On Study of Building Smart Campus under Conditions of Cloud Computing and Internet of Things

Chao Huang

Liuzhou City Vocational College, China

Abstract: two new concepts in the information era are cloud computing and internet of things, although they are defined differently, they share close relationship. It is a new measure to realize leap-forward development of campus by virtue of cloud computing, internet of things and other internet technologies to build smart campus. This paper, centering on the construction of smart campus, analyzes and compares differences between network in traditional campus and that in smart campus, and makes proposals on how to build smart campus finally from the perspectives of cloud computing and internet of things.

1. Introduction

Serving as two new things in the information technology society, the cloud computing and internet of things exert significant impact on society in every regard. Firstly, they are different in connotations; the former refers to a supercomputing model, while the latter is a data network system based on internet technology. However, they are closely related, which is because the internet of things collects information through tens of thousands of sensing equipments, and carries out analysis, calculation and statistics by relying on supercomputing ability of cloud computing after information is gathered. The smart campus which are lacking in traditional campus network, and this is also a key means to promote campus development by leaps and bounds at present.

2. Analysis of Basic Concept

2.1. Cloud Computing

Cloud computing refers to a network-based supercomputing model, and it provides calculation or storage services for internet users through non-local or remote distributed computer. In this calculation model, users are able to enter the data center and utilize data there through different application platforms, and the cloud computing boasts of powerful ability. This will not only provide internet users with simpler ways to process information, but also save resources and improve overall utilization of resources. Currently, cloud computing has become a popular technology in this new era, and a research focus of scholars and network companies.

2.2. Internet of Things

Internet of things refers a new type of electronic technology or data network system based on the internet technology. Electronic product cod is the basis of this electronic technology or network system which marks or identifies all entities in the world by using RFID identification technology so as to achieve dynamic monitoring of physical items [1]. The internet of things can be understood from two perspectives: firstly, in terms of function, it carries out data exchange, connects virtual space and actual objects through network digital model, and realizes super-space time control to objects through network system. It includes a digital calculation module and data calculation. Technically, the internet

of things is about the things link structure of RFID technology, remote sensing technology, nanotechnology and intelligent identification technology. Of course, the internet of things itself is an expansion of internet technology, which is because internet of things develops mainly on the basis of network technology, and then controls physical items in a wider range. However, in the development evolution, the internet of things is also a business or application; especially in today's society, the internet of things should continue to optimize its application in addition to technical innovation, and develop internet of things model centering on users' experience.

2.3. Smart Campus

The term "smarted campus" is different from the traditional campus, and in this concept, the cloud computing, internet of things and other internet technologies are utilized to connect campus teaching, research and management and campus resources, in order to integrate different information system platforms and to form a unified information management platform. In this platform, desired information can be obtained by different departments and various applications, which not only realize information resource sharing with the entire system of a campus, but also solve problems like high cost, slow speed and inefficiency in traditional campus caused by different system severs. In general, the campus's information network has become more transparent, precise and flexible, and the campus experiences scientific management and quality management.

3. Traditional Campus Network Environment

3.1. High Costs and Poor Performance of Network

The traditional campus network system is independent hardware and software equipment; systems operate independently because they are developed by different companies with different application platforms and development time. It is the mutual effect that makes information islands come true. For example,nowadays in many colleges and universities, although they are equipped with conditions to build smart campuses (such as experimental buildings, experimental classrooms, computers for office and student personal computers), information resources will be subjected to system compatibility restrictions and fails to be shared among departments as different departments often apply different information systems. Moreover, the network performance in traditional campuses is relatively poor; this is because in traditional network system, there is significant difference between network edge layer and the core layer in bandwidth when hardware is configured, which will block communication blocked and greatly reduce network performance.

3.2. High Energy Consumption of Network and Low Resource Utilization

Moreover, problems occur like there high network energy consumption, unbalanced allocation of resources and poor resource utilization. For example, when the system is busy, it requires a lot of server configuration which is idle when the system is not busy. Besides, the information industry itself is a large energy-consuming industry, and with the increasingly high requirement of information system, the overall function of system has been enhanced, but the system's energy consumption has been greatly increased at the same time. In a separate system, the main business must be guaranteed through the means of backup, however associated traditional equipment load is so small that it fails to carry corresponding business requirements, resulting in wastes in equipment resources and information.

4. Campus Network Environment under Cloud Computing and Internet of Things

4.1. Realization of Resources Integration and Reduction of Capital Investment

Firstly, the campus networks environment under cloud computing and internet of things refers that in smarted campus network system, which generally integrates various campus resources and reduces construction costs of systems greatly. This is because in traditional network system, the data center is

complex, and a lot of money is spent in purchasing hardware and software equipments in order to manage and maintain it; the remaining is spent in overall management and maintenance, therefore the development cost is higher, and the speed is slower. However, in smart campus, the network environment is relatively simple and the requires are low to user terminal, and resources can be accessed by entering into the data center as long as there is a computer, a browser and internet access conditions. In the long run, this helps users get various information resources, avoid duplication settings and updates of hardware and software, and significantly enhance operation ability of virtual teaching equipments. In terms of capital, there is no need to purchase a lot of hardware and software equipments, and money is spent much on research and development of systems rather than system management and maintenance, which improves work efficiency and quality, as well as capital utilization greatly.

4.2. Reduction of Energy Consumption and Realization of Green Network

Secondly, as for campus network under cloud computing and internet of things, the system consumes much energy in operation than that in traditional system. The reason for this is that in traditional network environment, there are multiple servers, of which each will consume 17,000 kWh of electricity annually if it operates 24 hours in one day without interruption; according to server retirement ages, it is calculated that about 130,000 kWh of electricity will be consumed in 8 years. The energy consumption is so high that requirements of green development are not met. While in terms of smart campus network system under cloud computing and internet of things, multiple servers are integrated into one server, and other management operations and maintenance are put in the cloud, which not only reduces costs of hardware and software acquisition, and system operating, but also reduces power consumption as well as realizes a green network development due to reduction of a large number of servers.

4.3. Improvement of Information Security

Thirdly, the network environment in smart campuses is much safer than traditional network environment, and this security firstly ensures safe information. In the context of cloud computing, for instance the spread of viruses, the construction of cloud infrastructure can better solve the issue of virus prevention and control. Correspondingly, there is no need to monitor and manage redundant backup and quarantine particularly. The design of cloud security management architecture integrates hardware, such as server equipment, storage devices and network equipment into a huge hardware device virtualization resource pool, and what the cloud security management center needs to do is uniformly manage all data access points or access relevant data in the resource pool at any time; the platform provides data storage, backup and other services externally, which will monitor internal operation in real-time, improve the overall security of network, achieve centralized management of platforms and ensure safety of information.

4.4. Openness and Sharing of Smart Campus

Finally, the smart campus boasts of good openness and sharing. Here is a simple example; students are involved in system network of smart campus since they manage admission procedures after entering to universities. After they enter into a campus, universities built-in FRID chip in their mobiles by virtue of internet of things and wireless radio technology, therefore the mobile is equipped with functions of student identification and terminal payment. Students are able to complete identity confirmation, dormitory formalities, various payments or military training clothes claiming and books claiming through smart campus system when managing admission process, which saves many unnecessary steps and improves admission effectiveness. Moreover, in campus life, it is realistic for students in terms of attendance like entering-leaving dormitory, class, dormitory, or swiping card for meals in canteen, supermarket shopping, or entering-leaving library, book borrowing and returning, or information inquiries through smart campus system in mobile. For instance, when entering into or leaving a dormitory, students can perform identification by virtue of the smart campus system in their

mobiles so as to ensure safety; when students want to borrow or return books in library, there is no need to enter the account and password every time, because the smarted campus system has integrated all resources in campus, and students can complete all steps only through smart campus system in their mobiles. Moreover, the smart campus system connects campus public facilities, students' vehicles and computers together, and in the event of equipment damage or loss, the smart campus system will pass the information to the alarm system so as to repair facilities timely and to inform owners of the relevant information through mobile. Certainly, the openness and sharing with smart campus system aim at making multiplayer online office come true, which means that many people in different terminals can simultaneously log on a platform to obtain desired data information, and to achieve information resources sharing.

5. Construction of Smart Campus under Cloud Computing and Internet of Things

The campus cloud should be built prior to the construction of smart campuses under conditions of cloud computing and internet of things. The campus cloud refers the typical cloud architecture, and technologies applied by it are mainly virtualization technology and service architecture construction. Moreover, three levels of campus cloud refer infrastructure layer, the platform layer and the application layer (see Table 1). Before building the campus cloud, one needs to classify relevant physical servers, and then provides a virtual hardware pool of resources.

Table 1: Architecture Layers of Campus Cloud

Basic layers of campus cloud	Key points of layer construction	Purposes of layer construction
Infrastructure layer	Infrastructure refers service layer	Providing a virtualized hardware resource pool
Platform layer	Platform refers service layer	Providing software support platform with unified standards
Software layer	Software refers service layer	Providing various application services

5.1. Infrastructure

The first layer refers the infrastructure layer. When building the infrastructure layer, one needs to consider two things. The first one is the integration of various hardware device resources. For instance, large-scale server equipment, storage devices and network equipment should be integrated to reduce the space occupied by hardware devices and to fully utilize resources. Another one is to deploy virtual hardware resource pool of integrated hardware devices by using virtualization technology. Virtualization is the technical support of campus cloud construction. It is necessary to integrate hardware resources of colleges and universities into hardware resource pool by applying virtualization to break obstacles between physical structures, and dynamically distribute and manage resources, which can not only to improve resources utilization and reduce energy consumption on the one hand, but also backup and transfer redundant data, and improve security of information resources on the other hand. Besides, main safe management clouds of infrastructure layer are student cloud, teacher cloud and educational administration cloud; all cloud platforms are intensively managed by cloud management platform center.

5.2. Platform Cloud

Serving as another layer of campus cloud, the platform layer aims at providing software support platform with unified standards for software application system of users. Platform layer construction includes campus public service module, basic platform module and internet public service module. The application of these modules is able to provide users with functions of identity authentication, secure login and mail service.

5.3. Software Cloud

The software layer is the last layer of campus cloud construction in constructing smart campuses. The construction of this layer aims at helping users break with original software deployment so that users are able to access resource information after a naturally automatic log by virtue of corresponding application permissions and the cloud when there is a need. The software layer of campus cloud includes various software systems, such as student management information system software, office management system software, teaching management system software and experimental management system software.

6. Conclusions

In a word, the construction of smart campuses based on the cloud computing and internet of things is a campus information system in essence which is superior to traditional campus network in resource utilization and information security, and which is equipped with openness and sharing. In this system construction, the campus cloud is constructed by adopting virtualization technology and other internet technologies. The virtualization technology is used to integrate hardware resources to form a virtual resource pool, realizing dynamic allocation and monitoring of resources. Moreover, the construction of smart campuses will live up to its reputation for real-time monitoring of technology of internet of things, and large amount of data processing through campus cloud.

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