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A virtual Cloud Model for Education and Knowledge Enhancement

M. Malathi, V.Rajamani.

Abstract— With the rapid development of the Internet, there are numerous resources one can find in the web. These resources may be available free of cost or come with transaction and access fee. It will be of major use if one could get a single or multiple resources from a pool of resources for rent on utility basis, allocated dynamically with demand varying from peak loads to normal, sitting at home or at a convenient location browsing through the internet. We have made a research on virtual education and the solution is Cloud Computing. Cloud computing is largely under study for various applications and for its cost reducing features. In this paper, we have utilized the service of cloud computing technology in the educational sector. We have proposed a virtual cloud called VCloud which makes use of the cloud computing features and providing service to the students. This service can be effectively used in educational, research institutions, and also companies involved in research, schools particularly in villages.

Index Terms— Availability, bandwidth, interoperability, multitenancy, resource, scalability, Virtualization

1 INTRODUCTION

CLOUD computing is a model for enabling convenient, on demand network access to a shared pool of configurable and reliable computing resources(networks, servers, storage, applications, processing, bandwidths virtual machines)that can rapidly be provisioned and released with minimal consumer management effort or service provider interaction[1]. Cloud is getting more attention because of its cost reducing features by using virtualization and consolidation concepts. Small and Medium scale enterprises also started adopting the cloud to reduce the capital expenses. In this paper application of cloud computing in the education sector has been explored.

Present day education, shows enormous improvement in teaching, makes use of latest technologies but it is available to city based students. It is not available to students studying in developing towns or students living in villages. Similarly students studying through distance education mode cannot avail these facilities. Mendez [2] points out that in traditional web based learning mode, system, initial design, setup of the environment, systems configuration updates, and maintenance will be available in some premises but which needs considerable investment. Chandral [3] focused on current e-learning architecture model and on issues in current e-learning applications. The article presents the Hybrid Instructional Model as the blend of the traditional classroom and online education and its customization for e-learning applications running on the cloud computing infrastructure. The authors underline the e-learning issues, especially the openness, scalability, and development, customization costs.

The existing e-learning systems are not dynamically scalable and hard to extend. Integration with other e-learning systems is also very expensive. The system is not dynamically scalable. These facilities can be afforded by only funded institutions, self-financial colleges, companies and prominent government institutions. Students with poor financial background cannot go for e-learning as this mode is still unaffordable to them. Cloud computing can be utilized effectively for learning and teaching purposes. Cloud characteristics can be exploited and made suitable for learning purposes which overcomes these above mentioned shortfalls. Cloud computing is used due to its dynamic scalability and effective usage of the resources. It can be utilized under circumstances where the user has the availability of resources which is limited.

As more and more concentration is given to cloud computing because of its cost benefits, application of cloud for various problems has been making its progress. In the field of education, a lot of applications applying cloud had been studied, such as the technology for future distance education [4], teaching information system [5][6][7],the integration of teaching resources[8], teaching systems development[9]. In integration of e-learning and network, much emphasis is placed on building of software and hardware platform of e-learning system, functional structure, network security management and training, information technology integration to teaching [10], campus network environment [11], online education [12], semantic web technologies-based multi-agent system [13][14].Our main focus in this paper is given to the application of cloud computing in the field of virtual education. Considerable research has been made in this subject. The private Cloud is built for the access with n the enterprise where the users can utilize the facility without any charge [15]. The methods of meeting challenges such as user interface; task distribution and coordination are explained and evaluated in [16]. Praveen and Betsy [17] have described the application of Cloud in universities. Delic and Riley [18] assessed the current state of enterprise knowledge management and how it will evolve into a more global, dependable and efficient infrastructure with in Cloud computing. They have discussed architecture as well as applications. Here Importance is given to integration of online education, virtual learning, and providing virtual lab environment. Usages of cloud in content development, content delivery, instructional system design, information resource development, online course-building have been analyzed.

In this paper, we tried to attach cloud computing to virtual learning, designed VCloud made an active research and explored the advantages of using it for the family of Teachers and Students. In this VCloud students are the end users or consumers. One set of resources are lectures allocated on

demand whenever they need. These needs may vary from time to time. During examinations they may need many resources for a long duration of time. The cloud can shrink or expand its availability of resources. These resources can be utilized effectively by a student residing at villages and also students doing part-time jobs .Students are charged for resource consumption on utility basis only.

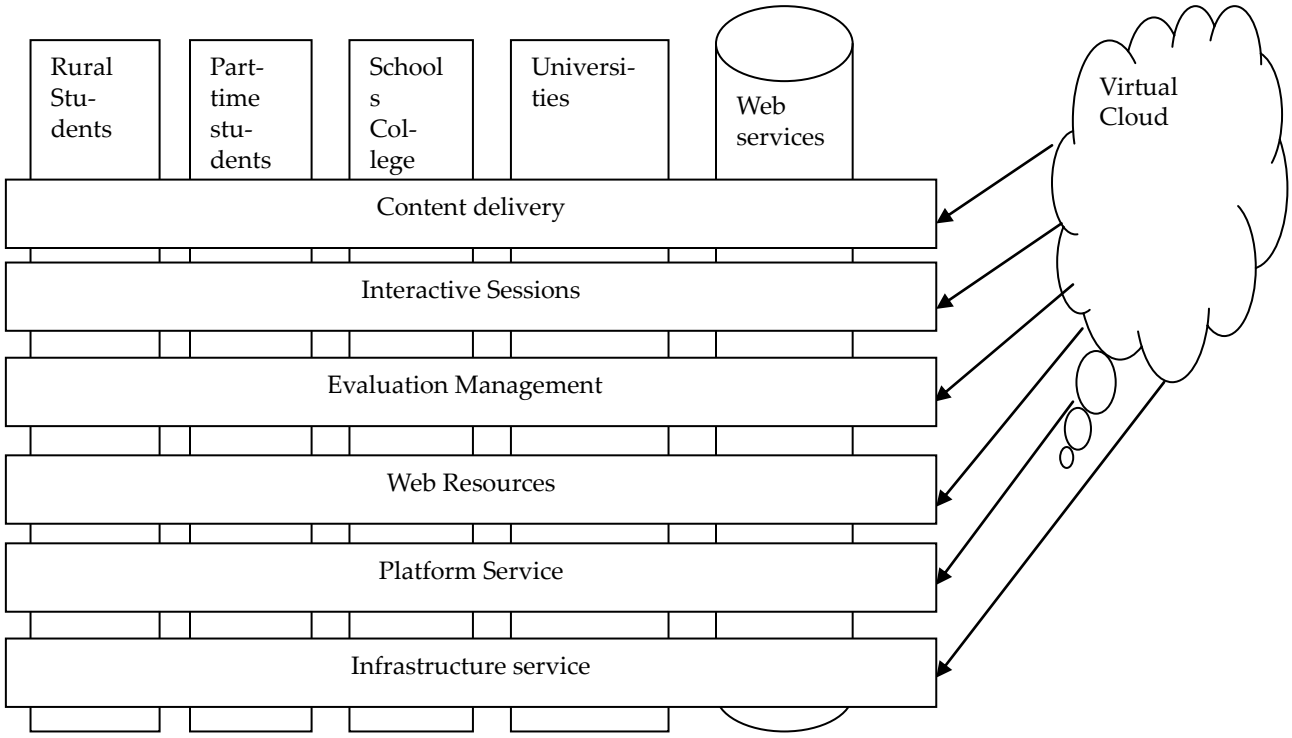

Fig 1. Connection Scenario of the participants in the Cloud Envronment

Teachers are paid for the access of their lectures and Cloud Service Providers also gain profit in the VCloud model. Section II gives the Characteristics that we make use of for the cloud to become a Virtual Cloud. Section III describes the delivery models. Section IV is a brief account about deployment models. In section V, design of cloud for an educational environment is proposed. Section VI describes how the different modules given in the design phase communicate. Section VII draws the conclusion.

2 Essential Characteristics

This cloud model is composed of five essential characteristics. The characteristics necessary to set up virtual Cloud are as follows.

2.1 On-demand self service

On-demand self service enables students to use cloud computing resources as needed without human interaction between them and the provider. A student can schedule the use of cloud services such as content delivery and content materials as needed whenever he demands. So this ease of use and elimination of human interaction provides efficiency and cost savings to both users and cloud service providers .

2.2 Broad network access

When cloud computing is to be efficient and is to be an effective replacement for in house data centres, high bandwidth communication links must be available to connect to the cloud services for a student. High-bandwidth network communication provides access to a large pool of IT resources. Many organizations use the three tier model or two tier architecture to make efficient use of Cloud Computing.

2.3 Location independent resource pooling

The cloud provider's computing resources are pooled to serve multiple students, which means they can form a group using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to their demand. Applications require resources. But these resources may be located anywhere in the geographic locations physically and assigned as virtual components whenever they are needed.

2.4 Rapid Elasticity

Rapid elasticity refers to the ability of the virtual cloud to expand or reduce the allocated resources quickly and efficiently to meet the requirements of the self-service characteristic of

cloud computing. During examination time the requirement of resources are more and during the vacation time it is less. This allocation should be done automatically and should appear as a large pool of dynamic resources that can be paid for and whenever needed.

2.5 Measured service

The amount of cloud resources used by a student can be monitored and billed automatically for usage of that particular session. Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., sessions, contents, interactive sessions, processing, bandwidth, and web services).Resource usage can be monitored, controlled, and reported by providing transparency for both the provider and consumer of the utilized service.

3 DELEVERY MODELS OF VCLOUD

There are three service models in this architecture. Once an Internet connection is established among several computers, it is possible to share these services within any one of the following service models.

3.1 Cloud Software as a Service (SaaS)

The capability provided to the consumer is to use the provider's application running on a cloud infrastructure. The applications are accessible from variant client devices through a thin client interface such as a web browser. The consumer does not manage the cloud or control the underlying cloud infrastructure.

3.2 Cloud Platform as a service (PaaS)

The capability provided to the consumer is to deploy on to the cloud infrastructure, applications which are created by the consumer or applications which are acquired and developed using programming languages and tools supported by the provider. Various types of PaaS vendors offerings can vary and can include complete application hosting, development, testing and deployment environment as well as extensive integrated services that include scalability, maintenance and versioning.

3.3 Cloud infrastructure as a service (IaaS)

The capability provided to the consumer is to provision processing, storage, networks and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating system and application.For papers accepted for publication, it is essential that the electronic version of the manuscript and artwork match the hardcopy exactly! The quality and accuracy of the content of the electronic material submitted is crucial since the content is not recreated, but rather converted into the final published version.

4 DEPLOYMENT MODELS

Virtual cloud can be deployed as public, private, community and hybrid clouds.

4.1 Public Vcloud

Public Vcloud or external cloud describes cloud computing in the traditional main stream sense, whereby resources are dynamically provisioned on a fine-grained, self-service basis over the internet, via web applications/web services, from an off-site third-party provider who bills on a utility computing basis[5].So the lectures, contents, interactive sessions**, virtual lab** setup materials are available to everyone.

4.2 Community Vcloud

Community Vcloud can be formed when a particular community like, students doing research or users belonging to a particular department may be electrical engineering may use the resources on a shared basis with reduced costs. With the costs spread over fewer users than a public cloud (but more than a single tenant) this option is more expensive but may offer a higher level of privacy, security and/or policy compliance.

4.3 Hybrid Vcloud

Hybrid cloud may be established where several organizations have a tie up with educational institutions having similar requirements and seek to share the infrastructure so as to realize some of the benefits of cloud computing. They may use dedicated servers.A hybrid storage cloud uses a combination of public and private storage clouds. Hybrid storage clouds are often useful for archiving and backup functions, allowing local data to be replicated to a public cloud.

4.4 Private Vcloud

Some vendors have used the terms to describe offerings that emulate cloud computing on private networks. These (typically virtualization automation) products offer the ability to host applications or virtual machines in an institution's own set of hosts. These clouds also are used to provide the benefits of utility computing, location independence, collaboration - shared hardware costs, the ability to recover from failure, and the ability to scale up or down depending upon demand. IT organizations and some universities use their own Private cloud(s) for mission critical and other operational systems to protect critical infrastructures and when they need more security for their applications.

5 DESIGN OF VIRTUAL CLOUD

In the initial setup phase, the Cloud Service Provider whether Public or Private or community cloud invites the teachers to record their lectures and send them to be stored in servers. Interested Teachers can participate in Virtual Cloud Computing Teaching Environment. They need to put their theory lectures, practical lectures, the study materials related to those subjects in Cloud Servers. They are given incentives for the access of their lectures by the student. If it is accessed repeatedly they are paid more for each instance. Teachers are paid incentives and students are charged based on their consumption of resources. Students can share their charges if they are group users and if they use multi-tenant model. Fig 2 shows the participants in the VCloud.

Student may request for a theory session or practical session whenever he is free, at a location wherever he is convenient, for a time he is interested, and he pays for only that amount of time. In this virtualized Cloud Computing Education Environment we define two layers namely Resource layers and Management layers. Resource layer define the services.

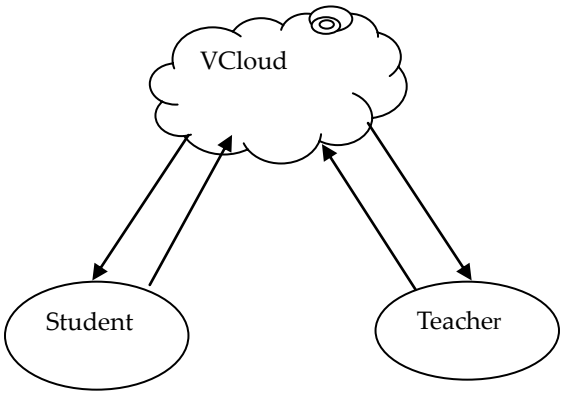

Fig 2. Participants in the VCloud

Student may request for a theory session or practical session whenever he is free, at a location wherever he is convenient, for a time he is interested, and he pays for only that amount of time. In this virtualized Cloud Computing Education Environment we define two layers namely Resource layers and Management layers. Resource layer define the services they provide. Figure 3 shows the VCloud framework. There are three kinds of services that form a resource layer which could be accessed over the internet by the students. Management layer describes five kinds of management modules.

The resource layers are software resource, platform resource and Infrastructure resource respectively. The management layers are student's management, Teacher Management, Connection management, Resource allocation management and database management. These layers are described here briefly.

5.1 Resource Layers

5.1.1 Software Resource Module

Mainly these are study materials and web services for various theory subjects and for practical subjects provided by the Teachers of Educational Institutions across cities, states and countries that can be accessed over the Internet. Here the entities involved are students(End Users),Teachers and Cloud Service Providers.

5.1.2 Platform Resource Module

A virtual evelopment environment for conducting lab sessions. This can be achieved by the logical partitioning of physical computing resources into multiple execution environments including servers, applications and operating systems over the Internet. Virtualization is based on the concept of a Virtual Machine Monitor(VMM) known as a hypervisor. Xen, an open source hypervisor, is widely used for cloud computing. The entities involved are Students and Cloud Service providers.

5.1.3 Infrastructure Resource Module

Basic and complex storage capabilities can be provided as a service over the Internet. This enables the pooling and sharing of hardware resources, such as servers, storage and perimeter devices (firewalls, routers).The entities present are students and cloud service providers.

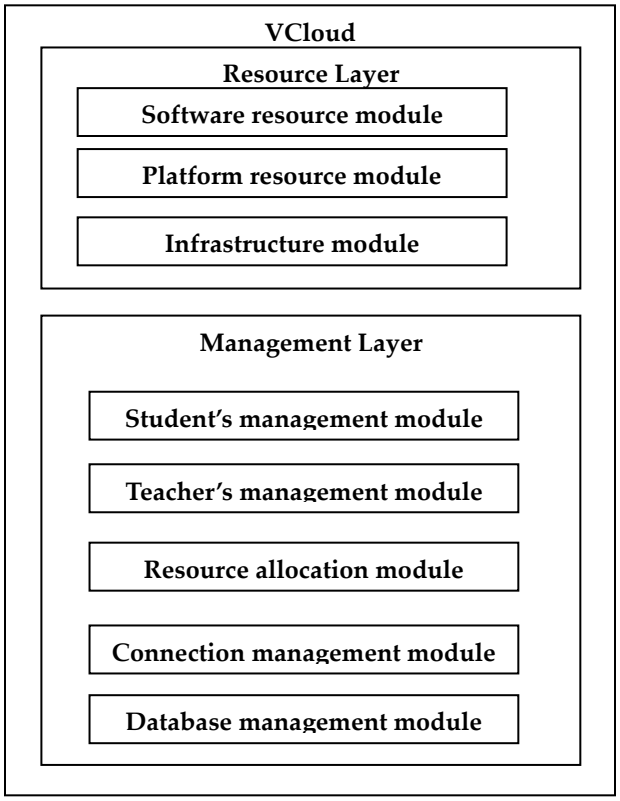

Fig 3. VCloud Frameworks

5.2 Management Layers

There are five types of management modules used in this layer. They are Student (end user) management, Teacher's management, Resource allocation management, Connection management and Database management modules. Fig 3 shows the VCloud framework employing these layers and modules.

5.2.1 Student management module

This includes management of login and authentication information, requests for resources, availability of resources, renewal information, Interactive sessions, online tests, over all time of access, single tenancy, multiple tenancy online payment and other basic information for the students. In this module student can log in to the course availability details, faculty availability and required sessions. Based on the session information they will be charged.

5.2.2 Teachers management module

This module contains login and authentication information, theory sessions, practical sessions, duration of access

study material for theory subjects as well as practical subjects, interactive session's online payment and other basic information for the Teachers.

5.2.3 Resource allocation Module

It is the core module of the management system [19], This module includes available resources, allocation resource usage, resource status and resource renewal systems to manage. This module also manages Student's as well as Teacher's resource allocation system, payment details and the demands expected in future.

5.2.4 Connection management Module

This module deals with the ways in which student and teacher access the resources which includes remote access management and remote connection management, authentication details and authorization services.

5.2.5 Database management Module

There are servers for maintaining databases of all the modules mentioned above. For example Students login and a information, Teachers login and authentication information. To store requests, availability, duration of access of the resources, payment information Similarly for the teachers, login and information, duration of usage of their resources by the students, payment details. Resource allocation database is maintained in the servers. This database stores the details of the requests it had received, requests that have been serviced, availability, renewal, duration of service and other information.

6 Communication Among Core Models

6.1 Figures and Tables

The management system of VCloud has to effectively communicate among these five modules.

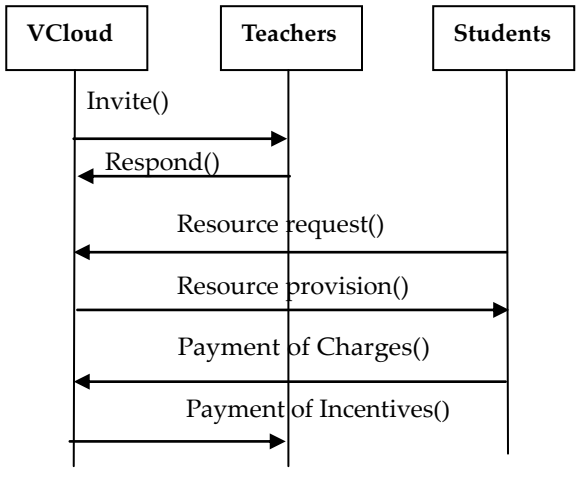

Fig 4. Communication among the participants in Vcloud Architecture

Figure 4 shows the Communication scenario among the participants in Vcloud. Student or End user access the web portal and places a request for resource. If the resource is available from the list of database, request is satisfied for the period of time and payment is charged and received from the student for the software, hardware and network usage by the Cloud service provider. Meanwhile Teacher is given incentive for that particular request and if that particular teacher's study material is requested for many times she or he can be paid for the successive requests. Both Teachers and students can access the Web portal. Students access the web servers and resources list and select the resource. Web server forwards the users request to resource management module for processing. The resource management module sends back the Web server, the resource information by IP address and student's account. Finally student is able to listen to the lecture given by any faculty from any location sitting at his own place.

The figure below shows the interface after student has logged in. He has to choose the Universities, the subjects,

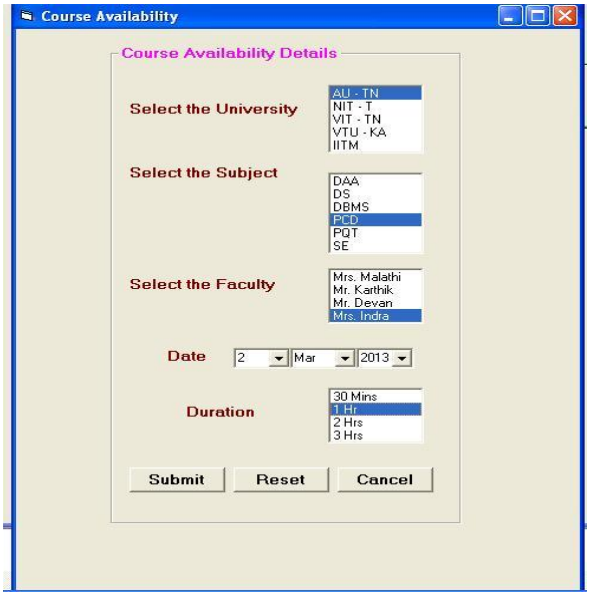

Fig 5. One of the Interface

available faculties and duration of access of the lectures. He will be directed to another page where he will be charged the required amount.

7 Expected Benefits from the Architecture

The intended advantages derived from the proposed architecture are as follows:

7.1 Lower costs computer

To run a web application based on the cloud it is enough to have systems with low memory, less processing power, minimum storage. So PC's can be affordable for rural students and with poor financial background

7.2 Fewer maintanence issues

With no special software, and less hardware installed, there will be fewer maintenance issues

7.3 Lower software costs

Web applications of cloud are offered on a rental basis. So it reduces software costs.

7.4 Incresed computing power

More processing power on the cloud is available for the student. So it will be useful for him to do projects and research.

7.5 Easier group collaboration

Multiple students and lecturers can collaborate on documents and projects.

7.6 Latest Versions and software update

The Cloud always hosts the latest versions of the documents. So there is no danger of having an outdated version on the computer one is working.

7.7 Interopreablity across devices

There is no need to install specific software when one moves the application from PC to mobile.

7.8 Universal access to document .

Since the documents are available in the cloud student can access them anywhere geographically

7.9 Multitenant usage.

If students requiring a specific lecture form a group and access the lecture, the cost will be further reduced

7.10 Incentive for the Teacher.

Teachers are not needed to invest anything. Still they will be getting incentives for every access of their lectures by the students. So students not only from villages, but from cities also can share their ideas with reputed University students all over the world.

In this paper, we have identified an architecture which will be using cloud computing technology in education environment. The system has good expandability, and can induce information sharing among all classes of people.

Mainly, we have considered the benefits of cloud architecture. Future research will include the strategy , for migration to the proposed architecture based on the clouds. This model can be effectively used in schools of remote villages, in the distance education field, for online training of business professionals, for children who cannot attend schools and people from poor financial background.

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