

Enhancing Datacenters with Eucalyptus Cloud

Annapurna, K Venkateswara Chowdary, Y Sathyanarayana Murty

Abstract— The main challenge of the datacenter is the utilization of resources efficiently and provide the service to the organizations. This can be achieved by building PaaS (Platform-as-a-Service) cloud. Our idea is to empower the IT team to respond quickly to changing needs and to provide computing resources and servers when ever required. Private PaaS allows datacenter to retain control of security and performance characteristics while providing their developers with an agile environment for solution delivery. This paper discusses how PaaS closes the gap between design and the Implementation phases in SDLC. We have also decoupled the application and storage from application platform (Hardware, Operating System, Web Servers etc..) where user's data or applications are stored in volumes. The use of volumes adds advantage to PaaS. This paper discusses how in PaaS the responsibility of managing, and monitoring foundation layer is transferred from individual application developers to the PaaS platform, enabling to focus on building applications. We present a frame work for developing PaaS in cloud environment and various stages of environmental setup.

Keywords- Cloud, EC2, Eucalyptus, IaaS, PaaS, Volumes.

I. INTRODUCTION

Current trends in datacenters show a shift from physical, dedicated IT managed infrastructure to a private cloud. From a software development perspective, the most interesting category of cloud computing today is PaaS. PaaS provides a complete abstraction all the way up to development environments, including the middleware components, totally minimizing the IT operations involvement. The responsibility of managing, monitoring and dynamic resource scaling is transferred from individual application developers to the PaaS platform, enabling to focus on building applications.

In addition the PaaS model offers the flexibility to build and deploy standard sets of shared components, so all applications are deployed with a consistent software stack.

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IaaS (Infrastructure-as-a-Service) is usually seen to provide a standardized virtual server The user takes responsibility for configuration and operations of the guest Operating System (OS) , software, and Database (DB) [3]. PaaS provides platform standardized giving developer's agility of what they want in standard platform. When this is given in self service then more concentration can be put on development. In this paper a frame work for developing Platform as a Service is given. Open source cloud computing tool "Eucalyptus" is taken and proposed solution to create PaaS environment is applied. Eucalyptus is successfully implemented in our datacenter with IaaS and now as proposed in this paper it is upgraded to provide PaaS environment with the availability of volumes for persistence storage as supported by Eucalyptus.

Eucalyptus provides a command-line interface (CLI), called Euca2ools. The remainder of this paper uses Euca2ools. These tools conform to the command-line tools that Amazon distributes as part of their EC2 service (EC2 tools) [4]. This set of tools was written in python.

The remainder of the paper is organized as follows. Section II presents the Background. Section III presents the Platform as a Service (PaaS) in Datacenter. Section IV presents the Creating a PaaS Environment on Eucalyptus Cloud Experimental Setup. Section V presents the EBS Volumes in Eucalyptus Cloud. Section VI presents the Performance of PaaS and EBS Volumes. Section VII presents the Details of the Implementation in Progress. Section VIII presents the Future Work. Section IX Concludes.

II. BACKGROUND

A. Cloud Service Models

Cloud computing providers offer three basic services

Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS) Where IaaS is the most basic and each higher model abstracts from the details of the lower models as shown in Fig.1.

IaaS: Providers of IaaS offers computers-physical or (more often) virtual machines and other resources.

PaaS: In this model, cloud providers deliver a "computing platform", typically including operating system, programming language execution environment, database, and web server. Application developers can develop and run their software solutions on a cloud platform without the cost and complexity of

buying and managing the underlying hardware and software layers.

SaaS: Users are provided access to application software and databases. Cloud providers manage the infrastructure and platform that run the applications.

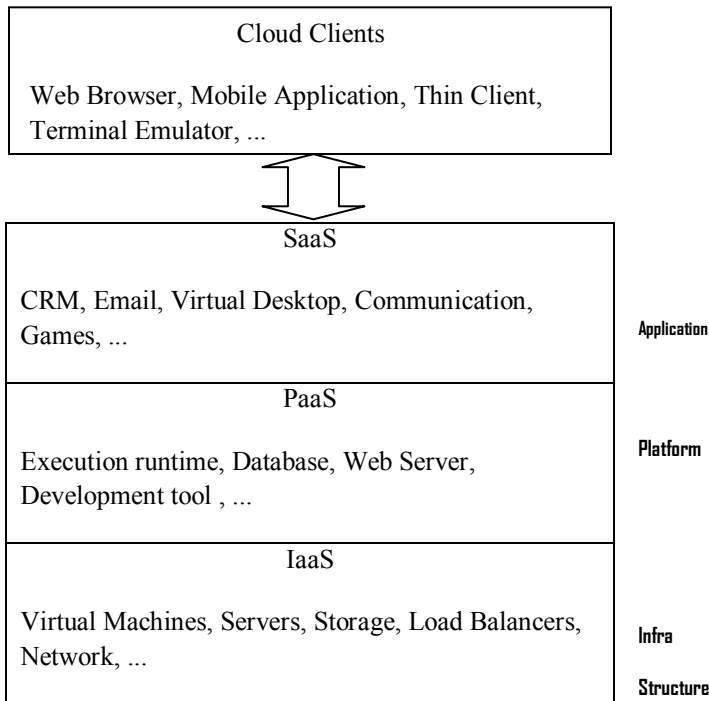


Figure 1: Cloud Service Models

B. Eucalyptus

Eucalyptus is a Linux-based software architecture that implements scalable private clouds within the existing IT infrastructure. Eucalyptus is also an acronym that stands for “Elastic Utility Computing Architecture for Linking Your Programs to Useful Systems (EUCALYPTUS) [1]. It is an open-source cloud-computing framework delivering the IaaS model. Eucalyptus maintains high fidelity with AWS APIs, which means that we can use or reuse any existing AWS compatible tools, images (AMI), Scripts to manage our own private cloud environment. We implement AWS APIs on top of Eucalyptus, in the cloud ecosystem that can communicate with AWS.

Eucalyptus cloud mainly has five high-levels of components i.e., Cloud Controller (CLC), Cluster Controller (CC), Storage Controller (SC), Node Controller

(NC) and Walrus [12]. Each component has its own functionality and usability in organizing a cloud.

III. PLATFORM AS A SERVICE (PAAS) IN DATACENTER

A. PaaS for Development Environment

Datacenters normally encounter different requests from different types of users. Some use datacenters for storage, some for hosting their applications, websites, whereas others use them as development platform. Each of them previews datacenters from a different angle. Building and running on premise application has always been complex, expensive and risky. Each application requires hardware, Operating system, database, middleware, web services and other software's. Once the stack is assembled, team of programmers has to navigate complex programming models like .NET, J2EE. A team of database system management experts are required to keep everything up and running. This is a traditional process whenever a new application is developed. So it generally happens that a team of programmers will stick to an environment for development as it is readily available with them. Whenever a change in application environment is required it requires lengthy development and redeployment cycle.

The applications which have been already deployed in datacenter also face version problem as they do not match with the latest version of platform deployed in datacenters. When the criteria are to upgrade the platform to the latest version so, either they have to be upgraded in latest platform or have to be removed. Up gradation to latest platform may not be always possible as the development team may not be available if it is very old application even though it is an in house development. Other way round the application if developed by an outside agency, upgrading is far from reach. In such case PaaS can easily provide both the versions of platform.

B. PaaS for Test Environment

A traditional test environment (staging server) usually is a scaled-down copy of the production environment. Setting up one such environment requires a lot of time and effort because the setup process includes tedious tasks such as procuring the right hardware infrastructure (including an app server, database server, web server, etc.) and installing

the required software (such as the application, database, testing tools, and monitoring tools if needed).

It is imperative to be able to test on private cloud before delivering the application and its data to a third party. The application can be tested on different versions of platforms as well on different operating systems if it is a cross platform application. In a traditional environment if the same has to be done, we have to setup a real time server again to test application.

IV. CREATING A PAAS ENVIRONMENT ON EUCALYPTUS CLOUD- EXPERIMENTAL SETUP

A. Experimental Setup

Eucalyptus 3.1.2 was installed in datacenter where IaaS is already operational. In addition to that one of the prebuilt images of centos (available at Eucalyptus site) was taken up. .(dot) img file was mounted on the loop device. One was installed with tomcat and other instance was mounted and installed with php. On demand from user, the user gets a virtual machine up with ready to use php-postgresql installed or a virtual machine as a JSP server with network automation. Start developing user application in user favorite environment or deploy user prebuilt application and test run.

B. Installing a Tomcat Servlet Container into an Existing Image

We had an image which works great in our IaaS, but it has no platforms required for development. We can of course install them into the instance every time it boots, but the setup required here is a PaaS environment.

- i) First we create a mount point for it
mkdir temp-mnt
- ii) Associate a loop block device to the image (we assume here that /dev/loop5 is free)
losetup /dev/loop5 root.img
- iii) Finally mount it
Mount /dev/loop5 temp-mnt

C. Install Tomcat into an Image

To configure a Tomcat on CentOS, The CentOS has Tomcat 5 available as yum package, with gcc-java. But we used the original Sun JDK to run Tomcat without problems.

Tomcat can run with only JRE, so Java JRE 6 update 35 [6], jre-6u35-linux-i586.bin file which is an auto installer was downloaded for Linux. After installing jre apache-tomcat-5.5.26.tar.gz was downloaded and moved it to /opt and gun zipped it.

```
#gunzip apache-tomcat-5.5.26.tar.gz
```

```
#tar xvf apache-tomcat-5.5.26.tar
```

We get apache-tomcat-5.5.26 folder in opt directory. Now tomcat has to configure with Java path. We need to set the environment variable JAVA_HOME and we need some script to run Tomcat as a daemon to put in /etc/init.d

```
#vi /root/Desktop/euca-centos-5.3-i386/temp-mnt/etc/init.d/tomcat
```

```
#!/bin/bash
# Tomcat auto-start
export JAVA_HOME=/opt/java/jre 1.6.0_35
case $1 in
Start)
sh /opt/apache-tomcat-5.5.26/bin/startup.sh
;;
stop)
sh /opt/apache-tomcat-5.5.26/bin/shutdown.sh
;;
restart)
sh /opt/apache-tomcat-5.5.26/bin/shutdown.sh
sh /opt/apache-tomcat-5.5.26/bin/startup.sh
;;
esac
exit 0
```

Link the daemon with the startup.

```
# sudo ln -s /root/Desktop/euca-centos-5.3-i386/temp-mnt/etc/init.d/tomcat /root/Desktop/euca-centos-5.3-i386/temp-mnt/etc/rc1.d/K99tomcat
```

```
# sudo ln -s /root/Desktop/euca-centos-5.3-i386/temp-
mnt/etc/init.d/tomcat /root/Desktop/euca-centos-5.3-
i386/temp-mnt/etc/rc1.d/S99tomcat
```

Similarly another image was installed with Drupal content management system which is initiated and is being used to develop an application of project management system.

V. EBS VOLUMES IN EUCALYPTUS CLOUD

As we are going to develop or test an application on PaaS environment we require more storage than the image holds. Secondly we would like to work with persistence storage, so we create volumes and attach them to virtual machines and store these applications on volumes. Volumes are synonymous with Elastic Block Storage (EBS) volumes in Amazon Web Services. They are permanent storage that can be mounted as devices by Eucalyptus instances. These storage volumes behave like raw, unformatted block device or just like hard drives. We can create a file system on top of a volume.

A. Elastic Block Store (EBS) Volumes

EBS volumes are created in particular Availability Zone in Eucalyptus cloud and stored in storage controller (SC). Once a volume is created, it can be attached to any instance in the same Availability Zone. Once attached, it will appear as a mounted device similar to any hard drive or other block device formatting it with file system. At that point, the instance can interact with the volume just as it would with a local drive. In that volume the user application or data has to be installed or placed to make user data or application safe in the virtual machine (VM).

A volume can only be attached to one instance at a time, but many volumes can be attached to a single instance. This means that we can attach multiple volumes and swap our data across them. If an instance fails or else the volume is detached from the instance. The volume can be attached to any other instance in that Availability Zone. Volumes allow us to store persistence data in the PaaS environment.

VI. PERFORMANCE OF PAAS AND EBS VOLUMES

It was observed that smaller the image faster the setup time. A Linux 6.2 image with Tomcat installed created a virtual machine is less than a minute's time. However

windows 2003 image took one minute to transform from pending to running state. This is far less than the time taken to setup a virtual machine manually and install the required platform onto it. Another important advantage of such setup is that once the image is verified for its setup and performance, number of instances can be created from such an image avoiding the overhead of testing the environment each time it has to be used. However it was seen that bigger the volume attached to these instances better was the performance.

A. Timely Delivery

The figure.2 depicts a graph for software development life cycle (SDLC) phases. The metrics in the graph are recorded for software development life cycle phases against the time utilization factor. The graph clearly shows the experiments conducted with Platform as a Service (PaaS) yields better results compared to the experiments performed without PaaS. The PaaS experiments utilize approximately 20 percent less resources compared to the experiments performed without PaaS.

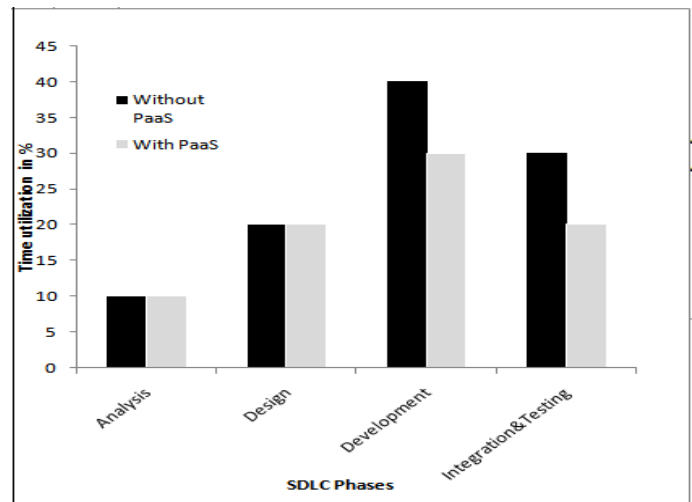


Fig.2. Time utilization in SDLC's with and without PaaS.

Standardized platform and software development stack increases developer productivity, leading to reduced application development life cycles.

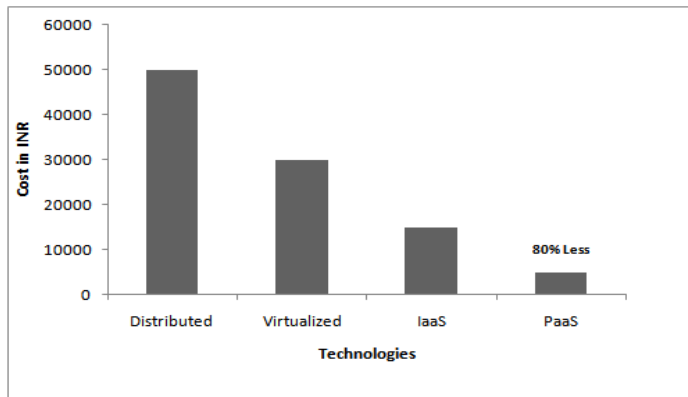


Figure.3. Total hardware and software labor costs for 100 Linux status at datacenter for one year

Self servicing and provisioning cuts down lead time in rapid prototyping and helps meet the agile business requirements. By developing PaaS appliances, enterprises with managed datacenter operations can focus on delivering the service to its customers instead of building and managing custom platforms.

B. Quality of Service

Abstraction and standardization of complex middleware software infrastructure brings consistent quality of service across enterprise applications.

Auto scaling based on application SLAs. Typically, PaaS supports scale-out and scale-down capabilities.

VII. DETAILS OF THE IMPLEMENTATION IN PROGRESS

To date, Eucalyptus-based PaaS cloud is operational in datacenter of Andhra Pradesh the Disha content application service provider has been migrated onto virtual server in the in the PaaS cloud [10]. On similar grounds it is proposed to have the staging server with PaaS model for application development and testing on platforms.

VIII. FUTURE WORK

Lack of architecture conformity results in significant costs in managing and maintaining application deployments. A PaaS deployment environment establishes the architectural consistency to all deployed applications as it standardizes the stack all the way up to middleware and provides standard architectural qualities like auto scaling, high availability and

application design pattern. So, it is proposed to move the staging server on the Eucalyptus cloud. On demand various platforms will be provided to the application developers to host their application on the staging server before moving them to the production server. After successful security audit of the applications they are moved on to the production server and the resources are relieved. The datacenter staff will be relieved of extensive work of preparing platform base for different applications. They have to sit and monitor the cloud and resources.

IX. CONCLUSION

National Informatics Centre (NIC) of the Department of Information Technology is providing network backbone and e-governance support to central government, state governments by converting all the datacenters (SAN) into a private cloud, where in all the computational resources such as the CPUs, disk storage system, specialized software systems and so forth, will be provisioned to all the users connecting to the cloud. Using the enabling technologies enumerated, e-governance applications can be deployed as web services to provide interoperability, business continuity, transaction persistence, server provisioning and so forth.

In this paper, a private PaaS cloud layer is proposed for the implementation of Eucalyptus cloud in Datacenter and saving the users application or data in the EBS volumes.

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