

Application Research of Cloud-based Education Network Platform

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Abstract

Cloud Computing is a new application model for decentralized computing which can provide reliable, customized and maximum number of users with minimum resource. The development of cloud computing marks a great leap towards designing a unified, open and flexible educational information platform, sharing educational resources, and diminishing gaps in the use of educational information. This paper introduces the concept, characteristics of cloud computing, and discusses the framework of cloud-computing-based education platform, then take World University City for example, and discuss the significant advantages in the education information platform, which is brought by the technology of cloud computing.

Keywords: cloud computing, education information, world university city

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1. Introduction

Since the 1990s, IT has developed rapidly and been widely applied in education in China, which affects and changes educational and learning methods and means. However, problems like scattered resources, high cost, the digital divide, and lack of qualified education resources also exist. "Ten-year development planning of Education Information (2011-2020)" issued by the Ministry of Education in march 2012 proposes that a preliminary educational information system with Chinese characteristics will be built in ten years or so, so that our whole education information will be close to the international advanced level, which will promote the scientific development of education. However, there are a huge number of China's various educational institutions, schools, colleges and universities, and most schools are confronted with problems of massive investment and manpower inputs as well as resource shortages in the information construction process. If a cloud-based education network platform can be established, the use of computing, storage, networking and other services provided by the cloud computing can raise the level of resource sharing, which will effectively solve the problem of repetitive construction of education information infrastructure in our country and alleviate the uneven development of education. It will contribute to narrowing the digital divide and provide powerful online applications services for schools at all levels, thereby greatly enhancing the level of educational information.

Cloud computing [1-4] is the progress of distributed computing, parallel computing and grid computing, and it also comes from the evolution of Utility Computing, on-demand computing and Internet Computing. Cloud computing [5-7] distributes tasks to resource pool formed by a large number of computers to effectively provide a large-scale computing resources to users in a reliable form of services, allowing users to access a variety of computing power, storage space, and software services according to their own needs. Thus, the user can be freed from the complex underlying hardware logic, network protocols, and software architecture, and there is no need to build, operate and maintain expensive computing systems locally. By paying low fees, it is possible to complete tasks which need costly computing or processing in the local area.

Apart from this remarkable feature of low cost, cloud computing are also characterized by the following main features:

Service provided by the cloud computing could simplify the hardware configuration of end-users. Users can take advantage of a variety of terminal equipment (such as a PC, laptop,

smart phone, etc.) to access to cloud computing services via the Internet anytime and anywhere. Cloud computing device has very low requirement on the equipment from the client and it is very convenient to use.

Cloud computing [8-10] has the ability of on-demand scalability according to the hardware and software requirements, and the computing resources can be dynamically and effectively allocated. The cloud computing service can be quickly scaled to automatically adapt to the dynamic changes of the traffic load and meet the growing needs of applications and user scale. It can provide users with personalized service according to the different needs of users, avoiding the decline in the quality of service or resource waste caused by the overloading or redundancy of the server. Meanwhile, cloud computing use large-scale data centers and powerful servers to run network applications and network services, so it can provide high-performance computing services and the near real-time deployment and use, and for users of cloud computing services, cloud resources are almost limitless.

In cloud computing, data is stored on the server side and calculated by the server. Users do not have to worry about data loss, hardware damage caused by personal negligence, or data security issues cause by computer viruses and hacking. Cloud computing services are located on different servers, if one node has something wrong, another one will be automatically started to ensure the normal application and calculation; while the backup is unnecessary for the client-side, for it can be restored at any node. In addition, all data is copied to multiple server nodes to make multiple backups, so even the accidental deletion of data stored in the cloud or its hardware crash cannot affect the data security. If a node fails, it will be discarded through appropriate policies and its task will be transferred to another node. After the trouble is cleared node troubleshooting in real-time to join an existing server cluster. Cloud computing services could spread the data security risk to the vast "cloud" network server, so the information security is greatly improved.

Because the data are stored in the cloud rather than on the user's own equipment, so that while ensuring reliable and secure storage, it can carry out the integration and sharing of resources under the authority, easily achieving data and application sharing between different devices, such as the web album we use.

It is precisely because cloud computing has the above features that it enables users to continuously use the computer resources just by connecting to the Internet, realizing the concept of "Internet is the computer".

2. The Significance of Building the Education Network Platform Based on Cloud Computing

2.1. Greatly Lower the Cost of Educational Information Construction

For different types of schools in China, in order to cope with the growing demand for educational information technology and maintain the operation of existing IT infrastructure, a lot of manpower and material resources are often required. The investment for the routine office or teaching, research, experiment and other aspects all need huge expenses, especially some software which should be updated or eliminated shortly afterwards, and this means a huge waste of resources. The cloud computing application could greatly reduce the investment in hardware, software and other infrastructure; besides, there is no need for professional management and maintenance. In addition, it is conducive to achieve the rapid growth and diverse requirements of education information due to its scalability.

2.2. Significantly Improve the Support Service of Educational Information

In the past, a variety of teaching resources were distributed in various types of distance learning systems, using the traditional Browser/Server structure pattern which cannot burden a lot of people to access to the same system at the same concurrent. Cloud-based education platform provides strong support service, so it is ideal for the massive educational market. With the development of new generation of mobile communications and broadband technologies, mobile learning and virtual labs phones spring up, and users have strong demand for videos, so the large data centers are required to store large amounts of data and provide unlimited computing power, which can be achieved by the related technologies of cloud computing.

2.3. Greatly Facilitate the Sharing of Educational Information Resources

When the information network platform which is geographically dispersed and localized is transformed into a powerful unified information platform unrelated to the specific IT infrastructure, it will break the barriers of teaching conditions and environment to supply a teaching environment where teaching resources can be shared for all types of schools, thus ordinary schools will have the first-class environment which allows more teachers and students to utilize the virtual teaching resources on the Internet to improve the teaching level.

2.4. Effectively Improve the Security of Educational Information

On the one hand, the characteristics of the cloud computing, for example, the service is transparent for the users, the scheduling and management are centralized on the cloud, could provide safe and reliable computing services and data storage services for the faculty and students. On the other hand, computer virus prevention and control of the campus network, especially in the multimedia classroom and computer lab, has been a very tough problem, and the antivirus software licensing fees are costly for each school. Nowadays, by the cloud computing technology, the computer virus prevention in the campus can be achieved by purchasing services (ie cloud antivirus service) rather than software licenses.

3. The General Framework of Education Network Platform Based on the Cloud Computing

By the in-depth analysis of the existing cloud computing system, it can be viewed as the collection of a set of services. Combined with the current applications and researches of cloud computing, the general framework of the education network platform based on the “cloud computing” can be divided into three layers, core service layer, service management layer, user access interface layer, as shown in Figure 1.

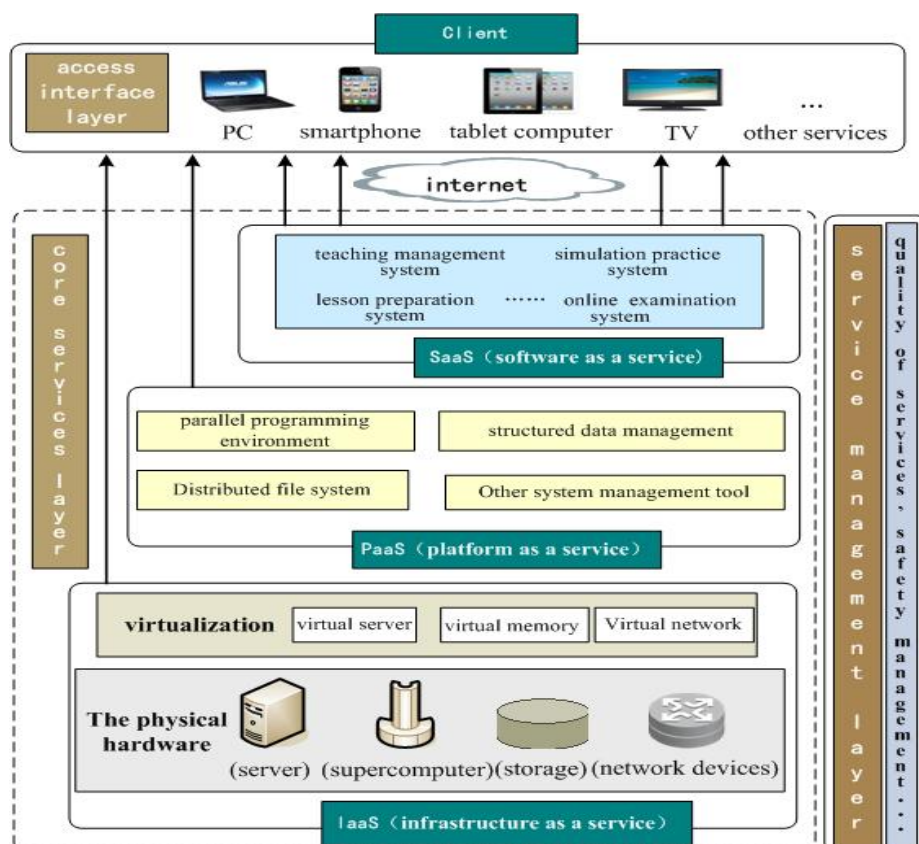


Figure 1. The Framework of the Education Network Platform Based on the “Cloud Computing”

3.1. Core Service Layer

The core services layer is to abstract the hardware infrastructure, software operating environment, applications into services which have high reliability, high availability, scalability and so on. So they could meet diverse application requirements. This layer is usually divided into three sub-layers: IaaS layer (infrastructure as a service), PaaS layer (platform as a service), SaaS layer (software as a service). A comparison for the services' characteristics of three layers is carried out in Table 1.

Table 1. A Comparison of IaaS, PaaS, SaaS

Core Service layer	service content	service object	usage mode	key technology
IaaS	provide infrastructure deployment services	users in need of hardware resources	users upload the data, program code and environment configuration	Data center management technology, virtualization technology, etc
PaaS	Provide services of application deployment and management	program developers	users upload the data, program code	Massive data processing technology, resource management and scheduling techniques, etc
SaaS	Provide internet-based application services	Enterprises and users in need of software applications	users upload the data	Web services technology, Internet application development technology, etc

(1) IaaS layer is the basis to provide high-level services. In this layer, the geographically-distributed physical machines constitute large-scale data centers through the grids and service encapsulation of cluster technology, aiming to provide massive hardware resources for the upper-layer cloud computing services, such as storage capacity or processing power. Meanwhile, in support of virtualization technology, IaaS layer is capable of providing logically independent virtual machine. This mechanism gives cloud computing architecture the capacity of dynamic allocation and computing resources management, which could achieve the demand provisioning of hardware resources and provide personalized infrastructure service. Based on the above two points, IaaS layer mainly studies the technologies related to data centers and virtualization technology, etc. When using IaaS layer services, users need to provide configuration information of infrastructure, program code running in the infrastructure and related users' data.

(2) PaaS layer, as the intermediate layer of three core services, could not only provide simple and reliable distributed programming framework for the upper-layer application but also requires scheduling jobs based on the underlying resource, managing data, and shielding the complexity of the underlying system. What it provides is the running environment of the application program of the cloud computing, that is, the software platform itself, which is primarily designed for the application developers. Therefore, there is no need for developers to worry about the resources, for the platform layer provides all the necessary platform resources for the operation and maintenance of the application programs. PaaS layer is mainly to study the massive data processing technology, resource management and scheduling techniques, etc. Via the software tools and programming languages of PaaS layer, when utilizing services, the application developers only need to upload the program code and data rather than pay much attention to the management problems of the underlying network, storage, and operating system.

(3) Facing the end-users of cloud computing, SaaS layer provides the Internet-based software application services. SaaS layer mainly studies the Web services technology, the Internet application development technology, etc. By hiring SaaS layer services, enterprises could solve the Informatization problem. For the average users, SaaS layer transfers the desktop application programs to the Internet, which is capable of achieving the ubiquitous access of the application programs.

3.2. Service Management Layer

The service management layer, on the one hand, could provide support for the core services to further ensure their reliability, availability and security. On the other hand, it supplies

the related management measures required by the cloud computing platform, as well as the lease and management of services for users, including user authentication, request management, user requests for distribution, billing management functions, and so on. Service management techniques include QoS assurance mechanism, security and privacy protection technologies, resource monitoring technology, service billing model, etc. QoS assurance mechanism, and security and privacy protection technology are used to ensure the reliability, availability, security of cloud computing.

3.3. User Access Interface Layer

The user access interface layer is used to achieve the access from the client terminal to the cloud, usually including the command line, Web services, Web portals and other forms. The access mode of command line and Web services could provide application development interface for the terminal equipment as well as convenience for the combination of multiple services. Web portal is another mode of access interface. Through a Web portal, cloud computing transfers the user's desktop applications to the Internet, which allows users to access data and programs through the browser whenever and wherever, thus improving the work efficiency.

4. Application of the Educational Network Platform Based on the Cloud Computing---- "World University City"

"World University City" is an educational network platform based on cloud technology. As a breakthrough in the educational information technologies recently, it has been adopted in nearly 2 million teachers and students under their real names of Hunan, Xinjiang, Shandong, Guangdong, Zhejiang, Beijing, and Guangxi. The maximum number of concurrent connections has been over 50 million, which attracts national attention.

Consisting of the cloud sub-platform and cloud space, "World University City" could build a sub-platform for the institution and a space for individuals. On the "World University City", users have equal status and could interact and share resources with each other. Besides, it is green safe with the powerful management, interaction and innovative features, specifically shown as follows:

4.1. Publish a Variety of Teaching Resources Instantly and the Sub-platform and Space on the "World University City" has Unlimited Capacity

As a result of the Massive Data storage and processing and video streams distribution, a sub-platform on the "World University City" can have various functions of the traditional sites (making comments, publishing, collection, sharing, recommendations, subscriptions, addition, deletion, blog, microblog, Witkey), and instantly publish a variety of teaching resources with massive data, such as video and multimedia files. Therefore, the live video and broadcast could be achieved which are comparable to the professional television station with powerful technical ability. For example, in Changsha Social Work College, the School Work Department, Office of Academic Affairs, Training Department and other ten faculties have established a broadcast sub-platform, so the live broadcast is available at any sub-platform. In addition, the traditional website's space is restricted for greater capacity means higher cost. While in the space and sub-platform of World University City, the capacity is unlimited, and each sub-platform and space is equal and enjoys the same services and benefits.

4.2. Super Powerful Custom and Personalized Management Capabilities

The sub-platform and space on the "World University City" have strong management capabilities, free setting and management could be conducted for the left-hand sections by "adding and managing categories", thus the personalized section settings can be fully realized and classification sections could be created for each sub-section. In addition, it is also capable of editing articles and sorting articles and videos without changing the address of each file when published. Resources' sorting does not affect the original hyperlink of each document. Nowadays, many sites have their own space as well as some personalized management, but there is no one to be comparable with the World University City. The custom content of this sub-platform space is as shown in Table 2.

Table 2. The Custom Content of the Cloud Sub-platform and Cloud Space

Number	Custom category	Custom content
1	Style	Massive optional templates; personalized building with code
2	Function	Free selection of hundreds functions; personalized function and free creation
3	Presentation Layer	Multiform presentation and selection on purpose; self-compiled code and self-created display mode
4	Column arrangement right	free addition and deletion, self-drafted column
5	Administration authority	access right, comment right, sharing right, and push right can be set independently
6	Privacy right	privacy and interests can be personalized; intellectual self-management

The construction of sub-platform and space is fully customizable, so each sub-platform and space on the "World University City" has high personalization and is brilliant. For example: Zhang Junrong, a librarian in Shandong Institute of Commerce and Technology, has personalized her own space into a vast digital library, where the online books can be read and borrowed.

4.3. The Convenient and Efficient Operation of the Cloud Sub-platform and Cloud Space

On the "World University City", to build the cloud sub-platform and cloud space is simple and convenient, so non-professionals can also build their own space very well as long as they can type letters. The cloud sub-platform is opened in more than 500 institutions included in Hunan Provincial Education Department in half an hour after two half-hour training. The space for 30,000 teachers and students as well as the sub-platform in various faculties could be set up in 1 hour.

To build the cloud sub-platform and cloud space, only a few steps are required. First, the space construction and management start from the "Management Space" at the top, and then you can build your own personalized columns in "Section Management", and freely choose to add or delete it. If you want to continue adding, just fill in the name of the corresponding column, select the column type, video or article, and click adding to form your own personalized column. Different access rights can be set for each column. There are mass templates in the "dress space", which can be selected freely according to your own personality, and the module can be added or deleted. After setting, you can publish articles and videos in the corresponding section.

The operation is so easy that even schoolchilds could build a colorful personal space. For example, Liu Yi Ying, a fourth-grade student in the Shandong Linshu Training School, applied the space to learning and she has set up her own learning bookshelves, learning navigation, and published 455 articles. Such a wonderful space built by a 10-year-old child fully embodies the convenience of the space function. Numerous examples can be given, and in the exhibition of excellent cloud space in Linshu, the spaces of more than 10 students has been displayed.

4.4. Cloud Sub-platform and Cloud Space are Interconnecting and Interworking, and Resources can be Intelligently Brought Together and Mutually Pushed

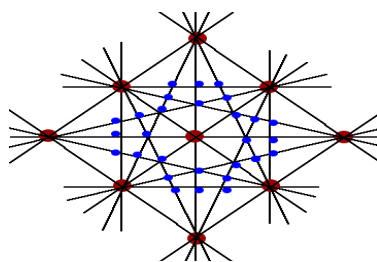


Figure 2. The Logical Association between Cloud Sub-platform and Cloud Space

"World University City" is just like countless intertwined networks, forming numerous nodes. Each node is a sub-platform for various institutions or a space between every teacher and student. The lines between points make up countless interconnected network highways. Cloud sub-platform and cloud space share infrastructure logical architecture and are interconnecting and interworking, which forms a network as a whole. Each sub-platform and space is the center, namely multi-center, which is also centerless. The logical association between cloud sub-platform and cloud space is shown in Figure 2.

Every sub-platform and space of World University City is a strong interconnecting and interworking personalized website, which can achieve full interconnecting and interworking, that is to say, sub-platform and sub-platform, space and space, sub-platform and space, space and sub-platform can be easily accessed. For example, on the "World University City" cloud platform, click on any of the little home icons, it will go directly to the appropriate cloud sub-platform and cloud space. If you click on the "Hunan Electric Vocational and Technical College", it will take you to the school's cloud sub-platform, and then click a teacher or a student from the sub-platform, you have easy access to their cloud space. Whether in school cloud sub-platform or in teachers and students' cloud space, you can return to your own cloud space by clicking just one key. This fully reflects the full interconnection and interworking between sub-platform, sub-platform and space, as well as space and space.

Resources between sub-platform and space of "World University City" can be automatically converged and mutually pushed. Each person can instantly find the publisher based on any articles, videos, pictures, messages, private messages, and dynamic messages, enter their space, and understand the publisher's situation. You can add to favorite and classify any articles, videos and pictures, and go to "My Learning Space" to further classify and manage your favorite content, thus making it easy to build and converge on a personalized mobile digital library with a lot of resources.

Meanwhile, personal space generated in the institutional sub-platform possesses institutional attributes, favorable to the implementation of effective management for institutions on the generated space. Here, the personal space belongs to institutions, so all traces of personal space operations and information resources will be gathered or displayed on the sub-platform of the institution. Institutions can easily publish messages or notifications to all personal spaces of theirs.

4.5. Save a Lot of Hardware and Software Investment and Operation and Maintenance Costs

"World University City" platform completely implements a comprehensive cloud service mode: software as a service, customized sub-platform as a service, basic logical architecture as a service, customized cloud storage of massive data as a service, global collaborative communication management as a service, intelligent gathering of resources as a service; hardware as a service. There is no need of considerable investment from educational institutions to buy server cluster devices and server cluster bandwidth, invest the network development and maintenance as well as software and hardware upgrade, saving a lot of expenses. At this point, the successful experience of Hunan Province has attracted national attention, which is worth learning from.

Hunan is a province of enormous vocational education, but not a strong one. In the face of weak basic conditions of vocational schools, inability to share quality teaching resources and the slow process of information construction, Hunan uses a new mode of "building a platform with the corporate investment and the purchase of services by schools according to specific requirements". Relying on the "World University City", it does not involve hardware inputs, and each school or educational institution purchases institutional sub-platform services corresponding to their scale by a standard of 100 Yuan per sub-platform. 10-16 Yuan per space is paid annually for the real-name personal learning space or professional characteristic space. The Internet bandwidth is covered by schools themselves. Such is a good way to significantly save funding in education information. It is estimated that the school's funding is only one-tenth of the traditional construction mode, achieving a user-friendly and affordable effect.

4.6. Space with the Real-name System is Safer and Healthier

"World University City" uses specific encryption algorithm and random algorithm to generate e2ID and use a unique education ID corresponding to the resident identification number to lock the publisher's identity. Real name cyberspace facilitates the management of national education administrative sectors, provincial, city, county and school ones. It can effectively deal with the infestation of spam and the difficult problem of social network management.

Meanwhile, the "World University City" adopts a smart, one-way, anti-modification data backup safety system to store data in the most secure and reliable cloud computing center, which are professionally treated and protected by the service provider, avoiding the common problems of data loss and data corruption or virus infection when they are stored on the local computers.

5. Conclusion

The practical application has proved that cloud-based education network platform is able to provide a user-centric, fast, secure data storage and network services to people, making it possible for them to carry out massive data computing and storage free from the constraints of time, place and high-end equipment. The cloud-based model for platform building can greatly reduce the cost of education information, and is able to use its natural scalability to meet the rapid growth of education information and requirements for diversified services, which will provide new ideas and solutions for information technology, serve as a strong impetus to the development of the whole education information.

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