# Development of Virtual Computing Lab Using Private Cloud

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***Abstract:*** *Virtual Computing Lab (VCL) is a very effective answer for the educational institution to meet the increasing demand of physical machines, different computational laboratories and large number of users in a limited budget and time. Cloud computing ('on demand computing') is a revolutionary technology that has taken the world by storm. A small private cloud built in our college intranet can help us to harness the advantages of cloud in educational field. Building a VCL using the private cloud can satisfy the requirements of our college's increasing set of computational need and user requirement. This VCL provides a flexible way to provide services through Virtual Machine (VM). It also provides versatility, security and cost effectiveness which was not possible in physical workstation model of laboratories. The private cloud developed can provide a variety of OS environment helping the instructors in development of courses and strengthening curriculum. . Students and teachers will be able to experience and feel variety of OS on a single desktop and understand its processing. In this paper we use EUCALYPTUS – an open source software framework for cloud computing for developing a VCL that provides Infrastructure as a Service (IaaS).*
***Keywords:*** *Cloud computing, Eucalyptus, Virtual machine, IaaS.*

## I.    Introduction

The VCL allows faculty and students to remotely access software applications that they don't have installed on their machine [1]. Developing a VCL on a cloud only adds to its benefit, cloud provides features like on demand computing, rapid elasticity measured service. The cloud architecture is a layered architecture and consists of 3 layers IaaS, PaaS and Saas. SaaS provides web based applications that are handled by a third party. These applications can be accessed through an interface on the client side. The applications need not be downloaded and can directly in a web browser, however some applications might require plugins. Cloud platform services, Platform as a Service (PaaS), are used for applications and code development. An integrated development environment is provided to the user through which the user can develop and test applications. Cloud Infrastructure as a Service, provides virtualized computing resources over the internet. Instead of purchasing the required hardware, the users can use the IaaS based upon consumption and requirements. The VCL is a type of IaaS, providing self service models for accessing, monitoring and managing compute and network environment [2].
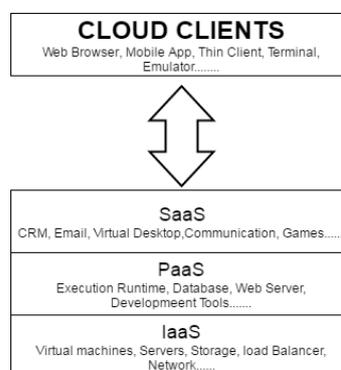


Figure1: Cloud Layered Architecture [3]

VCL is a free, open source cloud computing platform with the aim to provide dedicated compute environments to the user through VM. These compute environments can vary from a VM running particular software to a VM running complex High Performance Computing task on various high powered servers. It provides provisions to develop several different types of computing environment that we usually find in the college campus. A web-portal provides a self service interface to the user. From this portal the user can select the environment he/she wishes to work upon. The scheduling component then determines which resource to be

allocated to the request received. The compute environment is then provisioned, dynamically configured and secured to allow remote access to the user. Depending upon the user demand the computing resources can be scaled up or scaled down. The user connects to the compute environment at the server through SSH or any other supported protocols through its machine [4]. Thus the VCL developed helps students and faculty in meeting educational objectives by providing maximum availability and flexibility, via a web based virtual computing interface [5].

## II. Literature Review

The applications of cloud computing and virtualization is adopted by many sectors of business and industry and now is started to being embraced by the education sector. Cloud computing presents many advantages to e-learning by providing the infrastructure, platform and educational services directly through internet network and virtualization. VCL as a solution is used at many educational institution some of them are as follows

**Virginia VCL**: With cloud computing technology the VCL enhanced at Virginia. It provides students with access to the architectural, geographical, mathematical, research, statistical applications at any time any location with an Internet broadband connection. Virginia clearly demonstrates how VCL can be used to save and maximize the computing resources [6].

**VCL by North Carolina State University:** North Carolina State University with the support from IBM started the VCL in 2002. Later it became freely available Apache open source project. Now similar educational clouds based on the VCL are developed in California, Gerogia and South Carolina [7].

**VCL by IIT Kharagpur :** The Ministry of HRD, Gov of India started the Virtual Labs here. It is implemented under the National Mission on Education through Information and Communication Technology. The primary aim is to provide the users remote access to laboratories in various fields of engineering and science at all levels [8].

**VCL by Desktone:** Desktone is University of Maryland, Baltimore County's VCL environment. Desktone provides access to virtual lab computers with all of the computational environment and software usually available in the computer labs on campus. The Desktone virtual lab is available on  https://virtual.vdi.umbc.edu/ and can be accessed through the web portal [9].

**VCL by George Mason University**: Apache VCL, general purpose computing laboratory, similar labs implemented at other Virginia state universities.

**VCL by University of Alaska- Fairbanks:** VMware ESX and lab manager provides specialized labs for information assurance courses.[10]

## III. Existing System

The current system is plagued with many problems the lab assistants have to manage and load software on each machine individually, the issue of pen drives and virus along with it affects the machine adversely, also for loading a new software which have high computational requirements we have to buy new infrastructure as the existing one does not support it, all these problem can be solved by developing a VCL using Eucalyptus Private cloud within the college premises.

## IV. Proposed System

The existing systems providing VCL service are deployed over the internet and are geographically distributed in nature; these systems can only be accessed through the World Wide Web. Whereas, the system proposed in our project is to build a private cloud, deployed on the intranet of our college. The cloud will be built on a high end machine in the college having high processing speed, this will enable the user to access the resources and the applications on the cloud. The cloud will be accessible only through a machine in the college intranet and not via World Wide Web. The instances which a user can run will be independent to the volume (storage) provided to the user. Every user will have his/her own storage space which can be attached to a instance that is launched by the user. The cloud administrator will constantly monitor the load on the Node Controller (NC). The NC will automatically create and terminate instance as the user request for the same. An integrated virtual environment will be provide for the user through the private cloud developed at the remote desktop making them reap the benefits of VCL and a private cloud.

**Features of VCL:**
1. Every student and staff of college will have their own storage space (volume) in cloud so that they can store their data and access it later.
2. The student's final year projects can also be stored on this cloud by creating the environment required of each project using Virtual Machine (VM) to avail reference for future projects.
3. Students will be able to launch VM instances based on various practical experiments listed in the curriculum in the private cloud environment.
4. The use of pen drive by student can be restricted as it cannot be detected by the VM. If a virus gets downloaded within VM, then on closing the VM the virus will be erased along with the content of VM, thus not affecting the machine.
5. Each VM instance will have limited internet bandwidth, preventing any misuse [11].

## V. Methodology

Using EUCALYPTUS – an open source software framework for cloud computing which we can develop a VCL. Eucalyptus consists with four major elements: Cloud Controller, Cluster Controller, Node Controller and the Walrus. The node controller manages the inspection, execution, and termination of VM instances on the particular host where it runs. Nodecontroller is accountable for the virtual machine instance. When the user requests for the particular virtual machine image, the node controller starts and runs the required virtual machine image. All the information gathering and scheduling of virtual machine execution on specific node controllers is handled by the cluster controller. It also manages the virtual instance framework that run within the cloud environment
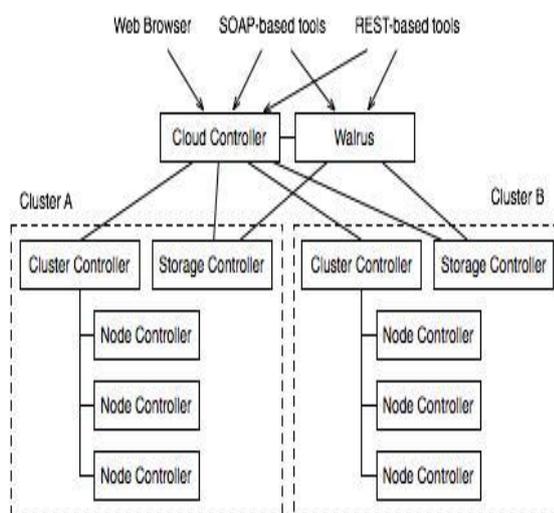


Fig2: Eucalyptus Architecture [12]

Walrus is a storage service that has support for third party interface. Walrus provides the mechanism to store and access the virtual machine instances and user data. The cloud users and administrators can enter the cloud only through the cloud controller, it serves as a entry point. It queries node managers for information about resources, makes high level scheduling decisions, and implements them by making requests to cluster controller. Cluster Controller then makes queries through the Node Controllers to implement the Cloud Controller requests. The users communicate with the Cloud Controller via the web interface using SOAP or REST messages. Cloud Controller transfers the requests from the user to the Cluster Controller. A Cloud Controller can possess multiple cluster controllers and one specific cluster controller can have several node controllers [13].

**Steps to setup a private cloud:**
1. Configure the interfaces on the Cloud Controller.
2. Restart the Network Services on the Cloud Controller.
3. Install the Hypervisor (KVM OR XEN).
4. Create a Virtual Hard Drive.
5. Install preferably a Server Operating System on that VM.
6. Configure the interfaces on the Node Controller.
7. Restart the Network Services on the Node Controller.

8. Install and update respective Eucalyptus Services on both the Controllers.
9. Synchronize the Cloud and the Node Controllers.
10. Disable the Firewalls.
11. Bridge the Connectivity Ports.
12. Check status for each component (both on CC and NC).
13. Register Services on the Cloud Controller.
14. Download Credentials from the Localhost on the Cloud.
15. Alter the Virtualized Component Specifications.
16. Bundle the VM Images.
17. Launch the VM Instances.
18. SSH command is used to provide security.
19. To run and manage the resources use hybrid firefox.
20. Check for EKI, ERI, and EMI files on hybrid firefox.

After all the above steps are implemented, we have to download credentials on the node and access the VM [14].

## VI.    Conclusion And Future Scope

The cloud computing concept is based upon virtualization, distributed computing, utility computing. Recently technologies like web, software services and networking are also utilized. This paper deals with the concept of cloud computing and the issues it tries to address in the education sector through a VCL. Cloud based VCL has many benefits like better hardware management as it uses the existing resources. Data security management and rapid configuration and launching of VM instances are possible. Demand and reservation based instance allocation is possible in VCL using private cloud. The load on lab assistants is also reduced, as he has to set the instances only once on the server, also there is no risk of virus affecting the systems in the lab. The system scalability is one of the main challenges in this system. It is very difficult to create multiple VM without increasing the storage capacity of the cloud server. The cloud based VCL has still not been used to its full potential, in future some of the following points can be implemented to enhance the above work.

☐   Developing a public cloud for the college/university for the same and making it accessible at homes.
☐   Increasing the load handling capacity of the VCL by increasing the number of server and also increasing the storage capacity for the users.
☐   The number of VM implemented can be increased.
☐   The cloud based system can be accessed through mobile phones.

With an increase in the number of user's, domain specific services, educational requirements, the approach described above can serve as a model for developing a scalable and reliable infrastructure.

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