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An Academic Cloud Framework for Adapting e-Learning in Universities

Madhumathi.C[1], Gopinath Ganapathy.[1]

School of Computer Science, Engineering and Applications, Bharathidasan University, Tiruchirappalli, India[1]

Abstract: Cloud computing based e-Learning provides continuous (any time, anywhere and any device learning) and collaborative learning. Cloud computing in an academic environment such as university will be benefitted by every students, faculties, administrators and research scholars. Most of the universities infrastructures are underutilized and in some cases over utilization of resources occurs in order to balance the usage of the resources we need an elastic technology. In order to develop an e-Learning platform for postgraduate students of computer science and research scholars new methodologies should be taken into consideration for project, problem based learning and virtual computorium. This type of cloud based e-Learning provides new blended learning methodologies for education. In this paper, an academic cloud framework is proposed in order to provide a new era in e-Learning. This framework addresses the services and deployment of cloud in a new dimension and each layer specifies the essential components needed to construct an academic cloud in a university.

Keywords: Academic cloud framework, cloud based learning, e-Learning cloud, Academic cloud services.

I. INTRODUCTION

University has various departments where many students need to access to the computing and resources such as highly available software and hardware. Cloud computing has the capacity of scaling and elasticity which is perfect for such an environment. A cloud computing service has ubiquitous access through a Web browser or mobile device with APIs or special desktop applications. Use of Cloud Computing on universities has many benefits such as accessing the file storages, databases, educational resources, research applications and tools anywhere, anytime on demand. Furthermore, cloud computing reduces universities' IT complexity and cost. The main goal of an academic cloud is to manage effectively the technological needs of universities such as delivery of software, providing of development platform, storage of data, and computing [1].

The implementation of cloud services at universities provides various opportunities and benefits for the users of the university. For example, in a typical university scenario, PC labs and servers are under-utilized during the night and semester breaks. In addition, these resources are on high demands mainly towards the end of a semester, following a dynamic rule of use. The Physical machines are hold even when they are idle, wasting its full potential [2].

Every day that goes by, research and educational needs of universities' change with developing technology. All the software and hardware of universities' must be renewed in accordance with the changes. For example, there are office applications, programming language, and multimedia developing courses in computer education. Also every year, the new versions of applications were used for courses with respect to the needs of industry. As a natural result of this progress, new software cause new hardware costs. Students frequently use both the software and development platforms during the study. The large majority of university budgets are devoted to meet these needs. Students will have access to all software anytime, anywhere and any technological devices connected to internet by suggested cloud structure. Also, students will have access to development platform, develop their own applications and store on university infrastructure. In this way, lecturers will focus their basic tasks and not lose their workforce [1].

According to Educase, a survey says that nearly all institutions have a major interest in e-learning, at least at the level of some departments. Online courses are ubiquitous, with over 80% of institutions offering at least several courses online and more than half offering a significant number of courses online. So it is the high time to move the teaching-learning activities of the university to the cloud.

The services and deployment model of an academic cloud can be used by the educational institutions to provide a new way of learning. The services of an academic cloud can be charged based on usage of the cloud by the

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students/faculty/research scholars of the educational institution.

Government of India is having the ambitious plan to raise the present 16 million enrolments in higher education to 42 million by 2020 as well as interconnect electronically India's 572 universities, 25,000 colleges and at least 2,000 polytechnics for enabling e-Learning and content sharing across country. The lunch of low cost, affordable Aakash tablet PCs for the student community is likely to increase the number of users' for educational online resources exponentially [3]. Around 45 million people will be in the age group of 18 to 20 years by 2020 in India. To make available quality education for them will be a challenging task [4].

Advantages of e-Learning/m-Learning in cloud

Potential Values of e-Learning/m-Learning in cloud computing [5] [8] are as follows:

- Provide opportunity for ubiquitous computing
- No need for backing up everything to a thumb drive and transferring it from one device to another.
- No need to copy all stuff from one PC to another when buying a new one. It also means students can create a repository of information that stays with them and keeps growing as long as the students/faculty wants them.
- Crash recovery is nearly unneeded. If the client computer crashes, there are almost no data lost because everything is stored in the cloud.
- Allows students to work from multiple places (home, work, library, etc), find their files and edit them through the cloud and browser-based applications can also be accessed through various devices (mobile, laptop and desktop computers, provided internet access is available) and thus transforms e-learning to m-learning.
- Most software is free, available and ready-to-use.
- Students can have a richer and more diverse learning experience, even outside class hours.
- Allows students to create content through the browser, instead of only searching through the browser.
- It provides a low cost solution to academic institutions for their researchers, faculty and students.
- It provides flexible infrastructure to maximize investments. Cloud computing allows user to dynamically scale as demands fluctuate.
- It helps to make data and services publicly available without jeopardizing sensitive information.
- It is almost impossible for any interested malicious student to determine where is located the machine that stores some wanted data (tests, exam questions, results) or to find out which is the physical component student needs to steal in order to get a digital asset.

II. RELATED WORK

Anthony Sulistio et al [2] of Hochschule Furtwangen University, Germany establishes CloudIA (Cloud Infrastructure and Application) framework to build private cloud for the purpose of running e-Science and e-Learning applications in university. In this framework, Cloud Management System (CMS) is used with different layers that specify the components used in building private cloud. There is no efficient load balancing algorithms used in the cloud and also more number of virtualization technologies has been specified in this framework. This framework is used to provide IaaS, PaaS and SaaS as services of the cloud to the university. It provides SCP (Server Container Platform) as Platform as a service to the students of the university.

Abishek Gupta et al [6] of Indian Institute of Technology, Delhi designed and implemented the workflow of an academic cloud. It specifies the virtualization stack with KVM hypervisor and libvirt API used to construct a community cloud above the university infrastructure. In this utilization of lab resources has been shifted from 1-10% to 40-50%.This workflow provides IaaS of the cloud to the academic institution. This framework also requires an efficient load balancing approach to address the performance issues of cloud.

Bo Dong et al [7] has presented an e-Learning framework called Blue-sky cloud framework in which physical machines have been virtualized and allocated on demand for e-Learning systems. It also solves the challenges faced by e-Learning systems. It also consists of three layers such as the virtual infrastructure, capability and data caching layer. It improves the availability, performance and scalability of e-Learning systems.

III. PROPOSED ACADEMIC CLOUD FRAMEWORK

An academic cloud framework is proposed for adapting e-Learning in universities using cloud computing in order to help the students, faculties, research scholars and administrators of the university to better utilize their infrastructure. This framework specifies the virtualization technology to be used to build an academic cloud above the

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existing university infrastructure in order to use the resources more effectively and also to support the QoS (Quality of Service) objectives such as high availability, performance, reliability, scalability, load balancing and security in the service models (IaaS, PaaS, SaaS) of the cloud [11].

The academic cloud framework is divided into five layers [9] [10] such as,

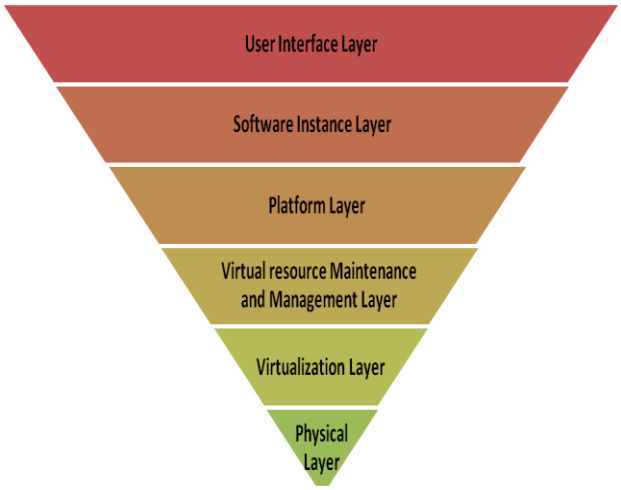

Fig. 1 Layers of Academic Cloud Framework

This framework consists of six layers as shown in Fig.1. Each layer has its own set of components within it. It is best suited for academic institutions which are ready to use cloud in their institution. These layers incorporate the three services offered by the cloud within them. This framework also supports various deployment methods in adapting cloud within their academic infrastructure. Apart from this, it is used to setup the cloud within the academic institution.

Each layer in academic cloud framework consists of various components. Security, Monitoring and Management are incorporated across all layers to ensure QoS objectives as shown in Fig.2.

A. User Interface Layer:

This layer acts as an interface between the endusers (students, faulty, research scholars and administrators) and academic cloud infrastructure. The end-users communicate with the academic cloud using the browser enabled devices such as (laptop, desktop, mobile phone, iphone, ipad) by means of the protocols such as RDP (Remote Desktop Protocol), SSH (Secure Shell),Http/Https (Hypertext Transfer Protocol) and LDAP (Lightweight Directory access Protocol) [2].

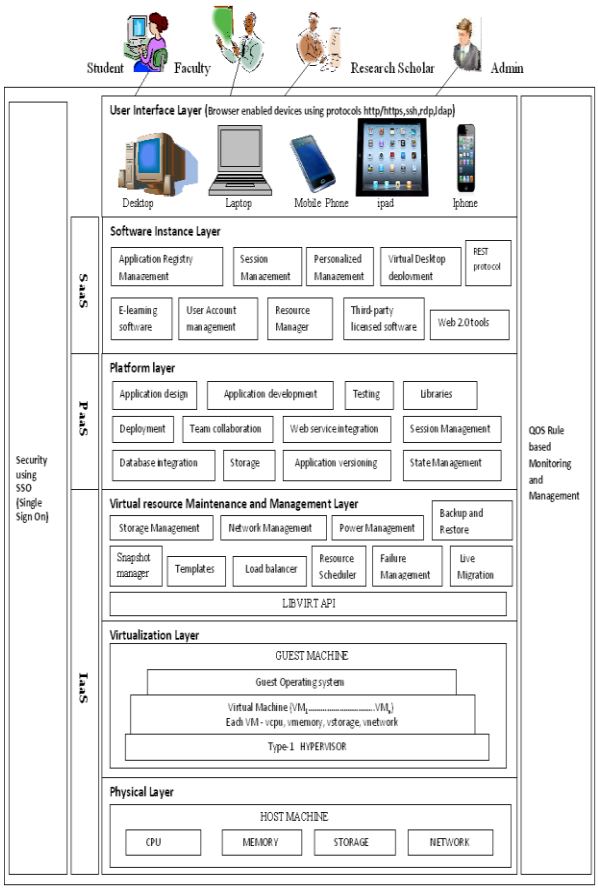

Fig.2. Proposed Academic Cloud Framework [2] [6]

B. Software Instance Layer:

This layer provides the "software as a service" to the end-users of the university. The e-Learning software using web2.0 tools or above and other licensed third-party software are installed in the University cloud and these are provided to the students as a service. Apart from this, it provides various customization options to the end-users using the protocols such as REST, SOAP etc [8].

C. Platform Layer:

This layer provides a platform to the end-users of the university to develop, test and deploy an application using the sdk, IDE's in the cloud. The users can also maintain database in the cloud. Various web services and libraries can be used by the end-users of the cloud.

D.Virtual resource Maintenance and Management Layer:

This layer maintains and manages the resources of the virtualized university infrastructure by means of the components such as resource scheduler, load balancer, live

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migration, templates, snapshot manager and recovery. Libvirt API is used to communicate with the virtual machines in order to monitor the virtualized resources more effectively [6].

E. Virtualization Layer:

This layer consists of Type-1 hypervisor (KVM/XEN/MS hyper-v) above the bare metal in order to create 'n' number of virtual machines. Each VM has its own virtual CPU, Memory, Storage and Network. Above VM, the OS is placed and it acts as guest OS in Guest Machine.

F. Physical Layer:

This layer consists of bare metals of the data centre and it acts as a host machine.

G.Security:

This layer provides single sign on (SSO) authentication to the end-users of the university across all the layers of the framework to access the cloud. [2]

H. Monitoring and Management:

This layer provides rule based monitoring and management of the resources and it is used to verify whether the QoS objectives are met across all the layers of the academic cloud framework [2].

IV. UTILITY/APPLICATION

Each student, faculty, research scholars must be given unique ID and password to login to the cloud by requesting to the use of one or more of the following such as the delivered software, developing platform and computing resources in cloud. The request is then validated by the administrator and a response is sent as approval in order to use the resources of cloud. The administrator must have an option to monitor the usage of the resources inorder to avoid the fault tolerance and to increase high availability of resources to the students/faculties/research scholars of the university.

The academic cloud based on the above framework provides the following services:

SaaS: (Software as a Service)
The students, faculties and research scholars can use the e-Learning software's [12], Educational software's, office packages and other free/paid application software's provided in the cloud on demand and these software's need not be installed on the physical machine of their own devices (laptop, PC or mobile phones).

PaaS: (Platform as a Service)
The students, faculties and research scholars can use the application development platforms such as sdk and datastore to develop, test, deploy, host and maintain their own applications in java and php on demand. By means of multitenancy their own applications can also be shared with their friends and faculties.

IaaS: (Infrastructure as a Service)
This provides the infrastructure such as storage, network, memory, processor to the research scholars on demand. It provides an experimental lab to the research scholars, who need to test their own research work (algorithms) in different operating systems, processors etc.

The academic cloud can be deployed in the following ways:

Private Academic cloud:
The cloud infrastructure is provisioned for exclusive use by a single university comprising multiple departments. It may be owned, managed and operated by the university, a third party or some combination of them and it may exist on or off premises [13]. It can be set up in universities using the virtualization technologies used in this framework with open source cloud platforms within the datacenter or servers. By means of the private academic cloud the data and all the information are stored within the universities infrastructure in a secured manner.

Hybrid Academic Cloud:
The cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load balancing between clouds) [13]. A hybrid academic cloud is an extension of private cloud in which valuable information of university is stored within their own infrastructure and other information or data is stored in public cloud by means of cloud service providers.

Community Academic Cloud:
The cloud infrastructure is provisioned for exclusive use by a specific community of students/faculties/research scholars from universities that have shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be owned, managed and operated by one or more of the universities in the community, a third party or some combination of them and it may exist on or off premises [13]. A community academic cloud can be setup in

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making Mou with many universities. The university's academic cloud can be used by affiliated and constituent colleges which come under the university.

CONCLUSION

This paper will be the base for the development of an academic cloud based on the framework in a more effective way and it will be implemented on simulation environment / cloud test beds using standard machines, in future the same can be deployed over the real cloud environment to enhance usability of e-Learning in cloud environment for students/faculties/research scholars of universities. This framework helps and satisfies organizations, institutions, learners and instructors to provide an efficient e-Learning mechanism using cloud computing. By means of the cloud based e-Learning, students will attain the 21st century skills within them and also increases the university-industry collaboration.

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BIOGRAPHIES

Ms.C.Madhumathi, MCA.,M.Phil.,SET., She did her B.Sc Computer Science, Master of Computer Application and Master of Philosophy in 2008 , 2011 and 2012 respectively from Bharthidasan university,India. She has received MCA degree from School of Computer Science, Engineering and applications from Bharathidasan University, Tiruchirappalli and was a University First Rank holder (Gold Medalist) in her MCA. She has one year teaching experience and her research interests include Cloud Computing and Cloud based e-Learning.

Gopinath Ganapathy, PhD is the Professor and Head of the Dept of Computer Science and Engineering, Bharathidasan University, India. He did his under graduation and post graduation in 1986 and 1988 respectively from Bharathidasan University, India. He obtained his PhD degree, in Computer Science in 1996, from Madurai Kamaraj University, India. Received Young Scientist Fellow Award for the year 1994 and eventually did the research work at IIT Madras. He published around 60 papers. He is a member of IEEE, ACM, CSI, and ISTE. He was a Consultant for 10 years in the international firms in the USA and the UK, including IBM, Lucent Technologies (Bell Labs) and Toyota. His research interests include Modeling, Patterns, NLP, Web Engineering, and Text Mining.