Design of An Education Cloud Based On Mainframe

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Abstract—Cloud Computing, the long-held dream of computing as a utility, has the potential to transform a large part of the IT industry. This paper presents a new cloud on mainframe education. "z Education Cloud" delivers three services, Infrastructure as a Service, Platform as a Service and Course as a Service. We described what it is capable of and discussed the key concept in the cloud. It is a new idea of mainframe education service with a fashion concept of cloud computing. As a result, we can deploy the z Education Cloud for national use. The proposal of z Education Cloud is a reformer in mainframe education changing the way to deliver education service.

Keywords-mainframe; service; education; cloud computing

I. INTRODUCTION

Mainframe is a server expert in online transaction and batch job and be widely used in different industries especially banking while mainframe skilled specialists are limited.

The Chinese State Education Commission (now the Ministry of Education) signed a memorandum of understanding with an IT giant in 1995 to begin an operation. The project aims to strengthen the construction of Chinese colleges and universities in the field of information technology disciplines and personnel training. In 2005, the company launched a new round of mainframe systems university partnership program to provide the eServer z-series servers to a few universities. Now if a college is to set a mainframe related course, application will be sent to a college with mainframe for sharing hardware resource. It is imbalance between universities with and without a mainframe in mainframe education.

Cloud computing makes it possible to share rare hardware and deliver services by infrastructure, platform and so on. Cloud computing has the potential to play a vital role in education. This paper explains how an education cloud can provide affordable and high-value education services that support 21st-century mainframe skill development. Additionally, the paper outlines a general framework and specific functions of the cloud that can help college mainframe education.

Z Education Cloud is a reformer in lots of aspects on mainframe education proposing a new model that all the colleges have equal opportunities to share a host machine. The cloud is expected to help to set up a new platform promoting mainframe education by delivering standard courses so that all the students and teachers those who love this special technology can enjoy the latest research achievement in mainframe education.

II. DISADVANTAGE OF THE TRADITIONAL METHOD

Now there are 5 mainframe centers in different areas in China supporting mainframe education. The main problems of educating the mainframe specialist:

A. For colleges and universities with a mainframe

- If you want to install and deploy a new mainframe system, you need an expert working for 2-3 days or more, which requires time, laboratory and money. Teaching progress will be delayed.
- Due to objective reasons, the existing system software is hard to upgrade. Using the antiquated system leads to that many new technologies cannot be introduced into the teaching.

B. For colleges and universities without a mainframe

- Only can share mainframe resources with other colleges and universities, and sometimes even share the same DB2 and CICS with each other which makes interference.
- It takes a number of working days to be able to use mainframe resources from submit an application. The response is relatively slow, which impacts teaching.
- The authority is often found not high enough to operate some command. Communication with mainframe provider is required. System is not easy to use.

C. For all colleges and universities

- Teachers' use of the Ministry of Education-IBM quality courses is limited to theoretical courseware. Not familiar with the mainframe system, teacher cannot deploy and operate the labs of the courses, which lead the lack of practical skills of the students. Quality teaching resources can not be shared across multiple universities.
- b) Due to the limited skills of the teachers, the system problems (non-hardware problems) cannot be solved.
- c) Platform for the communication between teachers and students in all colleges and universities is lacked.

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III. COMPONENT OF Z EDUCATION CLOUD

Because of those disadvantages of distributed deployment of mainframe in Chinese Universities, and that IBM is to donate a new and more powerful mainframe, an integrated deployment of national mainframe resource for education is therefore required.

So we need a platform on which teachers can apply for courses resource on mainframe, communication can be made. As we called, z Education Cloud.

Z Education Cloud is expected to solve these problems:

- Rapid deployment for the college mainframe educational environment, saving time, manpower, material and financial resources
- Colleges and universities will be accessed to the latest platform to teach the latest mainframe technology.
- Each course can have its own independent platform, including DB2, CICS, MQ, WAS with no interference between the courses.
- Automatic completion of the deployment of the experiments and case studies of quality courses makes possible the share of high-quality teaching resources.
- Automatic completion of all courses required authorization.
- Monitoring and management of teaching and learning environment.

Function of z Education Cloud:

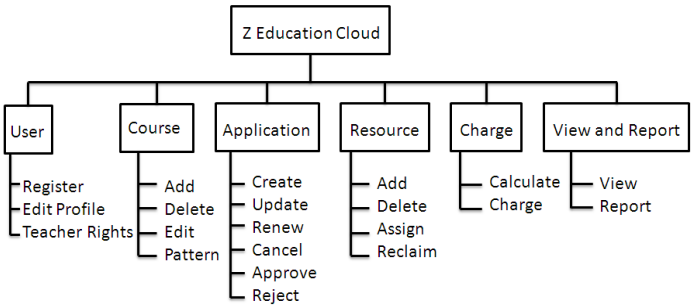

Figure1. The Function Structure Of z Education Cloud

A. User Management

There are 3 kinds of users of the system for now. They are admin, public user and teacher. Admin is to approve or deny the applications of mainframe courses resource and being a focal point of one university.

B. Course Management

Admin manages all the courses and related courseware and patterns. Z Education Cloud manages the courses in order to setup a series of standard courses, which share the latest education resource to all the partner universities.

Pattern is a group of mainframe resource and courseware for a certain course. It is designed to make it easy for teachers to apply mainframe resource by courses.

C. Application Management

Applications include resource applications and teacher. Public users can apply for the role of teacher and teachers can apply mainframe resource via Z Education Cloud website. Clients have a view of their own application records. Focal points have a view of not only their own records but all the application from the teachers of the college. After focal points' approve applications are delivered to the cloud admin to prevent malicious operation. Applications can be terminated early or have an addition of resource.

D. Mainframe Resource Management

Attention should be paid to the state of the mainframe. Rapid solve of problem guarantee the availability of the cloud. Lack of mainframe resource leads to that new application cannot be served. It is cloud admin's responsibility to watch the statistic and amount of resource and make an addition if short.

E. View and Report

View and report are essential for clients to have an idea of how much resource their school has used. It is more important for admin to maintain the system. The usage ratio determines whether to approve a new application and when to make an addition of resource.

F. Charge Module

Z Education Cloud delivers service not for free. These services are fee in accordance with the types and amount of resources used. A price config file records sets a series of unit prices of (1M) storage and user account.

$$F = \Sigma (R * P)$$

F stands of total service fee while R of the amount of a certain resource and P of the unit price of resource. The total service fee is charged in a formula which is showed above that the fee is the sum of the result of the amount of each kind of resource multiples the unit price.

IV. CLOUD ARCHITECTURE

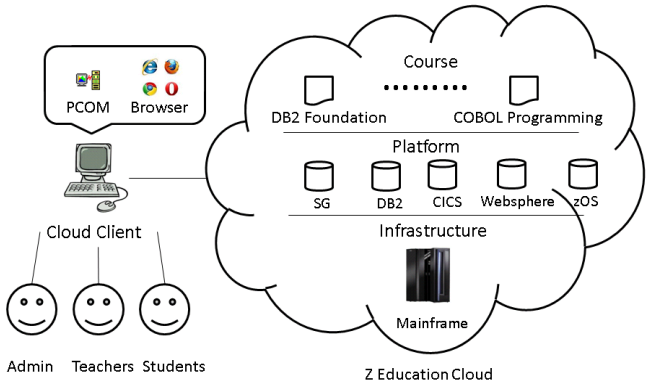

Figure2. The Logical Diagram Of z Education Cloud

Here is the logical diagram of Z Education Cloud. There are 3 kinds of clients, and what need to access the cloud are a browser and PCOM to mainframe, which are thin client

software. Z Education Cloud provider offers its services according to three fundamental models: Infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS).

The clients of the system:

- Public user is just a registered user so that the privilege is not high enough to apply mainframe resource. Public user has the access to the courses information and courseware.
- Teacher must be belonged to a certain university or a college. The role as a teacher must be applied and approved by admin. Teacher can apply mainframe course resource.
- Focal point is strictly not a new kind of users but a special identity for a teacher. Every university has the very one focal point to approve all kind of application from the teachers of the university. Focal point has a view of the statistic of the amount of resource his university ever used and applying for. Focal point can be regarded as a sub admin of a university.
- Admin manages the whole system. Besides approving the application, admin should keep the system in service. Admin has a statistic of the mainframe resource so that he can prevent the system from lack of mainframe resource.

All the essential applications required on PC are PCOM and internet browser. Clients apply mainframe resource and then logon to the system using PCOM, an interact tool of mainframe and it is a relatively thin client. The resource assignment and environment deployment are automatically done by the cloud.

A. Infrastructure as a Service

In this cloud service model, cloud provider offers mainframe as physical machine and networks. This vary one mainframe supports for all national mainframe education. Therefore the cost is limited and it is easy to maintain the machine. The systems, subsystems and middleware of the latest version are available to all the clients.

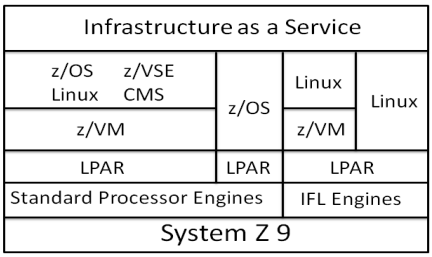

Figure3. The Architecture of IaaS

This figure illustrates that there are several processor engines or called center processors including standard for operation systems and IFL for Linux only. Logical partitions (LPARs) are, in practice, equivalent to separate mainframes. Each LPAR runs its own operating system. This can be any mainframe operating system. The operating system in each LPAR is IPLed separately, has its own copy of its operating system, has its own operator console (if needed), and so forth. If the system in one LPAR crashes, there is no effect on the other LPARs. Different LPARs can be treated as an independent system somehow like virtual machines so that the clients from different colleges are unaware of each other even sharing the same LPAR with different storage groups. Upon LPARs z/OS, Linux and z/VM can be installed.

In a mainframe system with three LPARs, for example, you might have a production z/OS in LPAR1, a test version of z/OS in LPAR2, and Linux for S/390 in LPAR3, which makes possible to design more courses.

B. Platform as a Service

Z Education Cloud is designed to deliver a whole mainframe platform for education with z/OS, DB2, CICS and other subsystems or middleware on which students develop COBOL-DB2-CICS program or practice Resource Access Control Facility (RACF), Job Control Language (JCL) and Restructured Extended Executor (REXX).

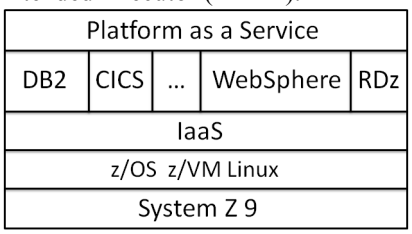

Figure4. The Architecture of PaaS

The figure illustrates that upon infrastructure z Education Cloud provides a group of subsystems and middleware as components of developing platform including DB2, CICS and WebSphere. These components are called mainframe resource in z Education Cloud.

There are 4 kinds of resource for now:

- User id is the access to mainframe Time Sharing Option environment or other subsystem. User id for teacher has the highest authority in the assigned mainframe systems or subsystems. User id for student has corresponding lower authority. For example, a student cannot browse other students' data set, and etc.
- Storage group to mainframe is like disk volume to PC. Users can create their data sets on the assigned volume.
- DB2 for z/OS is a rational database on mainframe and is required for courses such as DB2 Foundation, DB2 Application Programming and Large Scale Transaction System Design and Analysis.
- CICS, Customer Information Control System, a middleware subsystem, is preinstalled and be assigned one or many instances when an application is approved.

PaaS delivers automatically installation, deployment reclaim and uninstallation of mainframe resource as DB2, CICS, USERID and Storage Groups via JCL, RACF and REXX.

- Resources are installed in advance, which means there are lots of DB2 instance and CICS instance spared making assignment more efficient. Before installation, related JCL, RACF and REXX codes are customized

correctly. The instances have its own resource ID like DBN001, DBN002 and so on.

- When an application is approved, preinstalled resources will be assigned and deployed via executing several JCLs customized to connect different kinds of resources such as username and DB2 instance.
- At the end of a course, the resources should be reclaimed and all the authorities be revoked. First, the usernames will be expired so that clients can no longer logon the mainframe. Then, for teachers, the datasets and other records will be reserved for a few days if the teacher forgot to back up data. Expired resource will be cleaned for later use by recovering to its former image or reinstallation via executing JCLs.

C. *Course as a Service:*

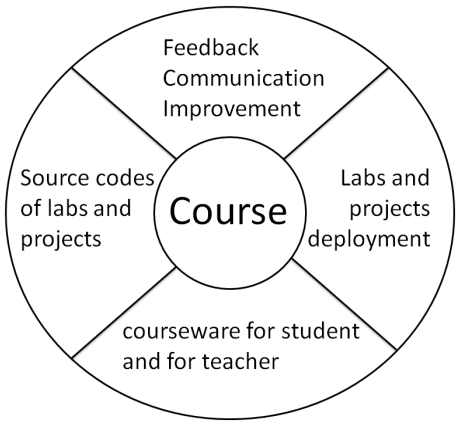

Figure5. The Characteristics of CaaS

As figure 5, z Education Cloud delivers Course as a Service including courseware, lab source codes, deployment of labs and course's self improvement.

Courseware includes the PPTs teachers use for teaching, reference e-books and lab guides for student without answer and for teacher with answer. Courseware can be downloaded from the z Education Cloud.

As a course application is approved and resource is assigned, the labs codes are copied to every username's storage with adoption of parameters. The deployment is automatic so that users can execute the labs immediately without modification.

CaaS sets up a group of standard courses teachers can take it into teaching practice easily. When the courses are accomplished, feedback is sent to the cloud, which makes a communication between course provider and user, helping the improvement of courses.

CaaS is a two-way service. All students and teachers are benefited from those qualified courses, which makes the sense of cloud computing.

V. CONCLUSION

Traditional college mainframe education depends on the 5 mainframe center in different areas of China. It makes the imbalance of education resource distribution between areas and schools.

In this paper, a completely new idea of z Education Cloud is proposed. It is an application of cloud computing including three layers of IaaS, PaaS and CaaS as a new concept. IaaS provides all the universities in the mainland the access to mainframe while PaaS automatically deploys a whole platform with z/OS and DB2 or CICS if necessary. The method of install and clone subsystem is illustrated in the discussion of PaaS. CaaS creatively delivers Course as a service with courseware, lab codes and codes deployment in package. CaaS makes the establishment of standard courses, which balanced education resource between advanced universities and others. All the schools in the nation share the most qualified courses.

We believe that the service oriented z Education Cloud has a great potential and is worth of further exploration. In future, it could also be investigated the power of cloud computing in this kind of solutions.

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