Manoj Sharma al. International Journal of Research Aspects of Engineering and Management
ISSN: 2348-6627, Vol. 1, Issue 1, FEB 2014, pp. 4-8

Evaluating Various Aspects of Cloud Computing Vendors with Comparison

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***Abstract*—As we know that now a days the use of computing services is rapidly increasing over internet, so there is a need to buy mainframe system for every enterprise to full fill the requirements of end users and this can be overcome by use of cloud computing services in a inexpensive manner. Cloud computing paradigm offers a wide range of computing services for enterprises in terms of elasticity, service dynamism and highly scalable technology. This paper focus on the comparison of different parameters such as (platforms, language, integrated database etc.), of various cloud service providers. So it makes very easy for any enterprise to choose the best vendor of cloud service provider according to their requirements.**

***Keywords*— cloud computing; comparison, SLA**

I. INTRODUCTION

In today's scenario everyone access internet through the most common websites like Google, Yahoo. So there is a need of some kind of place over internet through which anyone can use the resources dynamically to develop and deploy applications. This need leads to the invention of cloud computing technology, i.e. next higher level in the evolution of Internet. It is a different style of computing where dynamically scalable and virtualized resources are provided as a service over the internet [1]. The cloud is a collection data center hardware and software, which is responsible for providing services to the clients. In Cloud computing through clouds various services is offered such as computing infrastructure, computing power, business processes, personal collaboration, and applications. Clouds are categorized into three types.

1. Public Cloud: - In this the resources are dynamically provisioned to the general public on a fine-grained, self-service basis over the Internet.
2. Private Cloud: - It is infrastructure managed by third-party and operated solely for a single organization.
3. Hybrid cloud:- These are combination of Public and Private clouds, and offers the benefits to multiple users and clients.

Cloud Computing moves around three scenarios. In first scenario the cloud service provider offers hardware, software, integration, enable technology, infrastructure and application to its clients on demand basis. In Second scenario the Partners of this service provider create different cloud services that are directly accessible to clients and customers. In the Last scenario, the Business owner can use and evaluate various types of cloud services offered by the previous scenario.

This paper aims to provide a better understanding of various cloud service provider by comparing different parameters, so that any business organization or individual is capable of choosing the best one according to their financial, technical, infrastructure, hardware/software need.

The rest of the paper is organized as follows. Section 2 describes the types of cloud services. In Section 3 characteristics of cloud computing services are discussed. Section 4 explain the factor of evaluation for cloud computing services

II. TYPES OF CLOUD SERVICES

These services are broadly divided into three categories as shown in below figure.

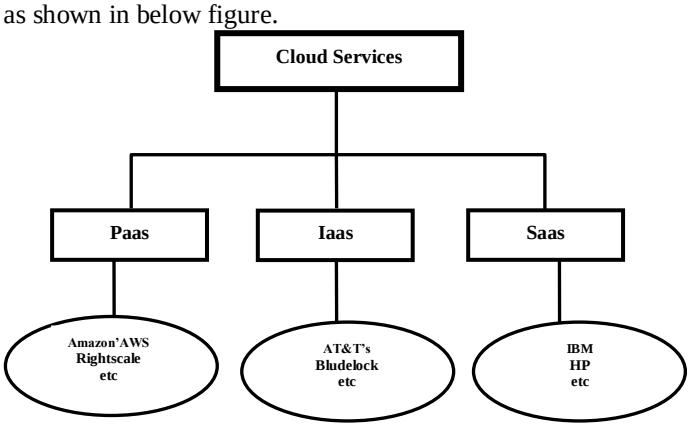

Figure 1:- Classification of cloud services

Platform as a Service(PaaS)

Platform as a service:- In the cloud PaaS is a collection of software and development tools hosted on the provider's infrastructure. Developers build and deploy their applications on the provider's platform.The customer may use API's and software installed on a PaaS provider. The aim is to design and deploy the application in a quick and efficient manner.

Infrastructure as a service (IaaS)

It is a preliminary point for anyone looking to receive a IaaS cloud services. The IaaS market, has proven to be one of the most exciting ones in the cloud space, and there have been several important factors, such as changes in pricing

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strategies, Pricing information, Compatibility operating Systems and languages, supporting services and many other have to be considered in order to choose particular service provider [2].

Software as a Service (SaaS)

This is where cloud service providers enable their clients to get access of infrastructure, software's etc. From productivity applications and CRM app's suites to software programs which manage cloud applications and deployments and even enable the creation of hybrid clouds, software as a service is exceptionally broad and runs the scope. Here we consider cloud software and application providers that are performing in different way, something new or something predominantly well [3].

III. Characteristics of Cloud Computing Service

There are many different cloud computing services present ,but they all are characterize according to type of services offered .Now we examine the common and specifice characteristics of Iaas, Paas, and SaaS cloud services. It is likely that the list can be expanded further, however, the selected characteristics allow more clear distinctions at each level.

Common characteristics

The shared characteristics are the license type, the intended user group, the security offered, formal agreements between the provider and the customer. In the following sections, each of these features will be discussed.

License type

A lot of cloud monitoring software is open-source based, as well as smaller cloud computing services, since small players often lack the power and influence to push proprietary software on the market [5]. License types also play a role when offering infrastructure- and platform-level services. IaaS providers do not suffer from software licensing issues when renting out their virtual servers without operating systems installed. However, when including operating systems and software packages, this can cause potential problems as to how the customer should be billed when using the service for a limited time period. Often additional fees for the software use need to be paid

Intended user group

Cloud computing services offered are varied according to the users (private, public, corporate). Mainly IaaS and PaaS offerings are intended for companies, whereas SaaS offerings exist for corporations, private individuals or both, such as the Google Apps [6]. However, this does not imply that services aimed at companies cannot be purchased by individuals. A further distinction can be made between mobile and fixed users. Mobile users access their cloud computing services from anywhere such as office, home and from laptop or desktop. Fixed users are static and always use the same device to connect to the service. Once cloud computing services intended to support smart phones and other lower source devices are available an additional group, based on this hardware type, can be considered.

Security and privacy

Security and privacy are major aspects, because we know very usefull and important data resides on cloud's data server. Any kind of data leakage and losses cause overall profit of company [7]. There has certain rules are implemented to ensure data protection from any loss.

Formal Agreements

Service level arguments (formal arguments) define which level of service, quality of service is given to client [8]. The SLAs include technical specifications of measures, such as uptime or turn around time. Most SLAs also describe on failure what compensation provided to client. Due to the lack of standards most cloud service providers use SLA agreements to convince potential customers to use clouds "even for mission-critical industrial services.

IaaS -Specific Characteristics

The main IaaS specific characteristics are the available operating system, software frameworks and applications. Mostly IaaS providers support Open-Solaris , Linux systems, and Windows .Widely supported applications include the Apache HTTP Server and the MySQL database software. Another characteristic that is important for developers is whether and what kind of development tools the provider supplies. This could include an API or special command line tools [9]. Services comprising virtual instances can be further differentiated based on the virtualization technology used.

PaaS-specific characteristics

An important platform-level characteristic is related to which programming languages and environments are supported. Google's App Engine, for example, currently only supports Python and Java environments. The supported operating systems and applications can also be a relevant feature.[10]

SaaS-specific characteristics

Software cloud services vary a lot. A characteristic to be considered is the customer/application domain of the offered service. This domain could be customer relations or other business management areas, office applications, social networking, and data exchange.

IV. Evaluation Factor of Cloud Services

Below table describe the various factors of cloud services, based upon these factors it is very easy to choose which provider best suit the requirements.[4]

Facator	Features
Platform Supported	
Language Supported	
Cloud Services and Tools	These tools enable a developer to build and deploy an application without having to download anything to their desktop
Integrated Database Supported	A database accessible to clients from the cloud and delivered to users on demand via the Internet from a cloud database provider's servers

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Maximum Limits	
Service Level Agreements	A Service Level Agreement (SLA) describes agreement on non-functional requirements between provider and customer. Service Level Agreements (SLAs) are generally used to provide metrics and other information on the performance of the Services
Choice of data Hosting Location	The physical location of the server used to store and process data and applications.
Data Backup	it ,refers to backing up data to a remote, cloud-based server. As a form of cloud storage, cloud backup data is stored in and accessible from multiple distributed and connected resources that comprise a cloud
Data Security	It means protecting a database from destructive forces and the unwanted actions of unauthorized users. It refers to a broad set of policies, technologies, and controls deployed to protect data, applications, and the associated infrastructure of cloud computing.

V. CLOUD SERVICE PROVIDERS COMPARISON

Below table describe the comparative analysis of four cloud service providers with respective key features.[12]

CLOUD COMPUTING CONCERNS

A. Security

There are significant security concerns that need to be addressed when considering moving critical applications and sensitive data to public and shared cloud environments.

a) *Authentication:* An authentication for a cloud computing environment enables cloud customers to retain control over their enterprise information when their applications are deployed in the cloud. User authentication is a function that service providers offer to ensure that users accessing resources (e.g., applications, web content, etc.) are authorized to do so. To ensure that a user is not an imposter, service providers (e.g., web servers) generally ask for a user's username and password to prove identity before authorizing access to resources

b) *Encryption:* The main method used for ensuring data security in the cloud is by encryption. It is used to ensure sensitive or confidential data is kept safe and secure when transferred to external-based cloud service providers. It provide confidentiality by hiding all useful information about the plaintext.

c) *Firewall:*-Firewall Service prevents against unauthorized access to network infrastructure, prohibits access to inappropriate web content, restricts downloads of infected files, and enables secure use of your network through a secure managed gateway. firewalls Adds additional security features like Intrusion Prevention, web content filtering, data loss prevention and we can an create security policies that allow traffic for particular services, ports, and addresses.

B. Compliance of The Cloud

Cloud compliance concern arises as soon as you make use of cloud storage or backup services. By moving data from internal storage to external it is necessary to examine closely how that data will be kept so that it remain compliant with laws and industry regulations. So, when it comes to cloud compliance the concerns are what data should be move to the cloud and what should be kept in-house, what terms should be written into SLAs to maintain compliance?

a) *Data Location:* - The location of a data center can have a significant impact on the performance of applications delivered out of a cloud computing environment. After all, a poor choice in physical location can incur additional risk for enterprises trusting their applications to a cloud computing provider. If a cloud computing provider's primary data center is in the country where which is in risky location, the performance of that application will be adversely affected by various problems.[3]

b) *Service Level Agreements (SLAs):*- it tend to be treated as boilerplate documents which spell out what is expected from your cloud service provider in terms of uptime or availability and support[5].

C. Compatibility

It is another issue that restrains large organizations from embracing cloud technology. When existing IT infrastructure may not be compatible with cloud technology or too complex to restructure. The problem arises when the company would have to replace much of its existing IT infrastructures in order to make the system compatible on the cloud [2].

a) *Application Compatibility:*- it is especially important when you are considering moving existing code to a cloud platform as a service. You should assess how the restrictions will

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impact your code and estimate the cost and time required to modify the application. For example, if your application currently uses sockets to communicate between concurrent processes you might be able to use messaging queues instead. This kind of change might actually improve the reliability of your application since messaging queues guarantee items in the queue are eventually made available to other processes which may not be the case when applications using basic socket-based protocols crash.[1]

b) *Language Support*:- In cases where you are developing new applications, consider what languages and frameworks are supported. Cloud Bees is a PaaS for Java developers, PHP Fog, as the name implies, is geared toward PHP shots, while DotCloud allows customers to mix and match databases, message queues, caches and programming languages of their choice. Amazon Beanstalk takes a slightly different approach in that it is designed to automate provisioning, auto scaling, and load balancing. Developers control the combination of features, such as machine type and storage type. If at any time developers want to dive down into the virtual machine details they have the same options as those who directly run VMs on Amazon EC2 hardware.[1]

Cloud Services			
Windows Azure	Force.com	IBM	GoGrid
Pass Iass	Pass	Iaas	Iaas
Platform Supported			
Windows7 Windows Server 2008 Windows Vista	Programmable cloud logic Real Time Website Programmable User Interface	Microsoft Windows 2003 and 2008, Red Hat Enterprise Linux 5.4 and 5.5, Novell SUSE Linux Enterprise 11	Windows Server 2008 Windows Server 2003 Redhat linux 5.1
Language Supported			
Vb.net C # PHP	Java Ruby Perl Vb.net	All (Root Server Access)	Java PHP
Cloud Services and Tools			
Windows Azure Software Development kit Microsoft Visual Studio Service Pack1	Apex Language Code Editor Upgrade Wizard	Smart cloud application services, New soft layer cloud services	Cloud Control Command Line tool Cloud Wizards Open Source Cross cloud Scripting Language
Integrated Database Supported			
SQL Azure	NA	IBM® DB2® database	MSSQL Workgroup(64 bit) MSSQL 2008 Standard (64 bit)
Maximum Limits			
64 MB (Individual blob)	2000 database objects total: 120 MB per user storage	125 MB per user storage	Horizontal Server Scaling vertical Server Scaling
Service Level Agreements			
99.9% Uptime	99.9 + % Uptime	99.5 % Uptime	100 % Uptime
Choice of data Hosting Location			
USA	NA	USA	San Fran Cisco
Data Backup			
User is responsible for securing and backing up the data	All Customer Data is stored on primary database Server which is clustered with a backup	Data is stored on main server which is linked with many backup	User has to keep backup copy of all data

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	database server	server	
Data Security			
Filtering Routers Centralized Monitoring FirewallsService Administrator Access	User Authentication Physical Security Database Security	User authentication, database security,firewalls	Provided via Server Paths' Strong Infrastructure and Telecom Facility

VI. Conclusion

In this paper Cloud Computing, its types, services and characteristics have been discussed. In table 1 we have describe the evaluating factors that has been used for comparing the various Cloud Service Providers and table 2 provides the comparative analysis of four competitive Cloud Service Providers. It is clearly visible from table 2 that all four cloud service providers are efficient according to the usages of client .Finally cloud computing concern have been explained..

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