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An Investigation Into Providing Educational Resources Over a Cloud Service Using The Openstack and Eyeos Platforms

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Abstract—The purpose of this research is to elucidate on cloud as a service in providing feasible educational cloud resources. The research focuses on the benefits derived in the use of cloud in the educational sector and the challenges in its implementation.

Keywords—*Cloud, Operating System,Virtualization, Eyeos, Openstack*

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I. INTRODUCTION

In today's technology-driven world, an organization and country can only be as agile as its Information Technology environment.

Cloud computing is Internet-based computing, whereby shared resources, software, and information are provided to computers and other devices on demand.The term "cloud" is used as a metaphor for the Internet.

Cloud computing is the delivery of computer resource through a web service interface (example SOAP or REST) on an as-needed basis. The term "cloud" refers to the organization of the underlying physical infrastructure remaining opaque to the end user[7].

II. RESEARCHOBJECTIVES

This research is aimed at breaching the gab between well-endowed schools and deprived ones and bringing educational resources to the door step of all in the Ghanaian educational first and Second Cycle institutions. The research achieves the following:

- Investigate the benefits and challenges in implementing cloud service in the educational sector.

- Study the technologies being used to provide cloud services

- How to provide educational resource using a cloud service.

III. BACKGROUND TO THE STUDY

Cloud computing has evolved through a number of phases which include grid and utility computing, application service provision (ASP), and Software as a Service (SaaS) [13].

One of the first milestones for cloud computing was the arrival of Salesforce.com in 1999.

The next development was Amazon Web Services in 2002.

Then in 2006, Amazon launched its Elastic Compute cloud (EC2) as a commercial web service [13].

"The most important contribution to cloud computing has been the emergence of 'killer apps' from leading technology giants such as Microsoft and Google.

Other key factors that have enabled cloud computing to evolve include the maturing of virtualization technology, the development of universal high-speed bandwidth, and universal software interoperability standards, said UK cloud computing pioneer Jamie Turner.This isthe current trend of cloud computing.

IV.SCOPE OF STUDY

One of the major goals of government is to educate the youth with or in ICT since we are in an information driven and digital-image cultural era. This has made the government put more resources in building computer laboratories especially in

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the deprived schools to breach the ICT gap. Thisresearch will focus on how to bring the educational resources advantage to the door step of the Ghanaian community.
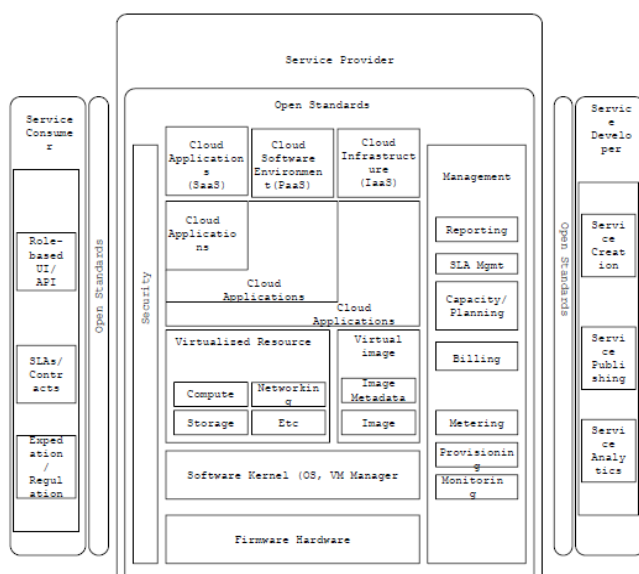
V. Cloud Computing

Most people have come to the place of understanding that cloud is a metaphor for internet as described by [23]. Any application that resides on the internet and uses the word internet is now changing the word internet to cloud.

According to the NIST (National Institute of Standards and Technology) Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.

Cloud computing is the delivery of computer resources through a web service interface on as-needed basis.

Based on the above definitions, some key points in the definitions were derived.

- It resides on a network (that is either a public network or private network or even a combination of both also called a hybrid).
- A shared pool of resources (be it servers, network, application, information, service).
- It must meet the needs or demand of its users.

From this point one can clearly draw out the line by saying cloud computing goes a step further than a web application although it uses a web service interface; it houses a pool of resources and provides them on need basis or on demand.

VI. Evolution Of Cloud Computing

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The next development was Amazon Web Services in 2002.Then in 2006, Amazon launched its Elastic Compute cloud (EC2) as a commercial web service[13].

"The most important contribution to cloud computing has been the emergence of "killer apps" from leading technology giants such as Microsoft and Google. When these companies deliver services in a way that is reliable and easy to consume, the knock-on effect to the industry as a whole is a wider general acceptance of online services," said Dan Germain, chief technology officer at IT service provider Cobweb Solutions.

VII. Taxonomy Of Cloud Computing

A. Service Consumers

Service Consumers use the services provided through the cloud. Service Level Agreement (SLA) is contracted between a provider and a consumer that specifies consumer requirements and the provider's commitment to them. Typically an SLA includes items such as uptime, privacy, security and backup procedures.

B. Service Developers

Service developers create the services on the cloud. They make resources available on demand. They provided Cloud as a network, as a service, as a storage, and as an infrastructure

C. Service Provider

Service Providers manage the cloud infrastructure. In the service provider portion of fig 1.0, the lowest layer of the stack is the firmware and hardware on which everything else is based. Above that is the software kernel, either the operating system or virtual machine manager that hosts the infrastructure beneath the cloud. Virtual Machine (VM) is file (typically called an image) that, when executed, looks to the user like an actual machine. Infrastructure as a Service is often provided as a VM image that can be started or stopped as needed. Changes made to the VM while it is running can be stored to disk to make them persistent. The virtualized resources and images include the basic cloud computing services such as processing power, storage and middleware. Thevirtual images controlled by the VM manager include both the images themselves and the metadata required to manage them.

D. Delivery Models

1)Software as a Service (SaaS): The consumer uses an application, but does not control the operating system, hardware or network infrastructure on which it's running. SaaS provides network accessible access to Software application programs [7].

2)Platform as a Service (PaaS): The consumer uses a hosting environment for their applications. The consumer controls the applications that run in the environment (and possibly has some control over the hosting environment), but does not control the operating system, hardware or network infrastructure on which they are running. The platform is typically an application framework.PaaS provides network accessible access to a programming or runtime environment with scalable compute and data structures embedded in it [7].

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3)Infrastructure as a Service (IaaS): The consumer uses "fundamental computing resources" such as processing power, storage, networking components or middleware. The consumer cancontrol the operating system, storage, deployed applications and possibly networking.IaaS provides access to virtualized computer Hardware resources, including machines, network resources, and storage [7].

E. Deployment Models

1)Public Cloud: In simple terms, public cloud services are characterized as being available to clients from a third party service provider via the Internet [11].

2)Private Cloud: A private cloud offers many of the benefits of a public cloud computing environment, such as being elastic and service based. The difference between a private cloud and a public cloud is that in a private cloud-based service, data and processes are managed within the organization without the restrictions of network bandwidth, security exposures and legal requirements that using public cloud services might entail. In addition, private cloud services offer the provider and the user greater control of the cloud infrastructure, improving security and resiliency because user access and the networks used are restricted and designated.

3)Hybrid Cloud: The cloud infrastructure is a composition of two or more clouds (private and public) that remain unique entities, but are bound together by standardized technology. This enables data and application portability. With a hybrid cloud, an organization gets the best of both worlds, gaining the ability to burst into the public cloud when needed while maintaining critical assets on-premise [22].

4)Community Cloud: According to VMWARE in a community cloud the cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns (for example, mission, security requirements, policy, and compliance considerations). It may be managed by the organizations or a third party and may exist on-premise or off-premise.

F.Resource Pooling

Resource pooling allows a cloud provider to serve its consumers via a multi-tenant model. Physical and virtual resources are assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specifylocation at a higher level of abstraction (e.g. country, state, or datacenter).

VIII. Opportunities And Challenges In Implementing
Cloud Computing

To every coin there are two sides so it is with cloud computing, there exist the opportunity or advantages and the disadvantage or challenge facing this technology. In the sub chapters we will discuss the various challenges and opportunity in cloud computing and narrow these to education.

A. Challenges in Cloud Computing

1)Security: The good news is that the very nature of the cloud may be compelling more real thought about security – on every level – than before. The bad news is that a poorly written application can be just as insecure in the cloud, maybe even more so.Cloud architectures do not automatically grant security compliance for the end-user data or apps on them, and so apps written for the cloud always have to be secure on their own terms.

2)Network Bandwidth: Since the cloud service run on a network it needs good bandwidth to execute. If the internet is slow it is very difficult to implement cloud. Just like eyeOS is a cloud operating system which has all the features of an ordinary operating system. It allows users to upload and download files and directories. This feature can be achieved and enjoyed with a high speed network but with a low speed network this becomes a headache since even the page might not even load.

3)Client Incomprehension: There are all too many misunderstandings about how public and private clouds (or conventional datacenters and cloud infrastructures) do and do not work together. Again there is misunderstandings about how easy it is to move from one kind of infrastructure to another, howvirtualization and cloud computing do and donot overlap, and so on.A good way to combat this is to present customers with real-world examples of what is possible and why, so they can base their understanding on actual work that has been done and not just hypothetical where they are left to fill in the blanks themselves.

4)Data Loss or Leakage: There are many ways to compromise data. Deletion or alteration of records without a backup of the original content is an obvious example. Unlinking a record from a larger context may render it unrecoverable, as can storage on unreliable media. Loss of an encoding key may result in effective destruction. Finally, unauthorized parties must be prevented from gaining access to sensitive data.

B. Advantages of Cloud Computing

1)Compatible platforms and API: Since cloud applications run on a network and mostly in a web format it only needs a browser to operate. Every operating system has a browser by default thereby making it compatible with all platforms (from Linux to Windows to MAC).

2)Low Cost: In terms of cost, cloud computing has the tendency to reduce cost in development, deployment, and management. One application or service provided by a cloud can be access by all, reducing the cost of licensing an application for all the users in an organization or installation to all the computers within the organization.

3)Elasticity: Elastic nature of the infrastructure to rapidly allocate and de-allocate massively scalable resources to business services on a demand basis. When workload increases most servers become slow but cloud computing rapidly allocate resources need to make the processing fast and de-allocate when the resources are no longer needed.

4)Self-service: In a cloud setup, the end user directly selects the computer resources desired through a self-service Web interface. This gives the user direct control over computer resourcedeployment and configuration, and it helps assure that the user's needs are more closely met. Self-service also frees the user from waiting in long IT service queues, and can thus enhance the productivity of the enterprise workforce[7].

5)Pool of resources: Cloud computing is characterized by a pool of resource. These resources can be application, server, storage, information and etc. Storage is one of the key resources provided by a cloud computing service which make it more unique than all other technologies.

IX. OPPORTUNITIES AND CHALLENGES IN IMPLEMENTING CLOUD COMPUTING AS A SERVICE IN THE EDUCATIONAL SECTOR

The implementation of cloud computing in the business world has yielded many uncountable result and thereby making businesses who adopt it more agile. The question that linger in the mind of educationalist is that can this also be implemented in the educational sector and so as to also enjoy the benefit of cloud computing? The following outline the pros oropportunities and the cons or challenges in implementing cloud computing in the education sector of Ghana.

A. Challenges

1) High speed internet or network: One of the key ingredients in cloud computing is a network. This should not just be a network but a high speed or high bandwidth network or internet. However most deprived schools in Ghana don't have internet service and those that even have it don't have a high bandwidth.

2)Security: One of the greatest challenge of cloud computing is security. Will our data or information be safe on the cloud? Cloud computing leaves the security to the application level so therefore if an application is not developed with high security most of our information or data can be compromised.

B. Opportunities

1)Cost: The cost of purchasing software and server and books for all schools cannot be overestimated since each year run license has to be renew, new books have to be brought to replace the tattered books and old books. and accessed from other location. Software can be bought and hosted on the cloud and all the school can access it, example one school management system can be access by all schools or one online library can be access by all schools in Ghana.

2)Pool of resources: Cloud computing houses a pool of resources such as storage, information, servers and more. This storage can be used for backing up information of the national, regional, and district education offices. We can also store e-books, tutorial video, power point which student can access from any location in Ghana.

3)Accessibility: Since cloud service are provided over a network and is accessible by a browser all types of devices which have browsers can access this service. From smaller devices such as mobile phone, PDA, tablets to laptops/notebooks and desktops can all access the services. This makes it possible for educational resources go be put on the phone being producedthese days which have browser service.

4)High Availability: Cloud computing does not have time to close and time to resume like an everyday worker. Cloud computing services run 24 hours 7 days a week.

X. PROPOSED ARCHITECTURE

After carefully evaluating the various open source cloud architectures some similarity were drawn out. These similarities are listed below.

- User, administrators, and developers
- The entry point into the cloud.
- Network
- A volume
- image store
- Hypervisor
- Virtual image instance
- A database

These components can be either one or more depending on its functionality to the cloud. The image store can be external or internal and if external an API is needed to get the image and a database to store details of the image.
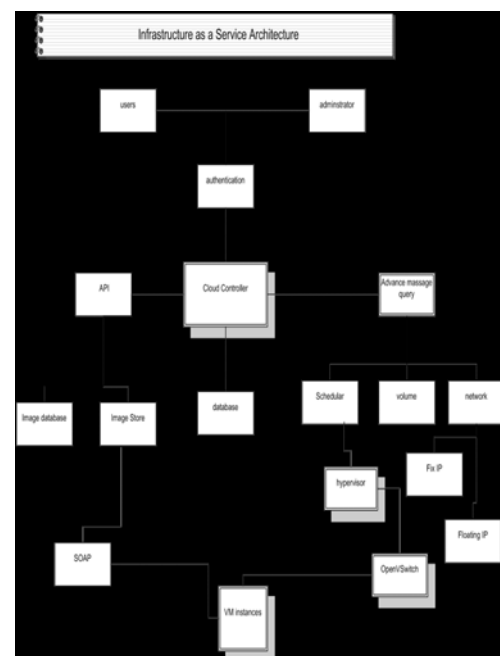

Fig 2.0 Proposed Architecture for Infrastructure asa service

- Authentication
- A cloud controller/ management

Educational Resources

EyeOS

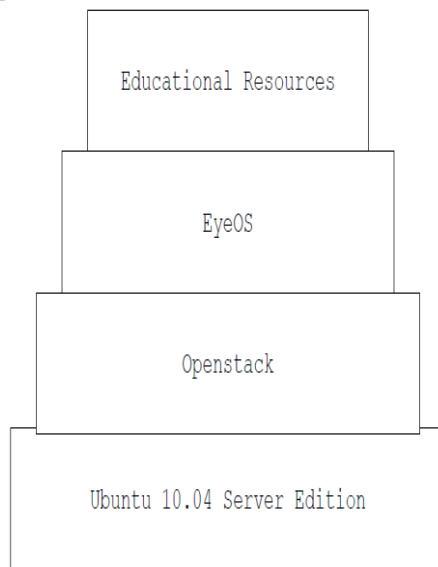Openstack

Ubuntu 10.04 Server Edition

Fig 2.0 Implementation overview

Users and Administrators interact with the cloud infrastructure.

The Cloud controller is the pivot of the cloud infrastructure. It has four basic components that are AdvancedMessage Query, API, Authentication, and Database. It is responsible for querying information about resources, making high level scheduling decisions, and implementing them via an advanced message query.

Authentication is an interface that acts as the entry point into the cloud. OpenNebula calls it Sunstone. It serves as an assurance that a communicating entity is what it claims to be. Out of this it would determine which type of user has privilege; be it the administrator or user. The authentication is accessed by an http request.

Since this architecture has an external image store there is a need for an API to communicate with the image store. The details of an image are stored in a database which can be accessed by both users and administrator.

Advanced message query enable quarries to be sent to the scheduler, volume and the network. We would use the RabbitMQ.

It comprises of two databases or persistent storage; one which works with the cloud controller and keeps record of the state of resources within the cloud and the other that keeps the Metadata of images in the image store.

The scheduler take a virtual machine instance request from the queue and determines which resource it should allocate to it as well as where it should run.

The volume is a detachable block storage device that is usuallyiSCSI (internet Small Computer System Interface).

Network part can have a fix IP or floating IP. These IP are allocated to an instance on creation. The fix IP stay the same until the Virtual Instances are explicitly terminated but the floated IPs can be dynamically disassociated and associated to other instances. The network can be Flat network.

Flat network is the simplest networking mode. Each instance receives a fixed IP from the pool. All instances are attached to the same bridge (br100) by default. The bridge must be configured manually. The networking configuration is injected into the instance before it is booted.

Hypervisor manages virtual instances.

OpenVSwitch allows a switch between Virtual Instances within the Hypervisor.

Virtual Instance is a word for a virtual machine that runs inside the cloud. The virtual machine accesses it image from the image store over a SOAP or REST API.

XI. IMPLEMENTATION

This section focuses on how to implement educational resource over a cloud as a service. It involves three basic segments. Namely:

• The installation of Ubuntu 10.04 server edition.

• The installation of OpenStack

• The installation of eyeOS.

• Integration of educational resource

Each segment is crucial to the mounting of Elastic Cloud service. Openstack services as an infrastructure as a service which paves the way for the eyeOS to be mounted as a Cloud Operating system.Openstack allows the management of the physical resources such as processing power and storagewhiles eyeOS services as a platform houses and run the educational resources. Refer to fig. 3.0.

A. Installation Ubuntu 10.04 Server Edition

First download the server version of Ubuntu 10.04. After that create a CD and start booting with the CD. Follow the Ubuntu installation instructions and install Ubuntu server

B. Installation of openStack

First, set up pre-requisites to use the Nova PPA(Personal Packages Archive) provided through http://launchpad.net/~nova-core/+archive/trunk. The 'python-software-properties' package is a pre-requisite for setting up the nova package repository.

sudo apt-get install python-software-properties

sudo add-apt-repository ppa:nova-core/trunk

Run update with sudo apt-get update.

Install the messaging queue server, RabbitMQ.

sudo apt-get install -y rabbitmq-server

Now, install the Python dependencies.

sudo apt-get install -y python-greenlet python-mysqldb

Install the required nova- packages, and dependencies should be automatically installed.

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sudo apt-get install -y nova-common nova-doc python-nova nova-api nova-network nova-objectstore nova-scheduler nova-compute

Install the supplemental tools such as euca2ools and unzip.

sudo apt-get install -y euca2ools unzip

C. Setting up the SQL Database (MySQL) on the Cloud Controller

You must use a SQLAlchemy-compatible database, such as mySQL or PostgreSQL. This example shows mySQL.First you can set environments with a "pre-seed" line to bypass all the installation prompts, running this as root:

bash

MYSQL_PASS=nova

cat<<MYSQL_PRESEED | debconf-set-selections

mysql-server-5.1mysql-server/root_password   password $MYSQL_PASS

mysql-server-5.1mysql-server/root_password_again   password $MYSQL_PASS

mysql-server-5.1mysql-server/start_on_bootboolean true

MYSQL_PRESEED

Next, install MySQL with: sudo apt-get install -y mysql-server

Edit /etc/mysql/my.cnf to change 'bind-address' from localhost (127.0.0.1) to any (0.0.0.0) and restart the mysql service:

sudosed -i 's/127.0.0.1/0.0.0.0/g' /etc/mysql/my.cnf

sudo service mysql restart

To configure the MySQL database, create the nova database:

sudomysql -uroot -p$MYSQL_PASS -e 'CREATE DATABASE nova;'

Update the DB to include user 'root'@'%' with super user privileges:

sudomysql -uroot -p$MYSQL_PASS -e "GRANT ALL PRIVILEGES ON *.* TO 'root'@'%' WITH GRANT OPTION;"

Set mySQL root password:

sudomysql -uroot -p$MYSQL_PASS -e "SET PASSWORD FOR 'root'@'%' =PASSWORD('$MYSQL_PASS');"

D. Installing the Compute Node

Install all the nova- packages and dependencies as you did for the Cloud Controller node. On this node, you must have nova-network installed and configured.

The Compute Node is where you configure the Compute network, the networking between your instances. There are three options: flat, flatDHCP, and VLAN.

If you use FlatManager as your network manager, there are some additional networking changes to ensure connectivity between your nodes and VMs. If you chose VlanManager or FlatDHCP, you may skip this section because they are set up for you automatically.

Compute defaults to a bridge device named 'br100'. This needs to be created and somehow integrated into your network. To keep things as simple as possible, have all the VM guests on the same network as the VM hosts (the compute nodes). To do so, set the compute node's external IP address to be on the bridge and add eth0 to that bridge. To do this, edit your network interfaces configuration to look like the following example:

The loopback network interface

auto lo

iface lo inet loopback

Networking for OpenStack Compute

auto br100

iface br100 inetdhcp

bridge_ports eth0

bridge_stp off

bridge_maxwait 0

bridge_fd 0

<end /etc/network/interfaces >

Next, restart networking to apply the changes: sudo /etc/init.d/networking restart

Restart All Relevant Services on the Compute Node

On both nodes, restart all six services in total, just to cover the entire spectrum:

• libvirtd restart;

• restart nova-network;

• restart nova-compute;

• restart nova-api;

• restart nova-objectstore;

• restart nova-scheduler

E. Installation of eyeOS

Step 1.

sudo vi /etc/apt/source.list

Navigate to the end of the file and click on the "I" to insert

Add the following statements:

deb http://archive.canonical.com/ lucid partner

deb http://security.ubuntu.com/ubuntu hardy-security main multiverse

After append the statement click on the "ESC" key and executing the following command to exit the vi editor

:wq "

Step 2.

Execute the following command

sudo apt-get update

Step 3.

Execute this code to install the following application

sudo apt-get install sun-java6-jre

sudo apt-get install openoffice.org zip unzip

sudo apt-get install python-support python-simplejsonrecoll

sudo apt-get install libimage-exiftool-perl

sudo apt-get install mysql-server phpmyadmin php5-imap php5-sqlite php5-gd php5-curl php5-mysql xvfb subversion

Step 4.

After installing MySQL we need to configure it for eyeOS to use it

mysql –u root –p

Enter the password you enter during the installation of mysql and create a new database named "eyeos":

CREATE DATABASE eyeos;

Now flush the privileges by executing the following command:

FLUSH PRIVILEGE;

Exit the MySQL command line and proceed with the next step:

QUIT;

Edit the MySQL config file by executing the following command:

sudo vi /etc/mysql/my.cnf

Locate the bind address line and change it to:

BIND ADRESS = 0.0.0.0

Save the file and proceed with the next step using the command:

:wq

Step 5. Configuring the mod-rewrite on Apache

Execute:

sudo a2enmod rewrite

Now edit the configuration file by executing the following command:

sudo vi /etc/apache2/sites-available/default

Change the following line in this configuration file:

<Directory /var/www/> the variable AllowOverride to ALL

Save and quit vi by using the command:

:wq

Restart apache

sudo /etc/init.d/apache2 restart

Step 6. Configuring the "php.ini" file

For the web installer to run properly you will need to allocate at least 128 MB of memory to the PHP process. Edit the php.ini file by executing the following command.

Execute:

sudo vi /etc/php5/apache2/php.ini

Search and modify the following lines:

memory_limit=128MB

display_errors=Off

post max size=200M

upload_max_filesize =100M

After that save the file.

Step 7 Download and install Stompy

Now download stompy.py by executing the following command:

sudowgethttp://stomppy.googlecode.com/files/stomp.py_3.0.2_all.deb

Execute the command:

sudodpkg –i stomp.py_3.0.2_all.deb

Step 8

Create a directory kaazing by executing this command

sudomkdir /usr/share/kaazing/

Navigate to the kaazing directory by executing the command:

cd /usr/share/kaazing/

Download kaazing-gateway-demos-8.12_2-bin.tar.gz

sudowget

http://kaazingcorp.cachefly.net/org/download/kaazing-gateway-demos-8.12_2-bin.tar.gz

Extract the kaazing-gateway-demos-8.12_2-bin.tar.gz by executing the following command:

sudo tar –xzf kaazing-gateway-demos-8.12_2-bin.tar.gz

Step 9 Download and install the Apache ActiveMQ Daemon

Create a directory for our ActiveMQ Daemon by executing the command

sudomkdir /usr/share/php5/apachemq/

Navigate to the new folder by executing

cd /usr/share/php5/apachemq/

Download ActiveMQ with the following command

sudowget

http://apache.x1-mirror.n1//active-activemq/5.4.1/apache-activemq-5.4.1.-bin.tar.gz

Now extract this tar file with the following command:

sudo tar –xzf apache-activemq-5.4.1-bin.tar.gz

In order to load the Apache ActiveMQ daemon, the Kaazing Gateway and OpenOffice Daemon at boot.Edit the rc.local file by executing the following command:

Edit the file so it will look like this:

```
sudo vi /etc/rc.local

#!/bin/sh -e

#

# rc.local

#

# This script is executed at the end of each multiuser runlevel.

# Make sure that the script will "exit 0" on success or any other

# value on error.

# In order to enable or disable this script just change the execution

# bits.

#

# By default this script does nothing.
```

sudosoffice "-accept=socket,host=localhost,port=2002;urp;" -headless &

sudo   /usr/share/php5/apachemq/apache-activemq-5.4.1/bin/activemq start &

sudo   /usr/share/kaazing/kaazing-gateway-8.12_2/bin/gateway.start&

exit 0

E. Download and Install eyeOS

First create a directory:

sudomkdir /var/www/apache2-default/

Secondly navigate to:

cd /var/www/apache2-default/

Thirdly download eyeOS

sudowget sourceforge.net/project/eyeos/eyeos/1.9.0.1/eyeOS_1.9.0.1.z

Fourth unzip this file with following command:

sudo unzip eyeOS_1.9.0.1.zip

Fifth give the folder the right permissions with the following command:

sudochmod 777 -R /var/www/apache2-default/eyeOS

XII. MAJOR EDUCATIONAL RESOURCES THAT HAS BEEN INTEGRATED INTO EYEOS

A. Word Processor

The Word Processor is other application on the cloud would allow a student to be able to design word document just like Microsoft word in Windows and openOffice in Linux. One can save a word document in either ".doc"or "odt" which can be downloaded and view in Windows and Linux respectively. Although these are possible it has its own format in which document can be saved and this is ".eyedoc". Also one can change front size and front family as well as the align text and indent. One can search for a word and also replace that word with a different word.

B. eyeShow

eyeShow is a power point design that is used for presentation. There is an insert button that allows you to insert text into the slide and the image button allows you to insert images into the slide. One can add as many slide as he or she desire. One can order a list in a bullet. A text can be format in different font size and font family. One can also make a text bold a text, make it italic and underline the text. Above all the following one can code the document in html with the use of div and inline css.

C. eyePlot

eyePlot is geometric application. The user states a function of x and based on the function a graph is drawn to represent the function.

D. Calculator

This is a scientific calculator just like casio calculator but with an extra feature for conventions and some basic constants.

E. eyeWIRIS

eyeWiris is a mathematic tool. It covers division, squares, square root, summation, product, simultaneous equation, limit, differentiation, Integral, matrix, geometry, and basic programming.

F. Zoho Sheet Processor

Sheet is the spreadsheet application in the suite. Zoho Sheet can auto-process external data feeds (RSS/ATOM) and has the ability to publish charts.

G. Internal Messaging

Internal Messaging allows user on the cloud to send each other memo and email as well receiving emails.

H. Uploading data into the cloud

Selecting'Upload your files' from the eyeOS desktop allow users to upload their documents into the cloud.

I. Pdf Creator

Pdf creator as the name is so is it. It is used to create a pdf file. One needs to click on the "open" and navigate to the

file. Once the file has been selected, click on "save as" to convert it into a pdf file.

J. Pdf Reader

Pdf Reader is model that allows you to search a pdf file and read it. One can save, zoom, and print. It exhibits the same features like the browser pdf reader.

XIII. CONCLUSION ANDFURTHER STUDIES

The main problem faced whiles installing the eyeOS is the installation of sun-java6-jre. Many options were reviewed but the easiest was to introduce the "deb http://security.ubuntu.com/ubuntu hardy-security main multiverse" to "source.list" file. By doing this, the debian repository enforce a secured thorough search for sun-java6-jre. Also the eyeOS package in the official documentation could not be extracted thereby proposing new path to a package that can be downloaded and extracted easily.

By using eyeOS as development environment to house all the educational based application, the operating system brought to fore the front classes and libraries that could aid asynchronous communications, multitasking and weak mobility.

In conclusion, there are two basic parts of providing educational resources over a cloud as a service. Namely:

- Build a full based cloud application using JavaScript, php, xml, Ajax and Xhtml.

- Building a normal web application and integrate into the cloud.

Ghana educational service can adopt eyeOS platform as service and openstack as the infrastructure as a service to provide educational resource to the less endowed schools in Ghana. Other resources such as e-library, and school management systems can also be integrated to upgrade the current resources that are available.

Students should be motivated to enter into developing eyeOS package since it is a new platform and carries the weight in making both code and data mobility a reality.

Areas for further studies are Security issues in eyeOS, Security Challenges in cloud computing, Improving transparency using eyeOS as a tool.

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