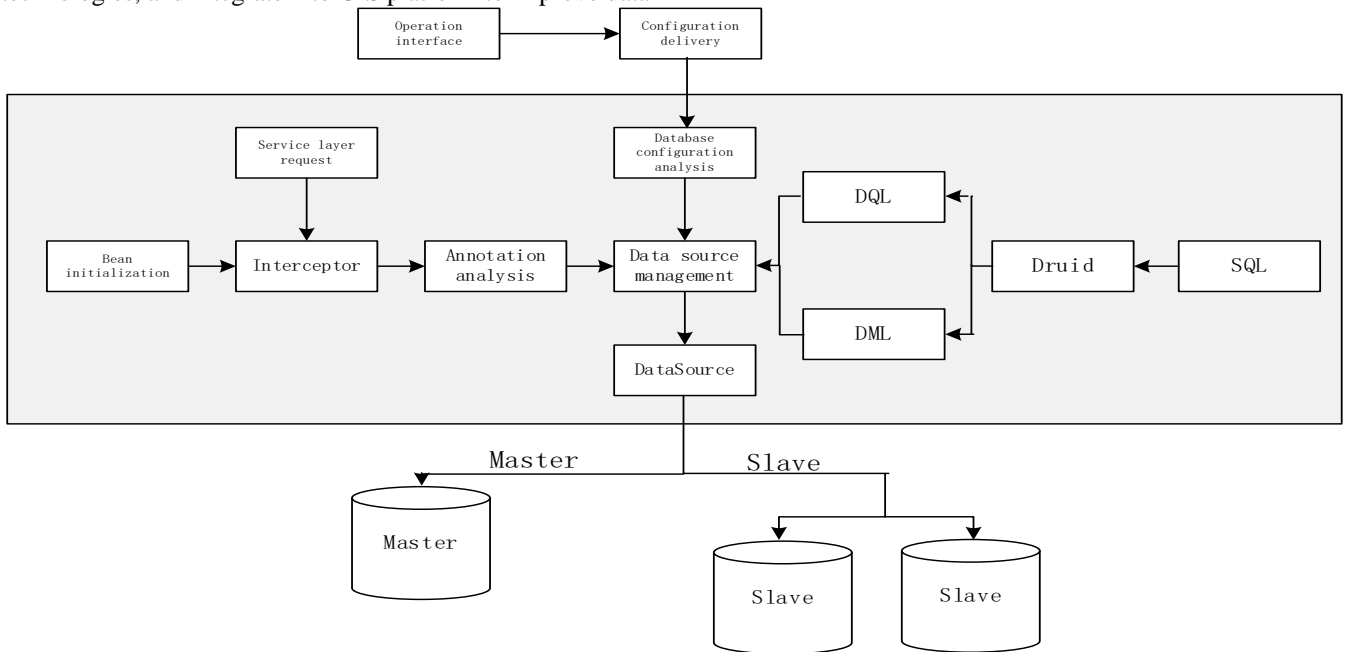


Figure 2 Control layer process's implementation

III. READ AND WRITE SEPARATION CONTROL LAYER DESIGN

DML (insert, update, delete) operates in the main library, and synchronizes data to multiple read banks through OTG synchronization. All DQLs can operate the master-slave database to enhance data reading. At the same time, support the method-level specified routing control, all the database operations in the specified method in the service operate the

same database (mainly the main library), ensure that the database read and write operations in the method operate the main library, avoiding data synchronization delay leading to read from The library data is abnormal.

The method-level transaction sends the SQL request of the entire method to the main library. This method requires an interceptor and uses an AspectJ style interceptor. The entire distributed system can be regarded as a storage

warehouse of massive data. Multiple namespaces can be created according to different business scenarios. Each namespace can be individually configured with storage attributes, such as storage medium, number of copies, and default TTL [7]. The thread's multiple SQL thread local variables provide a selection reference for subsequent selection of the database. The control layer process is implemented as shown in Figure 2:

A. Read and write separation

The data source of the graphics service platform realizes read-write separation, which effectively reduces the access performance of the production library. At the same time, the read-only library is used as the database for management analysis.

B. Data model optimization

The optimization of the data model refers to the optimization and adjustment of the structure or model of the graph service platform database MongoDB, with the aim of improving the automatic mapping efficiency and the beautiful layout of the thematic map. MongoDB also supports failover technology, persistence technology, and full index support technologies that provide stability, security, and efficiency [8]. MongoDB has the following advantages:

- Document structure storage method, which makes it easier to obtain data.
- Built-in GridFS, support for large-capacity storage.
- Under the massive data, the performance is superior.
- Support automatic failure recovery (replication set).

IV. DATA MODEL OPTIMIZATION

The data file is stored in a specified directory of the server according to certain rules. When the data needs to be accessed, the application system reads the file on the server through the storage path stored in the relational database [9].

A. Turn on Profiling

The Profiling feature affects system efficiency, but it is not too serious. The reason is that he is using system.profile to record, and system.profile is a capped collection. This collection has some limitations and features in operation, but it is more efficient, so open it when you use it.

B. Query statement changes

Select Create Index on the fields of the query condition, sort condition, and statistical condition. Only the fields used are queried, not all fields are queried.

C. Read and write separation

Both the read and write are in the master node, and the slave node is in a vacant state, causing waste. For searching such a read operation, it can be implemented at the slave node.

D. File System Method

MongoDB's data files are pre-allocated, and in Replication, both non-Arbitrator nodes of Master and Replica Sets pre-create enough empty files to store operational logs.

V. DESIGN OF DATA INTERACTION MECHANISM BETWEEN NOSQL DATABASE AND RELATIONAL DATABASE UNDER GIS ARCHITECTURE

Now, there are many NoSql solutions, and MongoDB is the most popular solution. MongoDB is positioned as an open source, easy-to-expand document database. The ability to provide high-throughput data batch read and write capabilities based on common hardware clusters provides high reliability and scalability [10].

VI. DATA EXCHANGE DESIGN

Establishing the data interaction mechanism between NoSql database and relational database is to solve the problem of real-time, validity and integrity of cross-platform data interaction. Develop a middleware for NoSql and relational database synchronization data.

The data information that is verified to be ok is written to the map file in the NoSql database, and the problematic data is stored in the error data table. The data interaction mechanism is shown in Figure 3:

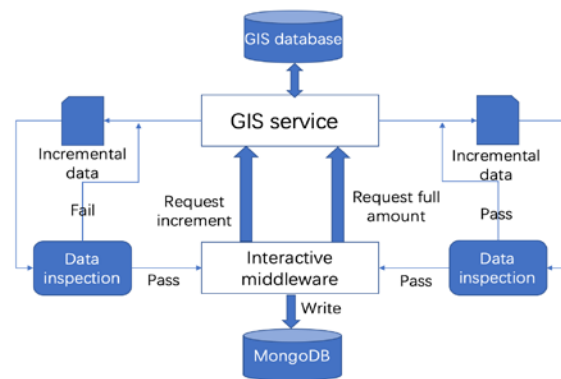


Figure 3 Data interaction mechanism

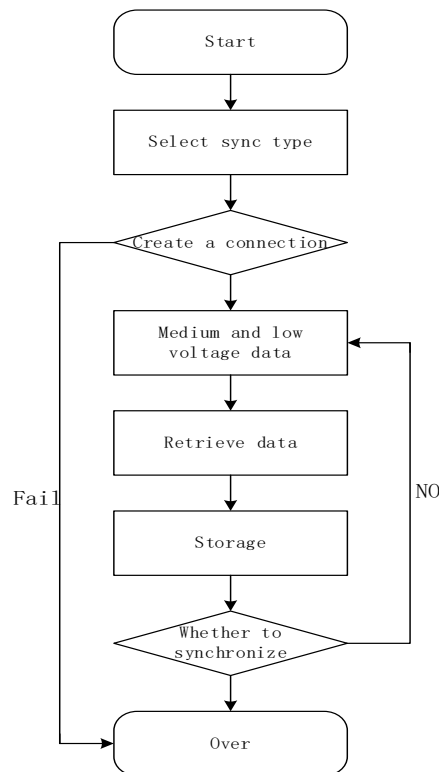


Figure 4 full amount of synchronization flow chart

A. Full data interaction

Due to the large amount of data, interaction takes a long time and cannot be performed frequently. The full amount of data interaction is relatively simple, there is no data loss, which makes up for the defects in the process of incremental data interaction. The interaction of the full amount of data can meet the requirements of data integrity. The full amount of synchronization flow chart is shown in Figure 4:

The interaction mechanism adds data verification function in the data interaction process to verify the data quality in the relational database, and the data verification function can meet the data validity requirement.

VII. CONCLUSION

This paper provides a data interaction mechanism based on NoSql database and relational database to solve the real-time, validity and integrity of cross-platform data interaction. Under the premise that the time of the main library and the synchronization library are the same, a timestamp field added by the data table is selected, and the synchronization time limit index is determined by comparing the time difference of the record. This paper solves the problems of the platform due to the large amount of data and poor data sharing capabilities.

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