Research on application of cloud desktop virtualization for computer laboratories in universities

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Abstract. University computer laboratory is an important place to cultivate, exercise the information literacy and to enlighten innovative thinking of university students in the new era. With the continuous development of cloud computing technology, the application of virtualized cloud desktop in university computer laboratory has become an inevitable trend. This text analyzes the disadvantages of traditional desktop deployment mode and the advantages of virtualized cloud desktop based on the construction status of computer rooms in universities, and studies, discusses how to apply desktop virtualization technology to build an experimental teaching environment of virtualized cloud desktop, that is easy to manage, flexible to deploy, resource-sharing and convenient to maintain.

1. Raising of the issue

The 19th CPC national congress made a major judgment that socialism with Chinese characteristics has entered a new era, clarified the historical orientation of education reform and development, and embarked on a new journey of accelerating education modernization, building an education powerhouse. The new demand for talent training in the new era highlights the prominent characteristics of emerging technologies such as cloud computing, big data and artificial intelligence, and changes the educational informatization process in the "Internet plus" era. With the continuous development of cloud computing technology, the adoption of cloud computing information architecture has brought profound changes to education informatization, brought a new mode to the allocation and management of resources, thus promoting education, teaching innovation supported by new ideas and new technologies. Facing the needs of the new era and the information society, it has become an irresistible trend to reform the traditional education, teaching mode, to promote the deep integration of new technology with education and teaching, to build a new educational ecology that is led by informatization and centered on learners.

The university computer laboratory undertakes the experimental and practical teaching task of cultivating the national informatization talents in the new era, it is an important place to cultivate and exercise the comprehensive ability of information technology of university students and enlighten students' innovative thinking, the laboratory construction and management level directly affect the quality of talent training and the process of educational informatization. At present, most computer Labs in universities and universities adopt the traditional desktop deployment mode, that is, a basic platform is built by using an independent PC with corresponding software system and network equipment, then different software is installed according to the needs of different majors to form various professional computer rooms, the management of computer rooms adopts the decentralized management mode. This deployment mode has the advantages of fast updating equipment and high operation and maintenance cost, tedious maintenance and low management efficiency; uneven
distribution of resources and low efficiency of use; insufficient system protection and data security; there are many disadvantages such as single teaching scene, complexity of teaching and difficulty in meeting individual needs. With the high-speed development of information technology and university enrollment system reform, the traditional desktop deployment model is difficult to meet the demands of talent cultivation in the informatization at the new age, and are common in universities the laboratory construction fund tension, lack of resources sharing, lack of management personnel, so the urgent need to build more powerful, flexible, safe and effective a new generation of computer experimental teaching environment - cloud desktop virtualization technology arises at the historic moment.

2. Overview of cloud desktop virtualization
A traditional computer desktop is the area of the home screen, that you see, when you open your computer and log in to Windows, that is our working desktop. Virtualized cloud desktop refers to the virtualization of traditional computer desktop to realize remote dynamic access of desktop system and unified hosting of data center, so as to achieve the security and flexibility of desktop use. Simple said is that the traditional PC storage, calculation, application and other functions will be migrated to the cloud data center through the cloud computing technology, the backend server (one or more) hardware resources will be integrated into a resource-base, through the server virtualization, generates a large number of independent desktop operating system (virtual desktop),while Windows desktop runs in the form of a virtual machine in the data center. Users can log into their own personal desktops remotely from the cloud terminal device (thin client, traditional PC or laptop, iPad and etc.) connected to the network and get the same experience as traditional PC.

There are two main architectures of desktop virtualization technology: one is virtual desktop infrastructure (VDI), which adopts the mode of “unified management and centralized computing”. The other is Intel's “intelligent desktop virtualization” solution (IDV), which adopts the mode of “unified management, distributed computing”. The two architectures have their own characteristics and advantages and disadvantages, the choice of architecture depends on the project budget of users and their demands for security, centralized control, mobility and other aspects, meanwhile, the platform stability, future scalability, market share and other comprehensive factors should be considered also. VDI architecture is highly recognized in the field of cloud desktop technology, and is currently widely used in the education industry. The advantages of VDI are in conformity with the architecture design of modern cloud computer, centralized control, high data security and strong mobility. VDI is not to give each user configuration of desktop PC with independent running operating system, but unified the operating system and application are stored in a data center servers and storage devices, the background to establish virtual machine was carried out on the user's desktop virtualization, a user connects with virtual desktop cloud server through the network transmission protocol(as shown in figure 1).This architecture enables users to have independent, full desktop access and control, and access virtual desktops quickly, flexibly as traditional local desktop.

![Diagram of Cloud Desktop Virtualization](image)
3. Application of the virtualized cloud desktops in university computer laboratory

The application of virtualized cloud desktops in university laboratories is mainly reflected in the integration of high-quality teaching resources, the provision of efficient computer experimental teaching environment, the realization of cloud management and service sharing, so as to provide more effective services for teachers and students.

3.1. Advantages of virtualized cloud desktop

Compared with traditional desktop deployment mode, virtualized cloud desktop has the following advantages.

3.1.1 Rapid deployment, effectively reduce the cost of operation and maintenance. All system installation, commissioning, management, maintenance and upgrade will be completed on the server side, and the control center centrally manages hundreds or thousands of virtual desktops, daily operation will be completed by maintaining only a "basic mirror", and the clients' states can be real-time controlled, centralized regulated, solved the problem in terminal maintenance of the traditional desktop deployment. At the same time, virtualized cloud desktop architectures are more convenient for dynamic expansion and can reduce investment costs in the long run.

3.1.2. Multiple protection, effectively ensure data security. The cloud desktop adopts centralized management, and the back-end server has the means of multi-policy data backup, so the fault recovery is fast. At the same time, centralized virus protection is carried out in the back-end, and the cloud terminal adopts ARM or X86 architecture design without traditional operating system, which can effectively reduce the risk of virus transmission.

3.1.3 Flexible access to ensure efficient use of resources. By means of desktop virtualization technology, resources in each computer room can be transformed from independent operation and decentralized management to a unified resource platform for the whole university, so as to realize centralized control, resource sharing and platform interworking. Provision of multiple access ways from the virtualized cloud desktop platform makes lesson preparation, office work and teaching more flexible and convenient.

3.1.4 To meet personalized teaching needs and promote teaching, research innovation. The virtual resources of the cloud desktop platform can be dynamically allocated at any time according to different needs, so as to achieve a more flexible experimental teaching experience. For teachers, they can customize personalized desktop environment and switch between different virtual desktops quickly to meet different teaching needs and improve teaching level; for students, they can create exclusive teaching environment for different majors and grades, improve students' learning interest, enthusiasm, and develop students' innovative thinking.

3.2. Deployment of a virtualized cloud desktop

The following is the proposal of virtualized cloud desktop solution based on the current situation and the actual needs of our university's computer laboratory.

The existing computer rooms in the computer lab of our university are all in the traditional desktop deployment mode, and most of the computers in the computer rooms were purchased from 2011 to 2014, and are basically in the state of elimination, part of the equipment is in urgent need of upgrading, and the equipment maintenance task is heavy, so the management is extremely inconvenient. Therefore, according to the laboratory existing conditions, teaching requirements and university budget situation, build the new three rooms using VDI virtual desktop infrastructure and the scheme of desktop virtualization + thin client to fully deploy the experimental environment of the computer...
change and reconstruct the related equipments and experimental environment, make late extension on-demand again, gradually achieve experiment room cloud construction and cloud platform management in the university-wide to improve the efficiency of information resources and the service level of teaching.

3.2.1. Network plan. This plan relies on the university informatization construction platform and is deeply integrated with it, so as to facilitate future unified management, operation and maintenance, maximize resource sharing and reduce operation and maintenance costs. When planning the network, the newly purchased servers and the existing cloud servers of the university will be integrated to form a shared resource-base. The cloud terminal equipment of the three computer rooms will be connected to the floor HJSW through the classroom switches, and then to the core switch through the optical fiber. The communication network between servers and between clients and data center servers should meet the requirements as shown in table 1.

**Table 1. Network requirements**

| Type                                      | Design                          | Remark                                                         |
|-------------------------------------------|---------------------------------|---------------------------------------------------------------|
| A communication network between servers   | Connection of 10Gb Ethernet     | Deploy an independent switching network between the virtualized base servers, which is only used for the storage data transmission with the double-link redundancy mechanism between the base servers. |
| A communication network between a client and a data center server | Connection of 1Gb Ethernet | PCoIP link mode is adopted to improve network transmission efficiency and reduce transmission delay. The network bandwidth requirement of a single desktop is no less than 256Kb/s. |

3.2.2. Deployment of the thin client. The thin client is a window to a virtualized cloud desktop, that communicates with the cloud desktop through a VDI transmission mode. At present, embedded processors into the thin clients are divided into two types: one is the CUP with complex instruction set, namely X86 architecture; another is the CPU with compact instruction set, namely ARM architecture. To choose the right thin client should be considered from the user demands, product performances, compatibilities, extensibilities, prices and other factors. The computer laboratory of our university has opened more than 20 experimental courses for the general undergraduate majors of our university-wide, among which the basic experimental projects account for 35%; comprehensive design experimental projects account for 50%; innovative experimental projects account for 15%. Based on our university's educational direction, professional setting and experimental teaching requirements, we chose the X86 architecture with high cost performance as the thin clients, and the basic configuration is Intel Celeron j1900/2gb memory /8GB SSD.

3.2.3. Establishment of the server virtual platform. Because the thin client works in the network environment, the programs and data it runs are concentrated on the server side. When a large number of thin clients starts access at the same time, it will inevitably result in an increase of server visits’ number and the increase of network data flow at the same time, that affects the response speed of the thin clients. Therefore, it is necessary to increase the bandwidth of the server side, configure multiple cloud servers to form a shared cluster resource-base, and adopt the storage architecture based on VSAN, so as to improve the working performance of the server side, the overall extensibility of the system and data security, and give better play to the advantages of the cloud desktop.
VMware VSAN is designed for virtual machine by VMware company as an extensible super-integrated storage architecture based on the v-Sphere kernel, it uses software to build many local disks in server into a corresponding distributed virtual shared memory (see figure 2), that has the advantages such as fast speed, strong resilience, dynamic, and easy extension, the total cost can be reduced to 50% in compare with other storages under the equal performance approximately.

3.2.3.1. Configuration plan of the virtual desktop and server. Virtual desktop is a server-based computing model that supports users to realize remote dynamic access of desktop system and unified hosting of data center. The cloud server generates a large number of virtual desktops through virtualization technology and sends them to terminal devices according to the proprietary virtual desktop protocol. Users only need to remember the user name and password, can use the terminal device to access their desktop system anytime and anywhere through the network. According to the professional settings and teaching requirements of our university, it is recommended that the virtual machine is configured with 3vCPU/4GB~6GB memory/60GB storage space.

Desktop virtualization depends on server virtualization, and the application requirements of users determine the number of server and server hardware configuration. According to the authoritative deployment suggestions, 1 CPU physical core corresponds to 5~8 vCPU, and different customer experiences correspond to different number of vCPU. Our university can plan according to the medium load demand 1:6 of virtual machine configuration.

In the server planning, the performance consumption of virtualization itself should be taken into account. At the same time, the redundancy reserve in the later stage should be taken also into account. It is suggested that the hard disk adopts 1:1 copy redundancy to ensure the data security. For caching, it is recommended to use SSD solid state disk to store read and write cache to improve overall performance. It is recommended to use the SSD flash disk with VSAN (its flash memory card has much higher computing performance than the ordinary SSD disk), and the capacity is usually configured according to the ratio of the flash disk capacity to the total capacity of HDD 1:10.

3.2.3.2. Deployment of the virtualized cloud desktop. VMware VIEW is a mainstream desktop virtualization brand in the industry and can provide complete virtualized desktop solutions. VMware VIEW integrates virtual desktop with vSphere, which is powerful, mature and proven.

In compare with other desktop virtualization products, VMware VIEW is well received by users for its advantages and characteristics of desktop management, such as reliability, security, convenience, scalability and hardware independence.

First of all, proceed the basic configuration of the server, because the server RAID card needs to use for VSAN storage, so configuration to enter the controller is the pass-through mode to convenient for installation and use of the server. After that, installation of VMware VIEW virtualization software will be completed on the server side, the virtualization platform will be accessed through the host IP address, which can built the resource-base, and then the resource-base, server and virtual machine will be added and managed, the mirror template will be made (installation of application software, required
by the operating system and user) and the virtual desktop will be deployed in batches.

3.2.3.3. Client access mode. Input on the client side the domain name address to connect with server to access, download and install the “VMware horizon client” software, click “VMware horizon client” icon on the desktop after installation, in the “new server” dialog box input the server name to be connected, in the “login” of the pop-up dialog box enter the user name, password and can complete login into the virtual desktop.

According to the plan to build the virtualization of the cloud desktop experimental platform, to test, install and debug system, various performance indexes can meet the expected requirements, after the trial use by students in our university in a semester the platform experience is good, strong stability, can well meet our diversified, individuated computer practice teaching requirements, and solve the problem of desktop terminal management and maintenance in the university. However, there are some disadvantages in this deployment scheme. The first, it relies too much on the network environment. The second, the technology is more complex, higher requirements for the administrator. Cloud desktop technology generally will not have a problem, but a broken server failure will cause serious teaching accidents, so should be taken the contingency plans in advance, on the one hand, process all the current virtual function servers with redundancy backup for quickly switch of the servers while its failure; On the other hand, the third party software is used to make regular full or incremental data backup for quick restoring of hardware or system in case of its failure.

4. Conclusion
To sum up, the virtualized cloud desktop solution has been gradually popularized and applied in university computer laboratories due to its features of low cost, easy maintenance, flexible deployment, high reliability and strong security. With the further development of cloud computing technology, the virtual desktop cloud solutions are also unceasing to be improved, so the university should choose the right products in the demands such as the construction of the university scale, object use for, teaching environment, construction costs while virtual desktop cloud deployment to provide more quality services for better serve the university informatization construction.

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