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A COMPARATIVE STUDY OF CLOUD COMPUTING SERVICE PROVIDERS

Shivangi Goyal

University School of Information Technology, Guru Gobind Singh Indraprastha University

Abstract— This paper describes cloud computing, a computing platform for the next generation of the Internet. The paper defines clouds, explains the benefits of cloud computing, and outlines cloud architecture and its major components. This paper also presents a comparative study of various cloud computing service providers. The comparison is based on the different parameters like pricing, maximum limit, data security, data backup. This paper also includes the advantages and disadvantages of cloud computing.

Keywords— Cloud Computing, Amazon, Google, Windows

I. INTRODUCTION

Cloud Computing (CC) gets its name as a metaphor for the internet. Actually, in the network internet diagrams, the internet is represented using a cloud between the connecting networks. This clearly depicts the free floating characteristic of the cloud computing and also justifies its name.

CC is the next higher level in the evolution of internet. It is surely an internet based network made up of large numbers of servers, which are generally based on open standards and are modular and inexpensive. The clouds are the main information carrying entities in this technology which is responsible for providing services to the clients. The clouds in CC provides a means through which everything from computing infrastructure to computing power, business processes to personal collaboration, application can be delivered to one's steps.

When talking of clouds, they are of three broad categories; Public clouds which are available for use to all, Private clouds on the contrary have reserved access rights and Hybrid clouds are combination of Public and Private clouds that is they can be partially accessed by the outside world and their services can also be exploited by a bunch of privileged users and clients.[1]

Chances are that you are using CC in your day to day activities. In fact you do it quiet often if you use online photo storage or online word processor to prepare some documents for use or online e-mail to communicate with your relatives/colleagues or an online spreadsheet to check your daily transactions or an online data processor when you quote any query to find solution to particular problem or any other

Internet-based application where in you are just required to log in and exploit the services as deeply as possible according to your requirements. Internet based applications appear daily such ads online slide show creation, online website building, online design tools, online mind mapping application, online collaboration softwares, online file format conversions, online social media etc etc etc. Some applications are easy to use while some are wanting.

CC is the game of three players. Firstly, the Vendors of CC provide application and enable technology, infrastructure, hardware, software and integration for clients' any demand. Secondly, the Partners of these vendors who create cloud services to offer and provide support services to clients/customers. Lastly, the Business Leaders who either use or evaluate various types of cloud services and CC offerings.

CC is a technology that allows us to access applications which actually resides at a location which is referred to as data centers. For example, think of an application that you were supposed to install at your organizations each work station. Either you do this manually on each work station individually or you set up a central distribution system which is responsible to install the application automatically on all of your work stations. Also don't forget the cost of purchasing all the licenses that you need to install the application on all of your work stations. Here comes the beauty of CC where another company hosts the application to be run on your work stations. That is they handle costs, manage software updates, generate periodic reports and depending on how you craft your contract, you pay for the services you use that is you pay as you go. It's a boon to telecommunication and travelling workers who can simply create an account with CC vendors

and log in to use their applications whenever and wherever they feel like. It frees us from backup management mess and it also enhances data security so that it can be accessed anytime one wants. CC is sometimes referred to as mysterious rather it is the highest of the high technologies.

Some of the benefits of CC are reduced cost data rates and leakages, they estimate and reduce service delivery time, their forensic readiness, high availability, easy scalability. CC also promises to cut down operational and capital costs and more importantly, let IT departments focus on strategic projects instead of keeping the datacenter running. Another feather to its cap is the fact that it is certainly a GREEN Technology. Since it is more browser oriented it reduces the processor and storage work at the user end so we won't be needing to buy powerful and expensive processors, but only a small atom like processor that we will be needing to focus on. Moreover, it also cuts down the costs to larger extent since we pay for only what we deploy and we deploy only what we need and use. Such featured technologies prove to be a boon to mankind. For instance it will be able to save lots and lots of paper as the books, notes, study material shall be available and presented online as soft copies and exams will go online saving millions and trillions of paper. Such features make it a top class computing technology under the listings of Green Technology. [1]

II. CLOUD SERVICES

Cloud computing is a general term for anything that involves delivering hosted services over the Internet. These services are broadly divided into three categories as shown in figure 1:

1. Infrastructure-as-a-Service (IaaS)
2. Platform-as-a-Service (PaaS) and
3. Software-as-a-Service (SaaS).

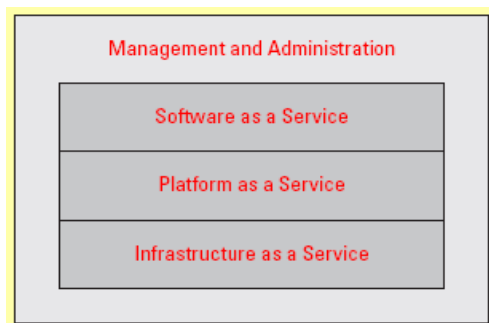


FIGURE 1. CLOUD SERVICE DELIVERY MODEL

INFRASTRUCTURE-AS-A-SERVICE: IaaS like Amazon Web Services provides virtual server instance API to start, stop, access and configure their virtual servers and storage. In the enterprise, cloud computing allows a company to pay for only as much capacity as is needed, and bring more online as soon as required. Because this pay-for-what-you-use model resembles the way electricity, fuel and water are consumed; it's sometimes referred to as utility computing.

PLATFORM-AS-A-SERVICE: PaaS in the cloud is defined as a set of software and product development tools hosted on the provider's infrastructure. Developers create applications on the provider's platform over the Internet. PaaS providers may use APIs, website portals or gateway software installed on the customer's computer. Force.com, (an outgrowth of Salesforce.com) and GoogleApps are examples of PaaS. Developers need to know that currently, there are not standards for interoperability or data portability in the cloud. Some providers will not allow software created by their customers to be moved off the provider's platform.

SOFTWARE-AS-A-SERVICE: In SaaS cloud model, the vendor supplies the hardware infrastructure, the software product and interacts with the user through a front-end portal. SaaS is a very broad market. Services can be anything from Web-based email to inventory control and database processing. Because the service provider hosts both the application and the data, the end user is free to use the service from anywhere.

III. CLOUD TYPES

There are four types of clouds as discussed below:

PUBLIC CLOUD

Public cloud describes cloud computing in the traditional mainstream sense, whereby resources are dynamically provisioned to the general public 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 fine-grained utility computing basis.

COMMUNITY CLOUD

Community cloud shares infrastructure between several organizations from a specific community with common concerns (security, compliance, jurisdiction, etc.), whether managed internally or by a third-party and hosted internally or externally. The costs are spread over fewer users than a public cloud (but more than a private cloud), so only some of the benefits of cloud computing are realized.

HYBRID CLOUD

Hybrid cloud is a composition of two or more clouds (private, community, or public) that remain unique entities but are bound together, offering the benefits of multiple deployment models. It can also be defined as a multiple cloud systems that are connected in a way that allows programs and data to be moved easily from one deployment system to another.

PRIVATE CLOUD

Private cloud is infrastructure operated solely for a single organization, whether managed internally or by a third-party and hosted internally or externally. They have attracted criticism because users "still have to buy, build, and manage them" and thus do not benefit from lower up-front capital costs and less hands-on management, essentially "[lacking]

the economic model that makes cloud computing such an intriguing concept”.

IV. SERVICE PROVIDERS’ COMPARISON AND SUMMARY

There are a number of service providers for cloud computing such as Amazon’s web services [2], Google’s

Application Engine [3], Window’s Azure [4], Rackspace, Proofpoint, RightScale, Salesforce.com, Sun Open Cloud Platform, Workday etc. Among these all a comparative analysis of the first three has been done and has been presented in Table 1.

TABLE I
COMPARISON AND SUMMARY OF THREE CLOUD COMPUTING SERVICE PROVIDERS

	Amazon AWS	Windows Azure	Google App Engine
Cloud Services	<ul style="list-style-type: none"> • Paas , Iaas 	<ul style="list-style-type: none"> • Paas , Iaas 	<ul style="list-style-type: none"> • Paas , Saas
Platforms supported	<ul style="list-style-type: none"> • Red Hat Enterprise Linux • Windows Server 2003/2008 • Oracle Enterprise Linux • Microsoft SQL Server Standard 2005 • Fedora Gentoo Linux 	<ul style="list-style-type: none"> • Operating systems • Windows 7 • Windows Server 2008 • Windows Vista 	<ul style="list-style-type: none"> • Java Runtime Environment • Python Runtime Environment
Languages Supported	<ul style="list-style-type: none"> • Any 	<ul style="list-style-type: none"> • VB.NET • C# • PHP 	<ul style="list-style-type: none"> • Java • Python
Cloud services and tools	<ul style="list-style-type: none"> • Amazon Elastic Compute Cloud (EC2) • AWS GovCloud (US) • AmazonRelational • Database Service (RDS) • 	<ul style="list-style-type: none"> • Windows Azure Platform Training Kit • Windows Azure Software Development Kit • Microsoft Visual Studio 2008 Service Pack 1 • Windows Azure platform AppFabric SDK V1.0 • Windows 7 Training Kit For Developers 	<ul style="list-style-type: none"> • Google Search • Gmail • Chrome browser • Google Maps
Maximum limits	<ul style="list-style-type: none"> • Amazon S3 - Store object up to 5 GB • Amazon EC2 [Elastic Block storage] - Volume sizes ranging from 1GB to 1TB • (20 TB/account limit while in beta) 	<ul style="list-style-type: none"> • Azure has a 64MB limit on individual blobs and also allows you to split a blob into blocks of 4MB each 	<ul style="list-style-type: none"> • Automatic scaling is built in with App Engine • No matter how many users you have or how much data your application stores, App Engine can scale to meet your needs
Security	<ul style="list-style-type: none"> • AWS network provides significant protection and also enables customer to implement further protection • Uses SSL (encryption) to maintain confidentiality 	<ul style="list-style-type: none"> • Filtering Routers • Firewalls • Cryptographic Protection of Messages • Software Security Patch Management • centralized monitoring, correlation, and analysis systems • Network Segmentation • Service Administration Access 	<ul style="list-style-type: none"> • Google’s 2 step verification

		<ul style="list-style-type: none"> • Physical Security 	
<p>Service/ Resource pricing</p>	<ul style="list-style-type: none"> • Amazon S3 - Storage Used / Data Transfer In or Data Transfer Out/PUT, COPY, POST, LIST or GET request (No charge for delete requests) • Amazon RDS - Based on per DB Instance-hour consumed, from the time a DB Instance is launched until it is terminated. • Each partial DB Instance-hour consumed will be billed as a full hour/based on provisioned storage and number of I/O requests /After the DB Instance is terminated, backup storage/ data transferred —in and —out of Amazon RDS • Amazon EC2 - Pricing is per instance-hour consumed for each instance type, from the time an instance is launched until it is terminated. Each partial instance-hour consumed will be billed as a full hour. 	<ul style="list-style-type: none"> • Billing is based on Compute, Storage, Storage transactions and Data transfers 	<ul style="list-style-type: none"> • An efficient application on a free account can use up to 500MB of storage and up to 5 million page views a month. When you are ready for more, you can enable billing, set a maximum daily budget, and allocate your budget for each resource according to your needs. • Billing is based on the following parameters - <ul style="list-style-type: none"> • Outgoing Bandwidth • Incoming Bandwidth • CPU Time CPU • Stored Data • Recipients Emailed

V. ADVANTAGES AND DISADVANTAGES

Following are the advantages of cloud computing:

Reduced Cost: Cloud technology is paid incrementally, saving organizations money.

Highly Automated: No longer do IT personnel need to worry about keeping software up to date.

Increased Storage: Organizations can store more data than on private computer systems.

Flexibility: Cloud computing offers much more flexibility than past computing methods.

More Mobility: Employees can access information wherever they are, rather than having to remain at their desks.

Allows IT to Shift Focus: No longer having to worry about constant server updates and other computing issues, government organizations will be free to concentrate on innovation.

Following are the disadvantages of cloud computing:

Security & Privacy: The biggest concerns about cloud computing are security and privacy. Users might not be comfortable handing over their data to a third party. This is an even greater concern when it comes to companies that wish to keep their sensitive information on cloud servers.

Dependency (loss of control): The users lose control over how their data is stored on a cloud. Thus they end up losing control over the backup of their data, restoration and Disaster recovery.

Cost: Higher costs. While in the long run, cloud hosting is a lot cheaper than traditional technologies, the fact that it's currently new and has to be researched and improved actually makes it more expensive. Data centers have to buy or develop the software that'll run the cloud, rewire the machines and fix unforeseen problems (which are always there). This makes their initial cloud offers more expensive.

VI. CONCLUSIONS

In this paper an introduction to the cloud computing, its services and types have been given. Also a comparative summary has been provided in the form of a table of the three cloud computing service providers namely Amazon's web services, Google's Application Engine and Window's Azure. These service providers have been compared w.r.t Cloud Services like Platforms supported, Languages Supported, Cloud services and tools, Maximum limits, Security, Service/ Resource pricing parameters. It is also clear from the table 1 that none of the service providers are weak and they have to be chosen as per the convenience of the user. Lastly the advantages and limitations of the technology have also been presented.

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