

A Review Paper on Cloud Computing

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Abstract — This paper explains cloud computing, rapidly emerging as a new model for delivering computing as a utility. The paper defines clouds, explains the service models, deployment models and major components of cloud computing. This paper presents a comparative study of various cloud computing service providers. This paper also includes the benefits and risks of cloud computing.

Keywords— Cloud Computing, Amazon, Google, Windows

I. INTRODUCTION

Cloud computing is everywhere. Pick up any tech magazine or visit almost any IT website or blog and you'll be sure to see talk about cloud computing[1]. Cloud computing is an emerging area of distributed computing that offers many potential benefits to organizations by making information technology (IT) services available as a commodity. A cloud computing system is characterized by its on-need self service, access over internet, pooling of resources, elasticity of service availability, and measurement of services utilized by individual users. During last few years, tremendous developments have been observed in the domain of cloud computing and different types of cloud providers have emerged.[7]

II. CLOUD SERVICES AND DEPLOYMENT MODELS

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).

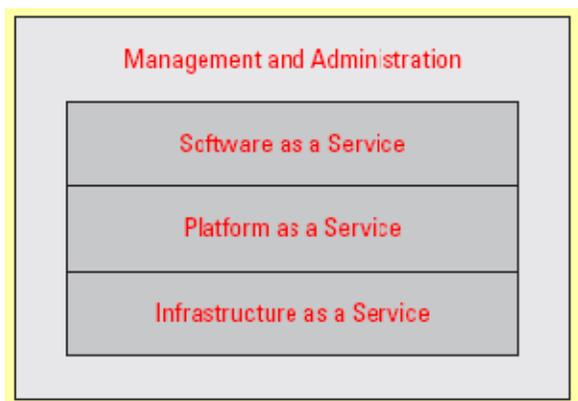


FIGURE 1: 1 CLOUD SERVICES

- 1. Infrastructure as a Service:** In Infrastructure as a service (IaaS), the raw resources like computation, storage and communication are provided as service to user. GoGrid, Joyent and Rackspace are some of the popular IaaS providers. A special case of IaaS is Data storage as a Service (DaaS), where the physical storage is provided as a service to users. The service also accompanies features for backup, reliability and redundancy etc. Examples are Amazon S3 and Apache HBase etc. In this scenario, you're using the cloud provider's machines. That is, you are using a virtualized server and running software on it. One of the most prevalent is Amazon Elastic Compute Cloud (EC2). [7-8]
- 2. Platform as a Service:** Platform as a Service (PaaS) is a way to build applications and have them hosted by the cloud provider. It allows you to deploy applications without having to spend the money to buy the servers on which to house them. The end-users are provided a platform i.e. an abstraction over existing infrastructure that can be used to build applications. Examples of PaaS providers are Microsoft Windows Azure, Google AppEngine Force.com and RightScale. [7-8]
- 3. Software as a Service:** In the Software as a service (SaaS) model, different types of utility applications i.e. accounting, spread sheet and word processing etc. are offered as service to clients. SaaS is simply the cloud vendor providing the given piece of software you want to use, on their servers. That is, unlike PaaS in which you developed your own application, SaaS provides the application for you. Google App Engine and Salesforce are examples of SaaS. [7-8]
- 4. Hardware-as-a-Service (HaaS):** In this approach, the entire hardware or data center can be rented by an organization to meet their hardware demands. The hardware resources can dynamically scale up or down as the end-user's requirements change. [7-8]

III. CLOUD COMPUTING DEPLOYMENT MODELS:

The concept of cloud has mainly been proposed for public deployment, but other options are also available. Cloud computing services and technology are deployed over different types of delivery models based on their characteristics and purpose.

Deployment models include public (external), private (internal), community, hybrid, and virtual private clouds.

public cloud is where resources, such as storage and applications, are made available to multiple consumers by a service provider, via a web application or web service over the Internet. The resources are therefore located at an off-site location that is controlled and managed by the service provider. These are typically low-cost or pay-on-demand and highly scalable services [6-12].

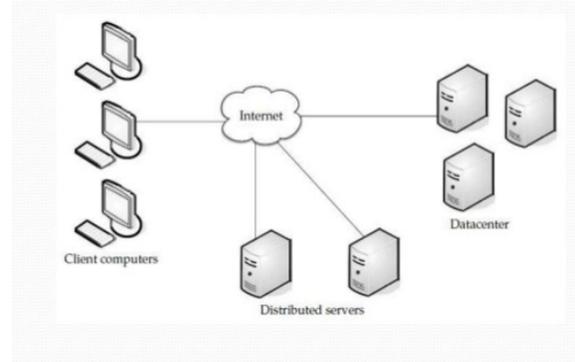
A *private cloud* infrastructure is operated for a single organisation. It may be managed by the organisation or a third party and may exist at an on-site or off-site location. Private cloud services offer the provider and the user greater control over the cloud infrastructure, improving security, compliance, resiliency and transparency. Private clouds, however, require capital expenditure, operational expenditure and a highly skilled IT team [6-12].

Community clouds are controlled and shared by several organisations and support a specific community that has shared interests, such as mission, policy, security requirements and compliance considerations. It may be managed by the organisations or a third party and may exist at on-site or off-site locations, and the members of the community share access to the data and applications in the community cloud. Community cloud users therefore seek to exploit economies of scale while minimizing the costs associated with private clouds and the risks associated with public clouds [6-12].

A *hybrid cloud* is a combination of two or more clouds (private, community, or public) that remain unique entities but are bound together by standardised or proprietary technology that enables data and application portability. Applications with less stringent security, legal, compliance and service level requirements can be outsourced to the public cloud, while keeping business-critical services and data in a secured and controlled private cloud [6-12]. Another deployment model, described by fewer sources, is one in which service providers utilise public cloud resources and infrastructure to create a private or semi-private *virtual cloud* (interconnecting to internal resources), usually via virtual private network (VPN) connectivity .

Cloud Components: In a simple, topological sense, a cloud computing solution is made up of several elements: clients, the data center, and distributed servers. As shown in Figure below these components make up the three parts of a cloud computing solution.

Three Components of Cloud Computing:



IV. BENEFITS AND RISKS

Following are the benefits 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 risks 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.

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.

V. SERVICE PROVIDERS COMPARISON

There are a number of service providers for cloud computing such as Google, Microsoft, Amazon, Yahoo!, Salesforce.com, IBM, and others. Among these all a comparative analysis of the first three has been done and has been presented in Table 1.

Table 1: Comparison of Three Cloud Computing Service Providers[1,2-5]

	Amazon	Microsoft	Google
Cloud Services	Paas Iaas	Paas Iaas	Paas Iaas
Platforms supported	Red Hat Enterprise Linux, Windows Server 2003/2008, Oracle Enterprise Linux, Microsoft SQL Server Standard 2005, Fedora Gentoo Linux	Operating systems Windows 7 Windows Server 2008 Windows Vista	Java Runtime Environment Python Runtime Environment
Cloud services and tools	Amazon Elastic Compute Cloud (EC2), Amazon SimpleDB, Amazon Simple Storage Service(Amazon S3), Amazon Cloud Front, Amazon Simple Queue Service (Amazon SQS), Elastic Block Store.	Windows Azure Platform Training Kit and Software Development Kit , Windows Azure platform AppFabric SDK V1.0, Windows 7 Training Kit For Developers, Windows Live, Exchange Online, Sharepoint Services, Microsoft Dynamics CRM.	Google App Engine, Google Web Toolkit, Google Search Gmail, Chrome Browser, Google Maps
Service/ Resource pricing	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. 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.	Billing is based on Compute, Storage, Storage transactions and Data transfers	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

VI. CONCLUSION

In this paper an introduction to the cloud computing, its services, deployment models and cloud components have been given. The benefits and risks of the technology have also been presented. Also comparison is 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 Cloud services and tools, 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.

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