Virtualization in Cloud Computing- a Study

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***Abstract*— The recent past have experienced tremendous rise and popularity of technologies like cloud computing and virtualization. Cloud computing is a construct that allows us to access applications that actually reside at a location other than your computer, most often, this will be a distant data center. Many organizations have already started implementing these technologies to further reduce costs through improved resource utilization. Cloud Computing and virtualization enable users to use applications on internet and intranet. In Cloud computing many of the services relies heavily on virtualized hardware. Because of this, we carefully reviewed existing virtual hardware services in order to both understand how the process works and to find the service that is best suited to Cloud computing and virtualization in different situations.**

Keywords—Cloud Computing; Virtualization; Virtual Machine; Resource Utilisation; Data Center.

I. INTRODUCTION

In Cloud computing, virtualization is the basis of delivering Infrastructure as a Service (IaaS) that separates data, network, applications and machines from hardware constraints. Cloud computing is becoming popular among IT businesses due to its agile,flexible and cost effective services being offered at Software, Platform and In-frastructure level. Software as a Service (SaaS) allows users to access applications hosted by different vendors on Cloud via internet. Platform as a Service (PaaS) enables developers to code, test and deploy their applications on IaaS. In infrastructure as a Service (IaaS) model, Cloud provider's offer services such as computing, network, storage and databases via internet. IaaS is the base of all Cloud services with PaaS and SaaS both built upon it. The primary features of IaaS are elasticity and virtualization. Virtualization enables a single system to concurrently run multiple isolated virtual machines (VMs), operating systems or multiple instances of a single operating system (OS) [1].

Cloud Suite relies heavily on virtualized hardware. Because of this, we carefully reviewed existing virtual hardware services in order to both understand how the process works and to find the service that is best suited to Cloud Suite.

Virtualization is one of the oldest areas of interest in computer science. One of the most successful examples of virtualization is the Java Virtual Machine (J V M) [3]. Using the J V M allows the Java programming language to produce identical results regardless of the instruction set architecture (ISA) that is used by the hardware platform. This is because, for all intents and purposes, the compiled Java code is running on the same machine hyphen albeit in a virtual setting. As long as a system has a J V M installed that can translate Java byte code into the appropriate ISA, then the results will be identical.

The Java virtual machine allows one piece of virtual hardware to be present on multiple discrete systems. Software like V M Ware allows multiple virtual hardware systems to be present on a single piece of physical hardware. Creating multiple virtualized hardware images on a single piece of physical hardware is one of the cornerstones of cloud computing. These concurrent virtual images are made possible by a hypervisor. Various types of virtualization exists such as Client virtualization, Storage virtualization and Server virtualization in cloud computing.

II. NEED, BENEFITS AND CONS OF VM MIGRATION

VM Migration is at the core of cloud computing. The needs and benefits of virtualization are as follows [2]:

- Multiple Systems: With virtualization we can run multiple applications even on different operating system on the same physical hardware.
- Power Management: We can improve the power utilization.
- Improve Resource Utilization: The resource utilization is increased with the virtualization.
- Load Balancing: Load can be distributed on available resources.
- Maintenance and Servicing.
- It improves system availability.
- It is scalable, as per the requirement with time.
- Security is provided by running multiple servers in isolation.

The major hurdle with the virtualization is that the network load during the migration increases which results in the increase of communication cost. One side effect of this is that performance of application running on virtual machine degraded.

III. VIRTUAL MACHINE PLACEMENT TECHNIQUES

The various algorithms implemented earlier for VM Placement in data centers are First Fit, Next Fit, Random Fit,

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Least full First, Most Full First, First Fit Decreasing (Single Dimension), First Fit Decreasing Product, First Fit Decreasing Sum, Dot Product, Minimizing Angle. First fit, next fit and random fit algorithms are simple algorithms. These algorithms do not consider the resource capacities needed for placing virtual machine and not consider the resource consumptions in physical machines. Least full first, most full first, first fit decreasing (single dimension) algorithms are designed based on CPU capacity. First fit decreasing product, first fit decreasing sum and dot product algorithms are designed for multi dimensional resources. In these algorithms, physical/virtual machines' resource volumes are calculated using all resources capacities. In minimizing angle algorithm all resources are involved directly for placing virtual machines. In this algorithm different resource consumptions are balanced so that physical machines are minimized. This algorithm concentrates on balancing resources instead of maximizing resource usage of physical machines in each dimension. After all these Virtual Machine Placement algorithms, Modification of the Best Fit Decreasing (BFD) algorithm is implemented in cloud data centers for placement of Virtual Machines.

IV. SOME MAJOR CLOUD AND VIRTUALIZATION SERVICE PROVIDER

Google (Google App Engine)

Google App is great for all types of applications such as Business, Consumer, Marketing, Mobile, and Website [4].

- Easy to Build: By using the familiar development tool it will allow the user to buildup and get started app quickly
- Easy to Scale: It can serve any number of users and automatically responds to data traffic change.
- Easy to Manage: Administer app through the centralize app web console always actives and works, can't need software installation, server or backup etc.
- Easy to Storage: GAE advanced storage infrastructure gives benefits to companies to store and access their data
- Highly Scalable.
- Flexible Security and sharing.
- Fast data access.
- Reliable Storage Access.

Table 1: Comparison of service providers over various matrices

	Google [4]	**Amazon [6]**	**Microsoft [5]**
Cloud Provider	Google App Engine	Amazon EC2	Azure
Service Mode	PaaS /SaaS Provider	PaaS/ SaaS Provider and IaaS	PaaS/ SaaS Provider and IaaS
Develop Support	Web service	Web service; Windows console application; Virtual Instance	Virtual machine
Feature	Easy to build; Easy to scale; Easy to manage, inexpensive.	Elastic; Completely Controlled; Flexible; Designed for use with other Amazon Web Services Reliable; Secure; Easy to Start.	Always up. Always on; Open; Unlimited servers. Unlimited storage. Powerful Capabilities.
Compute model[65]	Predefined application structure and framework; programmer-provided "handlers" written in Python, all persistent state stored in MegaStore (outside Python code); Automatic scaling up and down of computation and storage; network and server failover; all consistent with 3-tier Web app structure	x86 Instruction Set Architecture (ISA) via Xeon VM; Computation elasticity allows scalability, but developer must build the machinery, or third party VAR such as Right Scale must provide it	Microsoft Common Language Runtime (CLR) VM; common intermediate form executed in managed environment; Machines are provisioned based on declarative descriptions (e.g. which "roles" can be replicated); automatic load balancing
Storage	MegaStore/BigTable	DynamoDB;SimpleDB;Rel ational Database Service (RDS); ElastiCache	Azure storage service
Support SQL	Cloud SQL	-	SQL Azure
Availability	100%	99.97%	99.95%
Free Usage	Limitation usage in 1 GAE unite	Micro-Linux-instance	3 month for free

Table 1 shows comparison of these service providers over various matrices.

Microsoft (Windows Azure)

Microsoft windows azure is an open cloud platform which enable user to build deploy and manage applications across global network of Microsoft datacenters. The user can build applications by using any kind of language, tool or framework.net, node.js, java, php, it give facility to its customer that whatever language you want to install you can install and use it [5].

- Always up and always on: Microsoft window azure claim that its deliver services 99.95% to its users and enable its users to build and run highly available application without focusing on its infrastructure.
- Open: MWA is open source, it give facilities to its customer for using any kind of language, framework, or tool to build their applications.
- Unlimited Server and Unlimited Storage: MWA enable its customer to easily scale their applications to any size. Window Azure is available on multiple datacenters around the world, which enable its users to deploy their application near to their customers.
- Powerful Capabilities: MWA can deliver flexible cloud computing platform which can assure any application need. Its distributed caching and CDN service allow user to minimize latency and deliver great application performance anywhere in world [5].

Amazon EC2(aws.amazon.com)

- Compute: Amazon is scale to meet user application demands whether it's one server or large cluster [6].
- Amazon Elastic Compute Cloud (EC2).
- AEC is web service which provides resizable compute capacity in cloud. Amazon EC2 web service allows users to obtain and build up with minimal friction. Amazon EC2 provides complete control to their users for computing resources and let them run on Amazons computing environment.
- Networking: In networking Amazon customize and control user network resources, both inside and outside the cloud [6].

V. VIRTUAL LABS

Creating a cloud based ad hoc laboratory system, such as Cloud Suite, requires a variety of different technologies. The primary technology that is necessary for Cloud lab is hardware virtualization. Fortunately there are numerous examples available to us. We will perform an examination of hardware virtualization services in general and a specific exploration of the services offered by Amazon.com. In addition to virtualization we will also explore: existing virtual lab environments, templating systems, remote storage solutions, and finally, A P Is and Frame Works [7].

i. Amazon.com Elastic Compute Cloud

On August 25, 2006, Jeff Bezos announced the limited beta of Amazon Elastic Compute Cloud [8], referred to as Amazon E C 2. Amazon E C 2 is a service that allows users to, essentially, rent computational resources on an as needed basis. This type of service is made possible by using the Xen hypervisor, Xen allows Amazon E C 2 to create Virtual Private Servers as demand requires. These virtual servers make use of operating systems that have been optimized for paravirtualization. Once the end user has customized the virtual machine to their liking they are then able to save it as an Amazon Machine Image, or A M I.

An A M I is a system image that has been created to be used with E C 2. Users may customize these A M Is with their own software packages allowing an A M I to be tailored for any task. The Amazon Simple Storage Service (S 3) [9] is used extensively in the code written for Cloud Suite. S 3 allows a user to upload and download files using H T T P requests. Amazon Simple Storage Service, like the rest of Amazon Web Services, is not free semicolon however at the time of writing, Amazon offers a free tier of service available for the one year [9].

Amazon, and various 3rd parties, provide S D Ks that allow developers to interact with Amazon Web Services. The framework for Cloud Suite is written using S D Ks for P H P, Python (Boto) and Unix forward slash Linux command line. However S D Ks exists for multiple platforms and languages. The provided S D Ks greatly ease interaction with the cloud services provided by Amazon.

ii. Google Compute Engine

Amazon is far from the only available option for cloud services. Google recently announced 'Google Compute Engine' [10] , a service similar to Amazon E C 2, in addition to the long standing Google App Engine. In the next section we will take a closer look at cloud services offered by providers other than Amazon.com.

iii. Heroku

Heroku {11] deservers special consideration because it is one of the best examples of a platform for executing arbitrary programs in the cloud. Heroku allows the end user to develop an application and leave the running of that application up to Heroku. The developer pushes code to Heroku using the Git version control system. Once the code is present, Heroku relies upon H T T P requests to interface with the client application.

iv. Google App Engine

Google App Engine (G A E) [12] is another service similar to Heroku semicolon however, Google App Engine places a number of restrictions on what code developers may use. Unlike an Infrastructure as a Service provider, G A E places limits on what code may be executed as well as only allowing the proprietary Google Query Language as a data store.

v. Eucalyptus

Extensive research on cloud technology has been performed at University of California, Santa Barbara (U C S B). Two of the most well known products of that research are Eucalyptus and App Scale.

Eucalyptus is an open source emulator for Amazon E C 2 that can be run on local clusters square [13] . Since the initial release of Eucalyptus, it has grown to become a commercial success, and is included in the Ubuntu operating system.

vi. App Scale

AppScale is an open source implementation of several cloud A P Is, including Google App Engine. App Scale can be deployed over Amazon E C 2, Eucalyptus, or an Ubuntu image. App Scale uses virtualization to provide a uniform experience across multiple cloud platforms.

vii. Coursera - Online Education

With the growth of high speed internet access to distance learning has become increasingly more accessible. In addition to universities supplementing their courses with online offerings, many universities are also making classes available online for free. Coursera is a central location where those seeking to improve their education may participate in free online classes from sixteen universities including: Caltech, Stanford, and Princeton. Additionally many universities have begun offering free classes online for no credit. One such offering from University of California, Berkley made use of Heroku to allow students to publish a web based application and see results in real time. The Massachusetts Institute of Technology also offers free online courses. It is important to note that these online courses typically do not confer any sort of degree or certificate, Coursera being notable in that some of it 'courses do offer an electronic certificate of completion [14]. Courses offered online could make great use of a service like Cloud Suite to provide their students with an interactive lab component.

viii. Khan Academy

Khan Academy is a not for profit online educational resource. Khan Academy offers videos explaining a variety of topics. In addition to videos Khan Academy also offers a web based set of tools for developing mathematical proficiency. In late 2012 Khan Academy introduced Computer Science curriculum that offers programming instruction and demonstration. The programing curriculum is based on the Java Script language and is overseen by John Resig [15]. The program is designed to demonstrate the fundamentals of computer science to someone with little to no experience.

ix. University of Hawaii Virtual Lab

In 2007 the Department of Educational Technology at the University of Hawaii at Mano published a paper detailing an experiment where an online biology class made use of a C D hyphen ROM based virtual wet lab. The study compared the use of a virtual lab to what the study referred to as a 'face to face' lab. The data analysis showed that, while students found the virtual labs to be useful, face – to -face lab time was more valuable to the overall learning experience than a purely computer-based lab. The study was primarily focused on the effectiveness of the virtual lab and did not give great detail on the technology [16].

x. Navy Virtual Lab

The Naval Postgraduate School (N P S) [17] has developed a distance learning solution that allows non - resident students to perform signal processing laboratory assignments. The Electrical and Computer Engineering department has developed an innovative mix of hardware and software to allow students to access lab equipment regardless of their location. The collection of signal generators and field programmable gate arrays allow students to perform experiments in real time.

VI. CONCLUSION

Cloud computing is basically a framework that allows us to access applications that actually reside at a location other than your computer. Virtualization is a technique to provide abstraction between the hardware and software of a computer system. In virtualization we create a virtual version of a resource (generally computer system or application running on it). The virtualization and cloud computing makes the resources available to a remote location. Some resources are shared between multiple users and accessed at the same time. The technique uses the resource sharing and increase the system utilization.

The Computer is virtualized in a clustered computing environment controlled by Cloud computing to fully utilize the computing and storage. The cloud will provide dynamic resource allocation to ensure effective system utilization through carefully monitoring of resource workload and available physical resources, and providing managed solutions on a continual basis. The most important aspect of virtualization is to develop a platform that students can access remotely without time and location constraints. The Cloud provides a segregated virtual environment without affecting any system outside of the cloud as well as other virtual systems within the cloud.

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