Design of Electric Power Management System in Jilin Province based on SOA

Shou Ze REN[1], Yong Zhi WANG[1,a] and Tong WANG[1]

[1] *College of Instrumentation & Electrical Engineering, Jilin University, 130061 Changchun, Jilin China*

Abstract. Aiming at the problem of electric power data integration and sharing in Jilin Province, China, this paper proposed a method based on SOA which has high scalability, flexibility in strong power data and application integration. This approach establishes a web service-oriented system architecture, using SQL Server 2012 as its backend database and using C# as the programming language. And this approach has developed three kinds of terminal applications namely C/S(Client/Server), B/S(Browser /Server) and M/S(Mobile/Server). Client applications send all kinds of request to the electric power cloud computing centre, meanwhile web service components receive the requests and call corresponding functions to compute, and then return the results to the original app through the internet. The results show that system achieved the target we expected and successfully realized electric power information data integration, release and sharing.

1 Introduction

With the development of society and progress in technology, the demand for electricity in industry, agriculture, daily life increased sharply, the electric power industry is facing severe challenges. To dispose these problems, a variety of advanced technology has been applied to the power sector. The using of information and project management technology in the power industry have greatly improved the utilization of electric power resources and management efficiency and have reduced operating costs.

Lots of institutes developed different systems according to particular needs which have great difference in operating system, system model and data format, leading to different information exchange between systems, making it hard to realize information sharing and source exchange. Part of the network and application system become isolated systems, forming a large number of distributed heterogeneous "information isolated island".

The existence of "information isolated island" seriously blocks the effective sharing of information resources, and greatly limits the application of information resources in power system, and hinders the development of the electric power industry, resulting in a large number of repeated construction and waste of resources". The software system scale ,complex degree and operation flow changes deeply, so common system architecture is hard to realize fast dynamic adjustment and rapid optimization along with the changes in the market.

This paper proposes to build a power system for loosely coupled SOA-based collaborative design management platform, through coarse-grained services, loose coupling to shield the complex business logic, by witch to reduce the complexity of business processes through the organization of the professional division of labor, making the development of large software scale possible. Make various enterprise application systems combine into a unified platform for information sharing between the various isolated application systems to meet enterprise business needs across sectors by loosely coupled structure.

2 Electric Power Information Sharing Framework Based on Cloud Computing

Electric power information sharing framework is built based on cloud computing [1]. Electric power cloud center is implemented mainly by Service-Oriented Architecture (SOA)[2-3]. SOA is designed as development concept "software as a service, the service is the software"[4]. As a basic-unit programmer, Web service has good encapsulation, reusability, scalability, and maintenance and cross-platform operator in accordance with “data-service-application” organized by logic-levels. Meta data realizes opening directory in department data. Service composition and extension will leverage software sources scattered on internet in a form of web service in order to realize sharing capabilities. All in all, that is how SOA will create a loose coupling, scalable, managerial and self-service exchanging sources sharing environment of distributed spatial information

[a] Corresponding author: iamwangyongzhi@126.com

and complete construction of application system and maintenance upgrades in order to realize the public and mutual operation of spatial information among cities. In this case, we will regard web service as an object or component works on this web.

Recognized as a main operator of information sharing technology using web service, the SOA-based system builds a reusable source environment. System frame can be classified into database layer, data access layer, service process layer, network transmission layer and client application, as shown in figure 1.

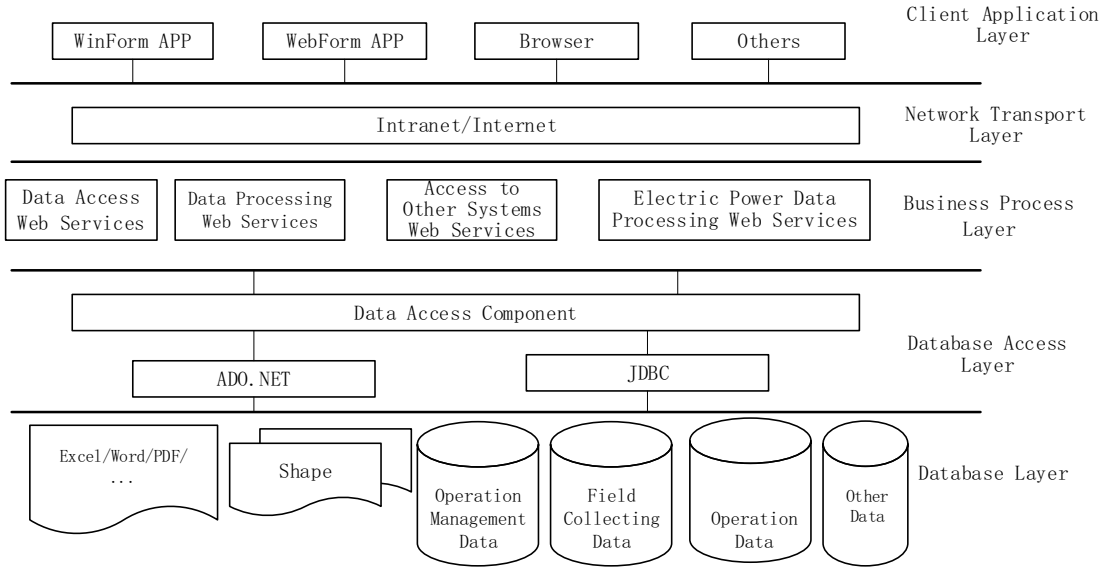

Figure 1. SOA-based Frame of Electric Power Information Sharing

(1)Database layer is the data source of electric power information management system. It is the core of the frame, including multi-media documents, Word, Excel, PDF, operation parameters of electric power, data of equipment monitoring collected by field bus system and stability data of power output voltage, the data of operation and management of power enterprise like electric price, sales of electric power, power consumption and client's information, etc.

(2)Database access layer is a service-processed provider for the business processing layer which accessing background database. It accesses to database and operates data by foreground as needed through ADO.NET and Java database connectivity.

(3)Service process layer consists of web service capable of querying data, which will change a request by client into web service's order. Service process layer can flexibly integrates with other system because of publicizing data access and analysis related to system through a loose coupling form of web service component.

(4)Network transmission layer refers to a channel to interaction between foreground clients and services. Requests by foreground clients transmitting under HTTP, TCP/IP protocols and format for data transmission is also XML.

(5)Client application layer uses based on shared data and the department of private data sources as information source. Supported by database, model database, network and sharing system, information sources, basic sharing data and private data will applied into trans-department and cross-region overall..

2.1 Distributed Data Storage

In order to effectively prevent redundant construction, information isolated island and the characteristics of electric power information resource heterogeneity, consider from the perspective of management and access efficiency, this system adopts the way combine the distributed storage and centralized storage to dispose the frequent base data in power engineering construction, make it centralized storage and management. These basic sharing data bridges between databases and this bridge will make different areas and departments have a spatial logic relation so as to achieve the goal of pooling electric power information sources.

Information with a lower shared frequency, also known as general shared data, is stored in the local database and provided to share in appropriate way. However, information used only by the department, also known as private local data, is stored in private local database.

2.2 Information Sharing Mechanism

The demand for sharing information can be divided into data-grade sharing and application grade sharing in accordance with granularity differences between systems. Data-grade sharing refers to data, also known as contents shared by system and shares a lower granularity. Data-grade sharing is appropriate to extract and send multitudinous data, which has nothing to do with controlled transaction logic and is a pure database level. Application grade sharing is improving frequency of business information system from application layer, however, functions for data exchange and general-purpose sharing related to controlled business logic shares a higher granularity.

Based on two information-sharing levels, a core mechanism for all electric power shared information includes as followed:

(1)We can integrate and manage distributed data in order to realize the sharing and exchange of data-grade among cities based on open directory for electric power information sources with a core metadata.

(2)The discovery, configuration, interaction, assembling, operation and management of service under technical manual for web service realize the sharing of service logic and business logic.

(3)Combined by Meta data and web service, we can build and realize application systems and application-grade sharing.

3 Application Instance

Information sharing platform includes a number of subsystems. For example, information management system of electric power operation condition, electric power project information management system, electric power marketing formation management system and data analysis system for electric power equipment monitoring. We will see electric project information management system as an example and introduce it.

3.1 Functional Model for Electric Power Data Management System

Electric power data management system is an electric power project information publication platform which is built by electric power enterprises, an information management platform and a assistant decision-making platform from the leadership level. Leveraging electric power data management system will realize all information's sharing from the whole project and pool information source altogether. Well-equipped system optimized support system for information management and regulated measures for the management of business.

According to the demand for the use of productive management in electric enterprises, this system classified into four parts, namely, system management module, electric power production module, equipment management module and data management module. The functional block diagram of the system is shown in figure 2.

(1)The system management module lays foundation for ensuring the normal operation and also provides system log management sub-module, personal information management sub-module, system log sub-module and user privilege management sub-module.

(2)The electric power production module includes management on engineering plan, management on engineering schedule, management on the implementation of the information and management on engineering files.

(3)The equipment management module includes the maintenance of the equipment basic information, the maintenance of the equipment failure information, and the management of the information for equipment inspection, inquire of equipment information and the management of inventory information of the equipment.

(4)As a core module, the main functions of data management model are described as followed: adding data, browsing data, statistical data and analysis data etc.

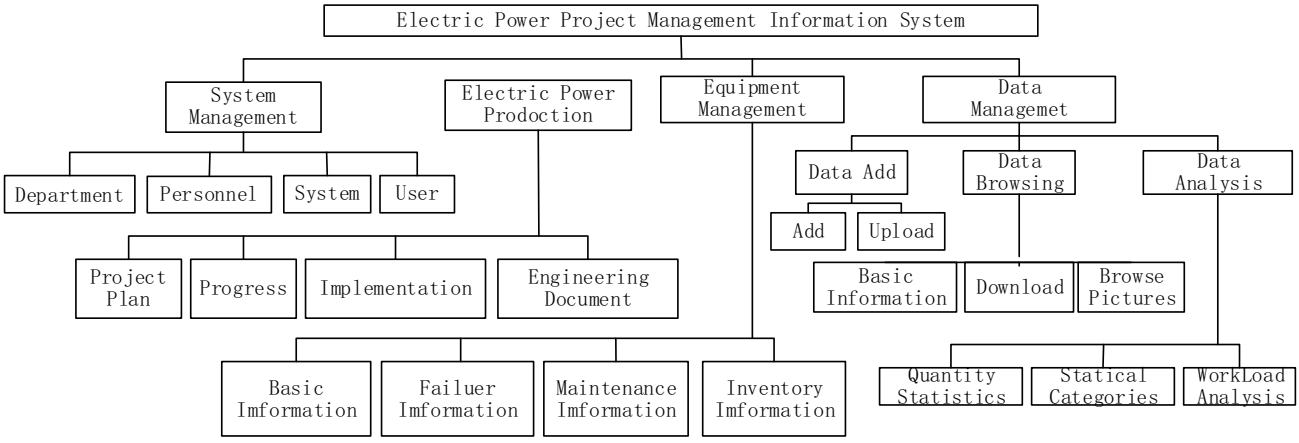

Figure 2. Functional Structure Diagram of System.

3.2 Data Mode

As a core of electric power data management system, the database is an entity of storing data related to electric power documents and lays foundations for all information sources. The design quality of database system influences directly the performance of the system. In order to improve the productivity and quality of development of the system, we ensure data independence and maintainability, shared data correctness and consistency，decreasing data redundancy, guarantee data security and reliability during database designing process in accordance with features of electric power document.

3.3 System Implementation

3.3.1 Implementation Technology

The MVC-based system adopts one-stop portal technology and technology concept. RIA-based (Interface Application Rich) technology to achieve the application of various types of client. The front-end UI communicates and interacts with data service through HTTP and SOAP protocol and service centre invoking other services and return results back to the foreground through HTTP and TCP protocol. The client processes and formats results that returned by invoking service. The results will be shown in table, word, diagram and so on.

Some documents need to be uploaded to server in the application of documents management system, which characterized by large files, size is up to 100MB and a large number of files. Digital signature and data encryption is required in the data security. HTTP-based transmission mode is our initial consideration. We found that the data being uploaded through HTTP protocol seems to meet the convenience of web programming after comparison. The speed of uploading documents is less than 1MB is a little bit faster than that through FTP protocol. But it's impossible to upload piles of documents and large files. If the documents are greatly larger than 1MB, the speed of FTP protocol is faster than that HTTP. The fact is that the larger the file is, the faster the speed of uploading is.

Now, FTP protocol adopts a more popular C/S mode that implements the documents transmissions which consists of FTP client program and server program. For example, remote server programs in Windows 2008 are installed on IIS information server and then we set up our environment. By setting up a FTP server, this setting specifies permission for operating documents in server by clients. He can only download documents from server if a client only have a read access; He can upload documents if a client have a write access; He can upload and download documents if a client have a read and write access.

3.3.2 System Realization and Effect

The interface of project information management which is shown in figure 5 is a core of documents sharing. A large number of documents relates to project. Browsing interface for picture information is shown in figure 3.

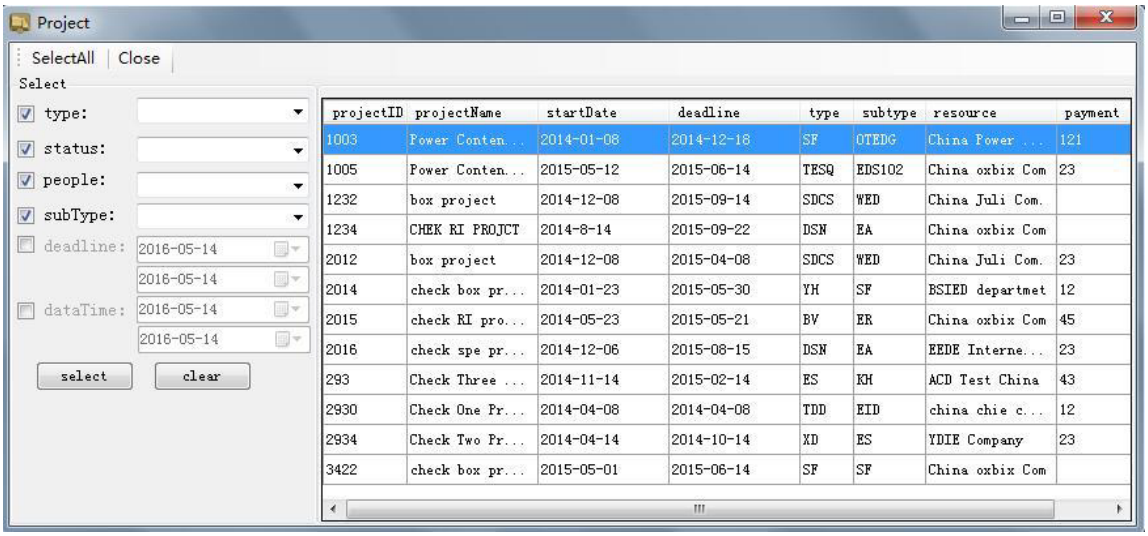

Figure 3. The Interface of Project Information Management.

4 Conclusion

Electric power project information management system can complete the fully sharing of project information, which will guarantee data consistency and real-time capability so as to revise discussion in time and complete the alternation of management. This purpose leads to a workflow management which is highly effective, provides effective support in the project of tomorrow and achieves the high efficiency of construction and management.

References

1. W. He,Y. Wang. Progress in geophysic,**29**,6,2886-2896(2014)
2. Y Wang, H Yang,L Lu. World Geology,**26**,4,447-452(2007)
3. Y Wang, H Pan, W He. Geological Bulletin,**28**,6,29-32(2009)
4. C. Hao,Y. Wang,et al. Applied Mechanics and Materials, (687-691),2952-2955(2014).
5. Y. Wang,Y. Zhang,J. Yi.,et al. Mathematical Problems In Engineering,2014,1-11(2014).
6. Y. Wang,Y. Zhang,F. Zhang,et al.Mathematical Problems In Engineering,2013,1-10(2013).