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IT-infrastructure of university based on cloud computing

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Abstract

The article is devoted to the organization of e-education environment of the university based on cloud computing. Cloud services and one of its components - a virtual work place introduce innovations in an education system. The introduction and the use of cloud services at the university will significantly reduce prices of campus machinery maintaining and servicing and will allow to equate in full measure a distance education with a full-time tuition due to a construction of interactive individual paths of training "in any place and at any time", providing high mobility of students.

Keywords: *Cloud Computing, Virtual work place, E-education environment, Virtualization.*

1. Introduction

Over the past few years, the concept of cloud computing and virtualization has become popular in the field of information technologies. Cloud computing has gradually entered in all spheres of society, including an education sphere.

In a modern society training of students, especially in technical educational institutions, is impossible without using the modern Information Technology (IT) of education. But, as a rule, the institutions have a limited budget for updating Computer Park as often as these rapidly changing computing possibilities of modern computers require. It is not a cheap pleasure for educational institutions to contain specialized computer laboratories for various educational and scientific issues [1]. The same picture is observed with the software when universities can not master expenses to keep appropriate informational service of students [2].

An application of the cloud computing could be an economic exit for educational institutions in this situation. Using of cloud computing concepts in educational process will allow reducing costs for purchasing licensed software and expensive computer park with bulk of memory and disks, also the programs, which are used during the lessons, and work results can be stored in a cloud [3].

Cloud computing is a relatively new term in the world of IT-industry, but nevertheless, has become very popular within the past few years. According to Google Trends statistics [4] the interest to the term "cloud computing" has arisen since 2007 and steadily rises.

Several well-known providers of Cloud computing announced services for educational institutions: Google Apps, Microsoft Live@edu, etc. These services can replace or complement the university system functions, such as electronic mail, scheduling plan, instant messengers, creation and storage of personal documents, providing general access to them [5]. In spite of growing interest to cloud computing in the academic community the technology of cloud computing requires a multifaceted study of subjects. The purpose of this research work is to identify benefits and weaknesses of this technology application in the educational institutions of Kazakhstan.

2. The advantages of cloud computing for educational institutions

Many educational institutions have seriously started to think about implementing and using of cloud computing services in the electronic learning environment of the university.

In the works [5-10] are described how it is possible to use effectively cloud computing in students teaching and training. We will generalize and consider some important questions that technology of cloud computing can help to solve in educational institution.

Deterioration of the IT equipment: First of all, universities will reduce costs for the purchase and maintenance of computer equipment. As a rule, the computer equipment morally and physically quickly becomes outdated, not fulfilling the requirements shown by the modern software [11]. Cloud computing technology helps to solve the problems of equipment depreciation, using the weak computers as "thin clients", the information processing occurs on the server side.

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Reducing the cost of software: An important argument for the educational institutions in favor of using cloud services, such as Google's «Apps for educational institutions," or «Live@edu» is that the using of cloud providers SaaS solutions is cheaper than providing the necessary services itself [5]. As a matter of fact, costs are missing. There is no need in acquisition and servicing of the corporate equipments and the software for granting of the given services.

Possibility of the virtual classes, laboratories organization: Technology of virtualization and cloud computing allows organizing virtual classes and laboratories, creating necessary quantity of virtual machines (VM) by quantity of students. Virtual laboratories allow students to work with the remote version of the software without their preliminary installation on stationary computers.

Outsourcing: Transfer of some functions of IT Department of universities to the cloud provider. As a rule, educational institutions willingly send e-mail of students to outsourcing cloud providers. E-mail is a service, which migration is relatively easy to realize, because the technology is simple, standardized and demands the minimum adjustment under needs of specific educational institution. Such companies as Microsoft and Google suggest to educational institutions to place free of charge email accounts of students and employees on the servers. Moreover, they can offer mail accounts with the domain name coinciding with a domain name, used by the educational institution. That is rather attractive to an educational institution.

Data backup: As a rule, a sufficient number of methodical materials is collected at university, for example video lectures, multimedia training courses, audio, video files, various student's projects that requires enough disk space. Creation of the backups of teaching materials and transferring them to the cloud solves problems with disk files and also problems of preservations and data recovery in cases of natural disasters [10] and physical malfunctions of campus servers.

Load balancing of servers: Many cloud providers such as Amazon allow to rent computing capacities as needed. This service can be useful for educational institutions to balance the load on their own server park. There are peak loads of servers in learning process, especially during the session and grading students.

Transition to a format «learning anywhere and anytime»: Cloud computing allows students to have access to your personal working environment in regime 24x7x365 irrespective of a territorial arrangement from any accessible devices (PC, laptop, PDA, etc.) if they have access to the Internet.

Important advantage of cloud computing application should be noted - the *decrease of costs on staff.* The number of institution IT staff decreases due to the transfer of services into the cloud. There is no more necessity to improve the knowledge of specialists in the narrow specialized software and advanced training of IT staff.

3. Practice of cloud computing using in KazNTU

This section describes the experience of implementation and using some cloud services in Kazakh national technical university after K.I.Satpayev (KazNTU).

Kazakh national technical university after K.I.Satpayev is the leading technical university and leader of engineering education in Kazakhstan. The university leads own history since 1934. Today KazNTU – one of leading universities of the country, among technical universities occupies 1 place in a rating of Kazakhstan universities. Being a leading technical university of the country KazNTU actively used information technologies in educational process and has a large computer park. At the university operates a large number of basic and applied applications and services the users of which are students, employees of research subdivisions, the administrative and managerial personnel. University dynamically develops and, therefore, the needs in the IT sector constantly grow. Among the important tasks for the university - the consolidation of IT infrastructure, increasing of its reliability and efficiency of resource utilization, decreases in expenses for service of IT-actives. Quickly growing park of computers and a condition in which they were exploited forced to think about reducing of expenses for managing IT, improving of the work reliability of used systems and reducing of reaction time in the case of problems. The cloud computing technologies and virtualization servers allowed achieving it.

Transition to innovative technologies of cloud computing will allow to university to reduce costs to purchase of the licensed software and expensive computer park with bulk of memory and disks, as also the programs which are used during the lessons and results of work can be stored in a cloud. Also carrying over of educational services to "cloud" will allow moving to a format «learning anywhere and anytime».

Like many educational institutions for KazNTU the first step in using of cloud computing was the transfer of students' e-mail support for outsourcing. E-mail - a basic, well standardized service, which can be easily supported from the outside and certainly is not a key for an educational institution. For the organization of corporate

mail KazNTU used "cloud solutions" from Microsoft, which gives free services of corporate e-mail for educational institutions. This e-mail answers for all technical requirements and gives ability to storing email on Microsoft's remote servers in "cloud", instead of on a local computers. It gives possibility to receive mail on mobile devices, possibility of operative connection to system from any place and at any time.

KazNTU is working on creation a private cloud of educational resources. To date, the University has implemented a number of electronic educational services through the portal of the University: e-library, e-learning courses, e-journals.

Each participant of educational process has virtual "private office" and anywhere and anytime has admission to the materials and the data if there is access to the Internet. All data are stored on the party of the server and necessarily results stand out to users.

4. A virtual workplace

As the following stage of introduction of cloud decision paradigm in KazNTU is planned realization of such directions of cloud computing as, an infrastructure as service (Infrastructure as a Service, IaaS), a workplace as service (Workplace as a Service, WaaS). Works on creation of user's virtual workplace (VWP) are conducted, access to which will be carried out both from university, and from an environment, from any device (the home computer, the laptop, netbook, the smart phone, etc.).

The idea of a virtual workplace creation is development of a convenient workplace for each student, containing those services and the software which are necessary for performance educational tasks, and also providing disk space for storage of documents created by student during training.

However, it was necessary to reconsider the existing server equipment of university for implementation of the virtual workplace based on cloud computing technology. KazNTU has begun reorganization of the IT Infrastructure by implementing server platforms virtualization. The computing infrastructure is constructed on the basis of blade-servers IBM BladeCenter HS22V, systems of storage IBM DS3512 and EMC CLARiiON CX300. The network of data storage systems (SAN - Storage Area Network) is constructed on the basis of Fiber Channel switchboards with throughput to 8 Gbit/sec.

The following issue for university was to choose a virtualization platform, comparing possibilities of various virtualization platforms from such developers, as

Microsoft, VMware, Citrix, Red Hat. We have stopped the choice on product VMWare vSphere 5.

VMware vSphere is one of virtualization platforms for creating of the cloud infrastructures, representing a complex of services and applications. It provides stable work of applications and possibility to react to various events quickly [12]. A number of services of an infrastructure are responsible for high level of applications and data availability, as well as high level of safety. vSphere helps to accelerate carrying over existing data centers to a computing cloud, allowing subsequently to increase capacities without damage to high school activity, and provides connection to compatible public clouds.

The virtualization technology allows to create virtual servers with various software and to transfer them on a uniform host-server. Thus there are some virtual servers, workstations, IT devices, etc. on a host-server. Virtual servers can take places function separately and independently from each other some, can be moved in a few minutes from one hardware to another, unite in virtual networks or function as uniform knot of processing of the information. This solution has allowed to raise reliability and autonomy of IT Systems, to provide a continuity of business processes of university, to lower power consumption, to raise efficiency of use of computing resources. Thanks to virtualization technology introduction in KazNTU about 25 % of a server infrastructure is already liberated, on 40 % of power consumption is lowered, floor spaces are released from superfluous hardware maintenance, expenses on acquisition of the hardware for new services are cut down. Besides, server virtualization provides access to virtual computers by means of the web interface. Hence, students can be connected to them at home and work in addition. Possibility of remote access creates conditions for distance learning, interest to which increases every year.

5. Conclusions

In the given article authors have tried to describe aspects of application of technology of cloud computing which can be rather attractive and economically beneficial for educational institutions. And also article purpose was to describe the practical experience of using cloud computing for creation of the electronic educational environment of high school. We wanted to demonstrate our own experience in implementing a number of services based on cloud computing.

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