Design of Admissions Examination System Based on Cloud Architecture

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Abstract. With the enrichment of admission scale and exam types, traditional hardware architecture of information system can’t meet the requirements of existing system. Different systems and processes have different requirements for hardware facilities. If allocating a set of hardware for each type of system, not only a large amount of hardware resources will be wasted, but also a huge burden will be set on the system operation and maintenance. This paper redesign the infrastructure service layer of the admission examination system with cloud architecture. We use cloud computing technology to realize the dynamic expansion and on-demand allocation of hardware resources, and provides an effective solution to meet the diverse requirements of the examination system.

1. Introduction
With the enrichment of admission scale and exam types, traditional hardware architecture of information system can’t meet the requirements of existing system. Admission system includes university entrance examination system, adult college entrance examination system, academic level examination system, etc. The processes of admission information includes registration, marking, application filing, and admission processes. The data of all the processes should be archived. Different systems and processes have different requirements for hardware facilities. If allocating a set of hardware for each type of system, not only a large amount of hardware resources will be wasted, but also a huge burden will be set on the system operation and maintenance. Cloud computing technology can realize the dynamic expansion and on-demand allocation of hardware resources, and can provide an effective solution to meet the diverse requirements of the examination system and the convenience of operation and maintenance.

This paper redesign the infrastructure service layer of the admission examination system with cloud architecture. We build the computing resource pool and the storage resource pool with virtualization technology, and realize the on-demand allocation and dynamic expansion of hardware resources. By constructing the heterogeneous interconnected examination resource area and the data archiving resource area, the hardware performance is fully exerted and the whole process management of the examination data is realized. In this way, system maintenance level and data management level of the examination system are improved.

Compared with the traditional architecture, there are three advantages of the admission examination system based on the cloud architecture: Firstly, to improve the utilization of system resources, we can achieve the dynamic adjustment and on-demand allocation of system resources. Secondly, to improve the availability and continuity of the system, the virtual server can be dynamically migrated in the resource pool. When the host hardware fails, the virtual machine can be
automatically migrated to other servers. Thirdly, cloud architecture can improve the operation efficiency of the system[5][6]. A reasonable resource partitioning is carried out for different business processes. By designing heterogeneous interconnected examination resource area and the data archiving resource area, the hardware performance is maximized, and the life cycle management of the examination data is realized[7].

2. Background

Admission system includes university entrance examination system, adult college entrance examination system, academic level examination system, etc. The provincial admission examination department has deployed a number of systems for every kind of exam. Each type of system has similar flow but the has different running time[8]. The independent deployment of these business systems not only causes a waste of large amounts of hardware resources, but also imposes a great burden on system operation and maintenance. Most of the research on cloud architecture were not applied to the admissions test[9][10]. Therefore, it is necessary to use cloud technology to build unified resources, as to realizing the unified deployment of each business system and the on-demand allocation of computing resources.

The processes of admission examination includes registration, marking, result releasing, volunteering, admission, etc. Most of the processes are mainly for examinees, with large amount of business concurrency and high requirements for business continuity, storage performance, bandwidth and delay[11]. The archiving process is mainly for the data administrator. The business concurrency is small but the data storage capacity and storage reliability are high. With the continuous accumulation of enrollment data, the storage should be smoothly expanded. Admissions examination data includes the candidate's registration data, test data, and admission data. Whole-life cycle management of the enrollment process data can improve the data management level of the enrollment business. Therefore, it is necessary to realize real-time automatic synchronization archiving of admissions examination data.

3. System design

3.1. Overall design of the platform

The admissions examination system based on the cloud architecture includes the examination resource area and the data archiving resource area. The platform has four layers from top to bottom: network core layer, computing resource layer, network aggregation layer, and storage resource layer. Except for the network core layer, the hardware resources of the two resource areas are isolated from each other, and the horizontal synchronization of data is realized through a high-speed data synchronization network.

Network core layer, consists of two core switches. The two switches use CSS technology and are virtualized as a logical switch. When a switch fails, services can be switched to another one in time to maintain communication continuity and reliability. Computing resource layer contains multiple application servers to provide hardware resources required for application deployment for each business system. Network aggregation layer interconnects computing resources and storage resources through network connections, and ensures high availability of network services through dual-machine mutual backup. The storage resource layer contains a storage disk array or multiple distributed storage servers to provide storage resources required for database deployment for each business system.

We deploy cross-resource ETL data extraction tools at the platform level. By the trigger synchronization, timing synchronization and manual summoning, we realize the horizontal synchronization of the resource list data area to the data archive resource area. The overall system design is shown in Figure 1.
3.2. Design of the examination resource area

The examination resource area is mainly for hundreds of thousands of candidates. When candidates apply for registration, payment, score inquiry, and volunteering, the data is bursty and the number of concurrent visits is high. We hang load balancing devices next to switches in the core resource layer to balance incoming traffic to different Web virtual servers to improve service support.

In the computing resource layer, we use KVM-based computational virtualization technology to achieve computing resource pooling and elastic scaling. We use computational virtualization to break the barriers between physical structures, enabling users to apply these methods in a better way than the original configuration. Resources, the new virtual part of these resources is not limited by the way in which existing resources are erected.

We have built a unified hardware resource pool for different business systems, and can realize the on-demand allocation of hardware resources according to the scale and concurrency of the business. The virtualized computing resource pool also supports the automatic expansion of the service system. When the load pressure of the existing service server is large, the virtualization management system can automatically replicate a part of the pressure to realize the dynamic expansion of resources.

The virtualization platform centralizes the cluster-based management of the data infrastructure. The cluster formed by the aggregation of multiple independent server hosts not only reduces the management complexity, but also has inherent high availability, thus providing users with a cost-effective High availability solution. The virtualization platform HA continuously monitors the virtual machines in the resource pool to maintain a "heartbeat" between the virtual machines. When the virtual machine loses the "heartbeat", it tries to restart the failed virtual machine. Whenever a physical server goes down, HA will guarantee enough hardware resources in the resource pool to enable the virtual machine in the failed server to be restarted successfully on other servers.
Centralized storage is suitable for applications with massive bursts of real-time data, high concurrency, and low latency. Therefore, we choose disk array as the underlying storage. The virtualized relational database server can access the disk array through the FC switch.

3.3. Design of data archiving resource area
Data archiving resource area mainly includes data archiving and query services. This type of service is mainly for the data management personnel. The business concurrency is small but the data storage capacity and storage reliability are high.

We use Ceph's storage virtualization technology to abstract distributed storage resources and provide users with unified storage resource services. The distributed storage server is connected to the storage aggregation switch and can be used as the back-end storage device of the computing resource layer. We use multiple X86 storage servers to share the storage load. It has the advantages of step-less capacity expansion, large capacity, simple management, good data security, and fast data reconstruction. Its horizontal and smooth technical characteristics are compatible with the resource flexibility of the cloud. As one of the most critical components of the data archiving resource area, virtualized storage is responsible for providing on-demand provisioning, flexible scaling, and secure and reliable data storage services for upper-layer applications.

For storage systems, reliability generally refers to the storage of stored data error-free capacity, generally in a period of time the probability of error is expressed, and storage virtualization storage system data reliability can be up to 119. In order to achieve high reliability in data storage, we use the multi-copy technology, which stores multiple copies of the user's data in the storage, such as a typical 3 copies. In this case, the user's data will only be lost if only 3 copies of the data are lost. In the storage virtualization system, the distribution of multiple copies of data is shown in Figure 2.

![Figure 2. Distribution of multiple copies of data.](image)

Since the data query and statistical analysis services of various systems run throughout the year and there is no obvious time period law, the use of computational virtualization technology will only allocate and recycle resources frequently, and the resource utilization cannot be significantly improved. Therefore, at the computing resource layer, we use two high-performance computing servers as the computing resources required for the primary and backup machines to support application deployment.

3.4. Main business process of the examination resource area
As a major examination province, it is easy to have large-scale candidates concurrently accessing the same operation, such as the general college entrance examination, the adult college entrance examination, the academic level examination, etc., which have a large number of participants, large-scale, and relatively concentrated examinations, online registration or score inquiry business. At this time, even the server blocked or even caused the downtime.

In the design mentioned in our design, the dynamic on-demand allocation of the cloud architecture is used, and the location of the candidate and the server, the orientation pressure of the database, and the like are pointed out for the enrollment or score query. We distribute the tasks automatically...
according to certain strategies through the corresponding task distribution algorithms[12]. At the same time, the current server access pressure is monitored to increase system resources for servers that reach the load threshold. The main process is shown in Figure 3.

![Main business process of the examination resource area.](image)

**Figure 3.** Main business process of the examination resource area.

### 4. Conclusion

This paper uses the cloud architecture system to redesign the infrastructure service layer of the admissions examination system, builds the computing resource pool and the storage resource pool through virtualization technology, and realizes the on-demand allocation and dynamic expansion of hardware resources. By constructing the admissions examination resource area and the data archiving resource area, the hardware performance is fully realized and the whole process management of the examination data is realized. The platform plays an important role in promoting the system operation and maintenance level and the data management level of the examination system.

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