The power quality intelligent monitoring system based on cloud computing

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Abstract: In the Smart Grid environment, power quality monitoring system is required to achieve wide-area, panoramic, massive, real-time, accurate and reliable data monitoring, which is a challenge to the traditional storage model and management of power quality monitoring system. "Cloud Computing" technology-based power quality monitoring system can ensure stable operation of the monitoring system, while meeting the dynamic expansion capabilities, high reliability and real-time.

Introduction

The number of power quality monitoring sites is increasing with the expansion of the system scale. Because the expansion of the system and uncertainty of access time, the requirement of concurrent data processing capability and dynamic expansion capacity continue to increase. Many kinds of power quality monitoring devices, functions and interfaces are not the same, upgrades and maintenance difficulties, monitoring data cannot be shared, the allocation of resources utilization is low, making it impossible to co-ordination analysis of the status each monitoring site, can not make an effective and economical monitoring treatment decisions, can not meet the future requirements of smart grid for the panoramic state of power quality monitoring information. Therefore, the establishment of a reliable, consistent, able to achieve sharing of monitoring information, to support all types of applications of smart grid for power quality monitoring system is necessary.

Cloud computing is the development of Parallel Computing, Distributed Computing and Grid Computing. Cloud computing is an emerging computing model. Computing tasks will be distributed in the resource pool consisting of a large number of computers. It allows users to access on-demand computing power, storage space and information services. Cloud computing is large scale, support virtualization, high reliability, scalability, on-demand service and extremely cheap. Cloud computing used in the power quality monitoring system management, can achieve the system's reliability and real-time[1].

The applications of "Cloud Computing" in power quality monitoring system

Characteristics of the monitoring data in power quality monitoring system are wide, panoramic, massive, real-time, accurate and reliable. Data center using conventional data storage and management methods cannot meet the needs of power quality monitoring system. Cloud computing is the result of parallel computing, distributed computing and grid computing development. Through virtualization, massive distributed data storage technology, parallel programming model and other technologies to provide users with the most reliable and secure data storage center. Adoption of cloud computing technology to build data platform, has many advantages [2-4].

(1) Mass data storage. Cloud data storage systems using distributed storage way to store data, Enable monitoring data to achieve the development of high sampling rate, continuous steady-state recording and mass storage.

(2) Full use of idle resources, lower construction costs. Currently provincial or regional power company idle a lot of server resources. Expansion of cloud storage technology is very simple, you

can directly use the idle server to build. Don’t require the same type of server, significantly reducing construction costs and the use of virtualization technology to improve equipment utilization.

(3) High reliability. Cloud computing uses a fault tolerant data, compute nodes isomorphic interchangeable and other measures to guarantee the high reliability of service.

(4) Effective management techniques. The scale of cloud computing resources is large. A number of server system may be up to thousands of units. And across several data center located in different physical locations. It also runs hundreds of applications. With cloud storage technology, Use status of each storage server can be seen on a management interface.

Hierarchical model of "Cloud computing" technology in power quality monitoring system be shown in Figure 1. The structure of power quality Intelligent monitoring system based on Cloud Computing should include four levels: Infrastructure Layer, Base management Layer, Business application layer and Service Access Layer[5].

Service Access Layer	WEB Browser	Special Client	Wireless terminal	Other
Business application layer	Real-time data	Statistics	Report Query	Special monitoring
	Limit Alarm	HCI	Rights Management	Other
Base management	System Management	User Management	System Monitoring	Data Management
	Load balancing	Resource deployment	Security Management	Other
Infrastructure Layer	Virtualized computing resources, storage resources, network resources, data resources, etc.			
	Computers, storage devices and network equipment and other physical and IT infrastructure resources			
	Monitoring equipment access			

Figure 1. a hierarchical model of power quality intelligent monitoring system based on "cloud computing".

Infrastructure layer: It is the foundation of data acquisition and storage in power quality monitoring system. The system can access various power quality monitoring devices. Computing resources and storage devices scattered in different places. Various devices are connected together by the electric power within the system WAN. Through virtualization technology for computers, storage devices, networking equipment and other hardware resources to abstract.

Base management Layer: By clustering and distributed systems, to achieve all storage devices of the "cloud" to work. Offers powerful storage services for peripheral devices. Achieve internal process automation and optimization of resource management. Including data management, load management, resource deployment and security management. Thus providing a dynamic and flexible infrastructure management services to external devices. Including system management, user management, system monitoring, etc.

Business application layer: It is the most flexible part of the "cloud". For different grid, it can provide different interfaces and application services as required. "Cloud" is a collection of various software applications. Including real-time data monitoring, data statistics, reports, queries, special monitoring, report query,limit alarm, interpersonal conversation, etc.

Service Access Layer: Power dispatcher can get the "cloud" computing services though the browser and the client etc.

The implementation of power quality monitoring system based on the "Cloud Computing"

Power quality Intelligent monitoring system is based on the "cloud". The whole system design goal is that if any computer or server to a "down", the system can operate normally. So the whole

system not only uses some special way in the hardware configuration, but to compensate for the lack of hardware through software.

A. *System Block Diagram*

To meet the demand for power quality monitoring, Monitoring system can be set up in accordance with the hierarchical distributed architecture. Monitoring systems can cover multiple regional grid, monitoring terminal access communication network of corresponding area. Different levels of users can obtain monitoring point monitoring and statistical information within the allowable range though system permissions management capabilities. A typical system configuration of the monitoring system shown in Figure. 2. power quality Intelligent monitoring device is responsible for collecting the power quality real-time data. Front server is responsible for data aggregation and forwarding. Together they collect monitoring data. According to the unified format to transfer data to the Power Quality Management Center. Power Quality Management Center is the central institution of power quality monitoring system. It is interactive data link between monitoring equipment and the client. It has many functions, such as monitoring data management and analysis, system maintenance, rights management, etc. It typically include database server, application server, WEB server, task scheduling server, etc. Between different centers of power quality management, to achieve data interaction through networking. Clients access the data center through the network with data access, browse, query functions.

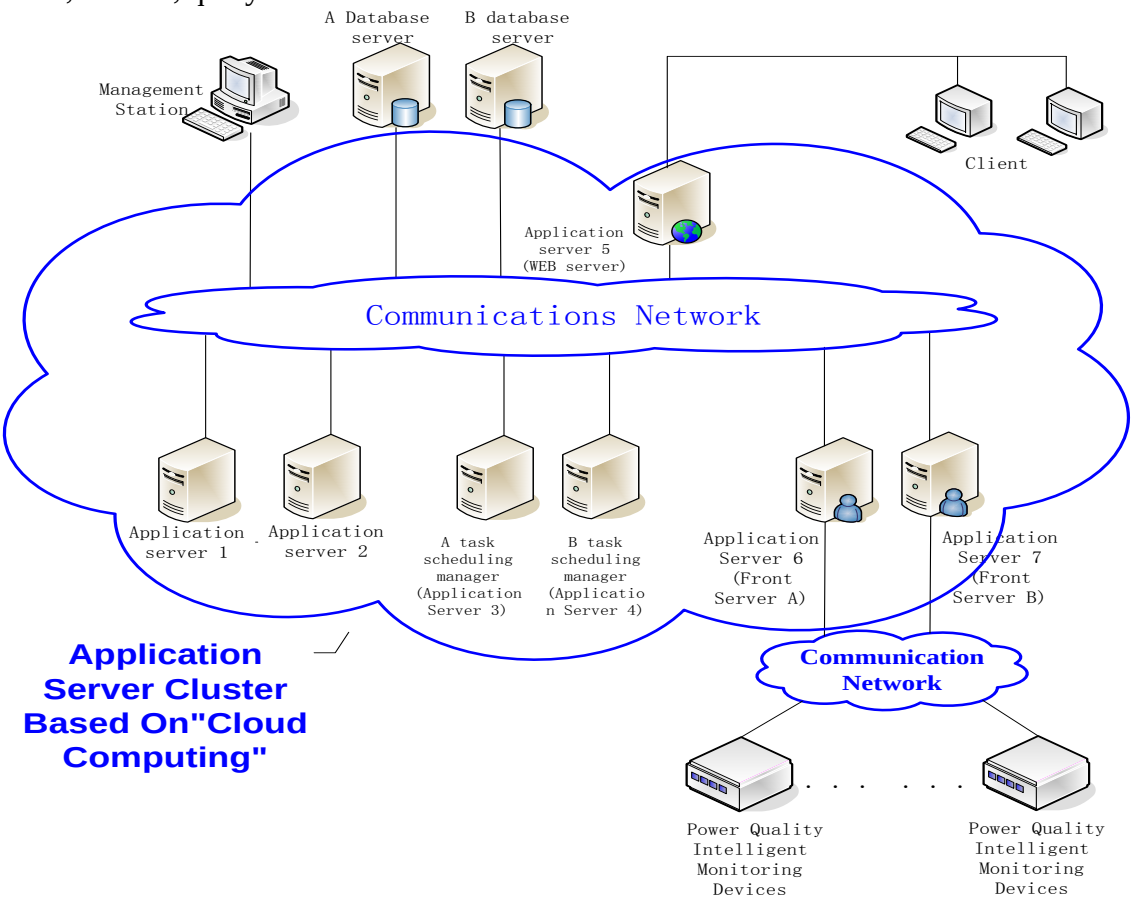

Figure 2. a system structure based on “Cloud Computing”

B. *Hardware Configuration*

Because the system uses a "cloud computing", making the entire power quality monitoring system has become a resilient system. The main configuration is as follows:

(1)Database Server

The database server uses dual hot standby mode. Hard disk storage for each database server are used RAID mode. While using a dual database synchronization software, to ensure that the integrity of the data in the server switching process.

(2)Application server cluster hardware configuration

System's "cloud computing" is mainly manifested in the application server cluster. Its hardware is divided into task scheduling manager, application server cluster. Task scheduling manager is responsible for the task allocation of application server farms and to supervise the operation of task, and can act as an application server. Application server cluster provide application services, such as pre-communication services, web services, online statistical power quality events, event alarms, report output, and human computer interaction.

C. *Software Configuration*

The whole system is running on the basis of the "cloud". Therefore, there is a basic platform in addition to some business software in configuration software. "Cloud computing" is a program run mode that establishing in the network. Its data exchange through a "soft switching" mode on each server. In order to achieve the feature of “dynamic equilibrium, each hot standby", you must have a management software is configured with it[6].

(1) “soft switch” software

It runs on each server. Its role is to map the information that will be required in each application process to local on the basis of TCP / IP . Realized the application process without concern for the real source of data.

(2) Task scheduling management software

It is a core software of "cloud computing", responsible for the entire mission to recover, issued and reallocate work. It only concerns the working status of the application process, without regard to the content of the application process for processing data.

(3) Process performance notification software

It is located in each server of application server cluster, collect the work of each application process. notified in real time task scheduling management software. It is not concerned with the specific communication data of sub-station communication protocol in application server, only care about running the state of the communication protocol.

D. *Features*

By introducing the "cloud computing" approach, power quality monitoring system can achieve the following functions:

(1) Make the monitoring system based on real cases to timely adjust concurrent data within the system. Real-time balance the data service response of each monitoring terminal and online clients.

(2) Make monitoring system to form a complete mutual hot backup mechanism. In the symmetric network architecture in the case of a server failure can automatically balance the appropriate load in the system. And to complete automatic recovery of data processing.

(3) When the monitoring system after a massive increase in monitoring nodes result in system performance degradation, it can achieve a smooth upgrade of the system in the case of minimizing investment costs, expand system capacity. Thus ensuring the normal and stable operation of the monitoring system.

(4) The monitoring system includes a data server and application server farms. Application server cluster size can be adjusted at any time according to the needs of business. In the case of small systems, data servers can share with application servers. All server functions can be simplified as a task in a server. Therefore, the power quality monitoring system based on cloud computing is suitable for any power quality monitoring system.

Epilogue

In summary, Power quality monitoring system using cloud computing technology, Allows multiple application servers balanced bear the heavy concurrent data processing tasks. Avoid the

adverse effects of stand-alone congestion and stand-alone malfunction. It is easy to expand, ensure service needs and system reliability for the minimum investment in the economy. Mutual hot backup and load balancing technology is based on the network structure. Flexibility and availability of the entire system is greatly improved.

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