Decision risk analysis for power grid planning based on AHP fusion RBF

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Abstract. In order to meet the structural and functional requirements of simulation laboratory for power grid planning study for application data processing, a set of application data subsystems for the simulation laboratory of power grid planning study is designed according to the actual demand of grid planning and simulation. Design thought of application data subsystem of simulation laboratory for power grid planning study is discussed in detail from overall structure to actual functions; the application data subsystem is subject to integration method based on the data bus and uses CORBA to solve the interoperability of distributed objects in cross-heterogeneous system; open structure is used to provide a network architecture which has redundant key function and support distributed processing environment, to meet the scalability, security, reliability, openness, easy maintenance needs. Main functions include: data exchange platform, data centre, graph centre, data query and pivot, information service, information maintenance platform unified by WEB, provide a unified platform support for accessed / embedded third-party application function, and so on. The level of power grid planning simulation is improved, a more rational planning program is verified, and greater benefits are created.

1 Introduction

Grid planning is important and complicated preparatory work in the construction of electrical power system and the quality of planning affects the investment efficiency and safety operation of power grid directly [1-3]. At present, China's power grid construction is advancing in the direction of strong and smart grid [4], which puts forward higher requirements for power grid planning. Reasonable grid planning is the premise to ensure a strong power grid, and it provides a standardized, effective, and orderly competitive platform for the power market. The power grid planning simulation simulates planning process before the actual planning; the results are analyzed and evaluated to provide guidance and reference for the actual power grid simulation [5]. Open architecture is adopted to provide the network architecture which has redundant key functions and support distributed processing environment, and it satisfies the requirements of scalability, security and reliability, openness and easy maintenance. These conditions are the most basic requirements on application data subsystem of power grid planning simulation experiment platform. Based on the actual situation of grid planning simulation, the data are obtained by analyzing the requirements of the application data subsystem in power grid planning and simulation. Application data subsystem of simulation laboratory for grid planning research should obtain basic data of power grid planning and simulation from the various systems firstly. Secondly, the accuracy of the data and the timeliness of synchronization are required. In fact, integration problems of secondary system need to be solved, so selecting the correct integration methodology is essential for the success of the entire project.

2 Overall architecture design of application data subsystem in simulation laboratory for grid planning research

According to information of application data subsystem of simulation laboratory for grid planning research, system is designed with advanced and mature information technology and concept based on design objectives and function requirements. It aims to build a practical, advanced,

mature, and reliable application data subsystem of simulation laboratory for grid planning research to provide reliable and comprehensive basic data for simulation of power grid planning, and further to improve the level of power grid planning simulation, verify and screen the rational planning scheme, and to create greater economic and social benefits.

Basic data come from ERP system, PMS system, and SCADA system, and is collected in data warehouse through interface of data adapter and uniform data service bus. The data include real time data, historical data, graphic data, and GIS information data. Application service corresponds to data service, the application data subsystem provides services for the power grid planning simulation platform through the application service bus, such as algorithm calling and other related application services.

3 Software architecture of application data subsystem in simulation laboratory for grid planning research

CORBA is one of the ideal solutions to the distributed computation technology of heterogeneous-cross systems. It focuses on solving the interoperability of distributed objects in heterogeneous environments. CORBA's real-time performance is the best in many types of middleware such as COM and DCOM CORBA; it allows both static calling and dynamic calling and also has high-level language binding, system self-description, and so on. CORBA distributed object model combines with J2EE environment through JavaIDL, which represents the most interoperable distributed and standard model, therefore, the application data subsystem of grid planning, research, and simulation laboratory should be based on software system of CORBA / J2EE multi-layer C / S and B / S hybrid architectures.

1) Application middleware

Application middleware can be seen as a middleware software package between upper application systems and different hardware systems and operation systems in bottom layer. The software package separates upper applications and systems in bottom layer effectively and constructs distributed parallel operation platform above different computer system structures and operation systems to provide a development platform and operation environment for design and operation of upper applications. The system uses distributed public object and requests proxy architecture middleware CORBA, J2EE bus as the communication and integration framework of system.

2) Data support layer

This system uses oracle database as database platform of system to manage data resource of application system, achieve business data storage management services, complete data storage, retrieval, optimization, self-fault diagnosis backup, recovery, and other operations through the large-scale relational database management system. Meanwhile, data bus includes integration of data resource in other current systems. The data layer effectively establishes database structure through data model, which objectively reflects the organic connection between the data in the system, realizes the centralized storage of application data subsystem in the overall power grid planning, research, and simulation laboratory, and establishes a unified integration platform of business data.

3) Service support layer

Service support layer includes service support and algorithm service library. The service support consists of system application framework, business model, calling control, and view representation. System application framework provides public services required by all the functional modules for the overall system. Business models, call control, view correspond to the model, controller and view respectively.

4 Function design of application data subsystem in simulation laboratory for grid planning research

4.1 Function design of application middleware

1) System management

System management is the core function of system, and is responsible for construction and maintenance of system core. It has basic functions as follows: basic configuration management of system; node management of system; server management of system; unified process management; unified basic operating environment configuration.

2) System safety

System safety management mainly provides solutions for system safety to protect safe operation of computer. It includes operating system security policy, network security (to prevent hacking), virus detection, vulnerability scanning, and password management.

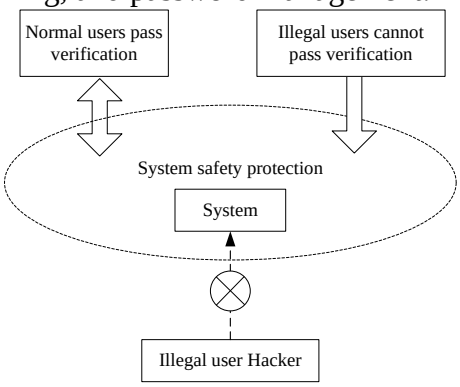

Fig.2 Schematic Diagram of System Safety Management

3) System diagnosis

System provides plentiful monitoring and diagnosis tools to prevent failure or recovery system rapidly when system is about to have failure or has already had failure and to ensure safe, reliable operation of system. They include: monitoring of system operation condition; monitoring of local shared information and received information of communication gateway; connection and management of communication gateway, operation condition monitoring; fault diagnosis function; monitoring and diagnosis results can be inquired and managed; The system log can be used to diagnose system.

4) Network management

Application data subsystem in simulation laboratory for grid planning research is a distributed system, which has complex network structure and many network nodes; in order to ensure the reliable operation of the network, the system provides series of network management functions: configuring the system network node; configuring the server network node; monitoring the network operating conditions; automatic switching in dual-network; automatic load balancing in dual-network.

5) Process management

Due to the complexity of the system and many applications, each node must run a large number of processes to achieve different functions. In order to ensure the normal operation of the process, the system provides sound and reliable process management functions: configuring processes running on different nodes; configuring processes running on different servers; configuring process starting methods such as daemon, cycle, timing; monitoring the running conditions of different nodes; giving alarm if abnormal process occurs, and automatically restarting.

4.2 Function design of presentation layer

1) Human-computer interface

The human-computer interface system is distributed full graphical human-computer interface which is developed based on the network window system X-Window, the industry standard OSF / Motif or Windows and the latest three-dimensional graphics standard OpenGL, it has the following

features: Window system and screen display system; interactive operation and management; trend curve function; picture copy function; notepad function; alarm function SVG and other graphic format support; automatic refresh.

2) Graph module tool

The system provides a full-graphic picture part editor and a variety of picture editors, the generation and editing operation of various kinds of picture parts can be achieved through 100% mouse operation, the picture can be generated in the amplification mode and the narrowing mode, dynamic element editing, editing of analog quantity and state quantity, and editing of other image format file are provided in picture editor. The graph module tool has the following features: graphics library integration support; full-graph picture editing; rich basic graphics components; user-defined graphics components; synchronization of whole network graphics file; strict graphics version management.

3) WEB platform

The system provides users with a unified WEB publishing platform to facilitate the flexible presentation of various models, graphics, data of application data subsystem in simulation laboratory for grid planning research. It has the following features: unified rights management; unified grid model maintenance; integrated management of grid parameter; unified report management; unified graphics publishing; multi-data source management; system notification mechanism; WEB browsing.

5 Conclusion

The complexity of power grid planning determines the design difficulty of application data subsystem in simulation laboratory for grid planning research. The Thesis discusses the design concept of application data subsystem in simulation laboratory for grid planning research in detail from overall structure to actual functions. On the basis of the CIM / CIS and data standardization, integrated method is used based on latest data bus and service bus to provide a variety of application service interfaces for the upper layer, thus to achieve unification of upper layer interfaces and cross-platform functions; also, it provides a variety of data adapter interfaces for the lower layer to shield the data structure differences from different data systems. Data access, sharing, and exchange are realized furthest through the data integration exchange platform. Open structure is used to provide the network architecture which has redundant key function and support distributed processing environment to meet the scalability, security, reliability, openness, easy maintenance needs.

Reference

[1] Liu M, Yao G, Tian N J, et al. Risk assessment of power grid catastrophic accident based on AHP and fuzzy simulation[C]// IEEE International Conference on Applied Superconductivity and Electromagnetic Devices. IEEE, 2013:18-21.

[2] Qu T. Comprehensive Judgment for Power System Planning Alternatives Based on AHP-DEA[C]// Fifth International Conference on Intelligent Systems Design and Engineering Applications. IEEE, 2014:300-303.

[3] Chen Q R, You D H, Long C, et al. The Forecasting Track of Power Grid Operation State Based on Risk Assessment[J]. Advanced Materials Research, 2014, 1008-1009:454-460.

[4] Wang S X, Zheng W D, Deng C, et al. Grid Enterprise Operational Risk Identification and Assessment Model[J]. Applied Mechanics & Materials, 2014, 521:786-792.

[5] Wei J X, Yang D L, Du P H, et al. Power Grid Emergency Management Capability Assessment Based on the Fuzzy-AHP Comprehensive Evaluation[J]. Advanced Materials Research, 2015, 1092-1093:429-433.