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Comparative Analysis of Cloud Computing Deployment Models

Dr. S. Thilagavathi

Assistant Professor Department of Computer Science NIFT-TEA College of Knitwear Fashion, Tirupur

Abstract

Cloud computing is known to all as one of the most popular technology in IT industries. Even non IT people are becoming habituated to use many applications of cloud computing day by day as well. New techniques of cloud computing are used to align information technology and business targets. So many opportunities are creating daily in the field of cloud computing. It offers easier access and excellent performance to execute the data on server through internet. Apart from these, people use YouTube, Gmail and so on as well which are completely dependent on cloud storage. Here in this paper, in brief on cloud architecture, services, storage, deployment models, benefits and challenges of cloud computing in real life. Cloud Computing represents a paradigm shift in how computing resources are accessed and utilized. Instead of owning and maintaining physical data centers and servers, organizations can access technology services such as computing power, storage, and databases on an as-needed basis from a cloud provider over the Internet.

Keywords: Cloud computing, Cloud Service Models, Service Model Architectures, Cloud Deployment Models, challenges & issues.

1. INTRODUCTION

Cloud computing is the “cloud” itself. For our purposes, the cloud is a large group of interconnected computers. These computers can be personal computers or network servers; they can be public or private. For example, Google hosts a cloud that consists of both smallish PCs and larger servers. Google’s cloud is a private one (that is, Google owns it) that is publicly accessible (by Google’s users). This cloud of computers extends beyond a single company or enterprise. The applications and data served by the cloud are available to broad group of users, cross-enterprise and cross-platform. Access is via the Internet. Any authorized user can access these docs and apps from any computer over any Internet connection. And, to the user, the technology and infrastructure behind the cloud is invisible. It isn’t apparent (and, in most cases doesn’t matter) whether cloud services are based on HTTP, HTML, XML, JavaScript, or other specific technologies. It might help to examine how one of the pioneers of cloud computing, Google, perceives the topic. From Google’s perspective, there are six key properties of cloud computing as below,

1.1 Cloud computing is user-centric. Once you as a user are connected to the cloud, whatever is stored there—documents, messages, images, applications, whatever—becomes yours. In addition, not only is the data yours, but you can also share it with others. In effect, any device that accesses your data in the cloud also becomes yours.

1.2 Cloud computing is task-centric. Instead of focusing on the application and what it can do, the focus is on what you need done and how the application can do it for you., Traditional applications—word

processing, spreadsheets, email, and so on—are becoming less important than the documents they create.

1.3 Cloud computing is powerful. Connecting hundreds or thousands of computers together in a cloud creates a wealth of computing power impossible with a single desktop PC. Cloud computing is accessible. Because data is stored in the cloud, users can instantly retrieve more information from multiple repositories. You're not limited to a single source of data, as you are with a desktop PC.

1.4 Cloud Computing is intelligent. With all the various data stored on the computers in a cloud, data mining and analysis are necessary to access that information in an intelligent manner.

1.5 Cloud Computing is Programmable. Many of the tasks necessary with cloud computing must be automated. For example, to protect the integrity of the data, information stored on a single computer in the cloud must be replicated on other.

2. CLOUD COMPUTING ARCHITECTURE

To store the data on cloud all kinds of organizations are using cloud computing system so that they can access to their system whenever they want. Basically cloud computing architecture is classified into two ways. One is Front End and other is Back End. Both of the ends are connected via internet.

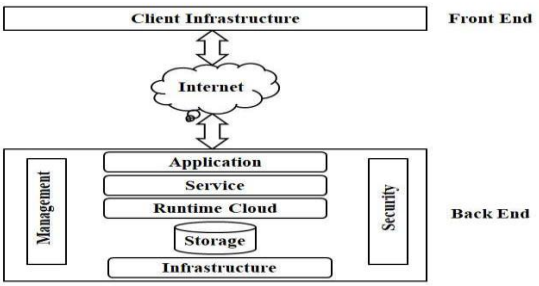

Fig. 1. Cloud Computing Architecture

To provide the security of the information for cloud users, back end is responsible. The service providers use the back end. All the resources those are needed to give services are managed by it. It comprises a security mechanism, large volume of data storage, servers, virtual machines, traffic control mechanisms, deploying models and so on[1].

3. CLOUD COMPUTING SERVICES

Cloud computing services are divided into three classes, according to the abstraction level of the capability provided and the service model of providers, namely:

1. Infrastructure as a Service
2. Platform as a Service and
3. Software as a Service.

3.1. Infrastructure as a Service (IaaS)

A cloud infrastructure enables on-demand provisioning of servers running several choices of operating systems and a customized software stack. Infrastructure services are considered to be the bottom layer of cloud computing systems.

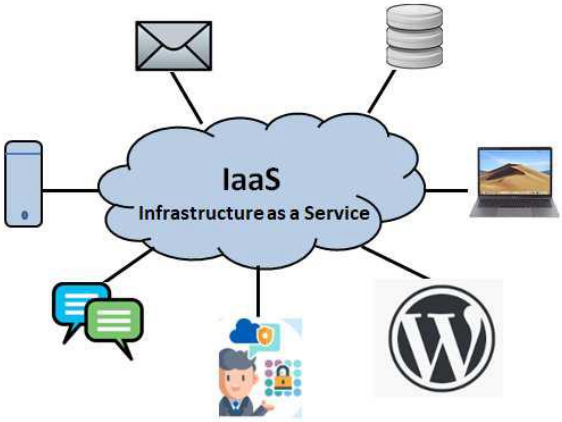

Fig. 2. Infrastructure as a Service (IaaS)

3.2. Platform as a Service (PaaS)

A cloud platform offers an environment on which developers create and deploy applications and do not necessarily need to know how many processors or how much memory that applications will be using. In addition, multiple programming models and specialized services (e.g., data access, authentication, and payments) are offered as building blocks to new applications.

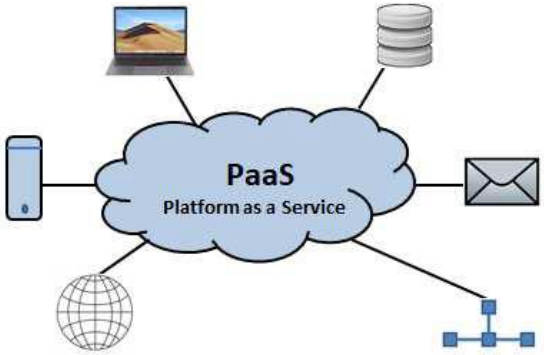

Fig. 3. Platform as a Service (PaaS)

Google App Engine, an example of Platform as a Service, offers a scalable environment for developing and hosting Web applications, which should be written in specific programming languages such as Python or Java, and use the services‘ own proprietary structured object data store.

3.3. Software as a Service (SaaS)

Applications reside on the top of the cloud stack. Services provided by this layer can be accessed by end users through Web portals. Therefore, consumers are increasingly shifting from locally installed computer programs to on-line software services that offer the same functionally

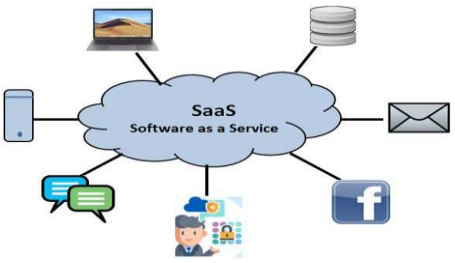

Fig. 4. Software as a Service (SaaS)

Salesforce.com, which relies on the SaaS model, offers business productivity applications (CRM) that reside completely on their servers, allowing costumers to customize and access applications on demand[2][3].

4. DEPLOYMENT MODELS

Cloud Computing Deployment Model is classified into four ways: 1) Public Cloud, 2) Private Cloud, 3) Hybrid Cloud and4) Community Cloud[4][5]. A brief discussion on all cloud. Deployment model as shown in Figure 5

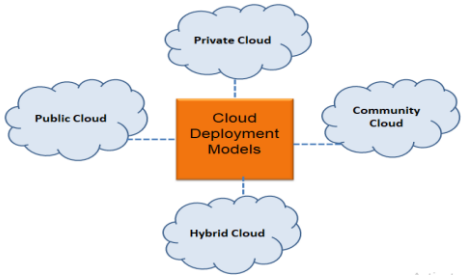

Fig 5: Cloud Computing Deployment Model

- Public cloud as a cloud made available in a pay-as-you-go manner to the general public‖ and private cloud as internal data center of a business or other organization, not made available to the general public.‖
- Establishing a private cloud means restructuring an existing infrastructure by adding virtualization and cloud-like interfaces. This allows users to interact with the local data center while experiencing the same advantages of public clouds, most notably self-service interface, privileged access to virtual servers, and per-usage metering and billing.
- A community cloud is shared by several organizations and a specific community that has shared concerns (e.g., mission, security requirements, policy, and compliance considerations)
- A hybrid cloud takes shape when a private cloud is supplemented with computing capacity from public clouds. The approach of temporarily renting capacity to handle spikes in load is known as cloud-bursting [6][7].

4.1 Effective cloud deployment model

With an effective cloud deployment model, an organization achieves numerous benefits, including:

- **Faster and simplified deployments.** Automate builds that deploy code, databases and application releases, including resource provisioning.
- **Cost savings.** Control costs using consumption-based pricing and eliminate capex-heavy on-premises environments.
- **Platform for growth.** Leverage the global infrastructure provided by cloud service providers (CSPs) to seamlessly expand the business into other geographies.
- **New digital business models.** Exploit the continuous release of features and services by CSPs, incubate new technologies and innovate digital business models.
- **Business resiliency.** Architect for the availability and fault-tolerance CSPs offer and ensure disaster recovery and business continuity of applications to make the business resilient[8].
- **Agility and scalability.** Use autoscaling and scalability to meet peak demands of the business without provisioning for excess capacity.

- **Geographic reach.** Access applications from any location, on any device, leveraging the connectivity backbone of CSPs.
- **Operational efficiency.** Use the inherent automation enabled by cloud to increase operational efficiency and reduce human effort.
- **A competitive edge.** Leverage infrastructure as code and development, security and operations to reduce the time to market for new features and stay ahead of the competition.
- **Empowered users.** Increase productivity by empowering users with self-service options on cloud, such as portals, pipelines and executive and operational dash boards[9][10].

5. COMPARISON OF CLOUD SERVICE MODELS: Iaas Vs Paas Vs Saas

Feature	IaaS (Infrastructure as a Service)	PaaS (Platform as a Service)	SaaS (Software as a Service)
User Control	Most control: OS, storage, applications	Manages apps and data	Minimal control—just use the software
Provider Manages	Hardware, virtualization	Hardware, OS, middleware	Everything including the application
Use Case	Hosting virtual machines, storage	App development, deployment	CRM, Email, Collaboration tools
Examples	AWS EC2, Google Compute Engine	Google App Engine, Azure App Services	Google Workspace, Salesforce, Dropbox
Scalability	High	High	Very high
Flexibility	Maximum	Moderate	Limited

6. COMPARISON OF CLOUD DEPLOYMENT MODELS

Comparative analysis of cloud computing across several key dimensions: service models, deployment models, providers, performance, security, and cost. This helps understand how different approaches and technologies in cloud computing stack up[11][12]

Feature	Public Cloud	Private Cloud	Hybrid Cloud	Community Cloud
Ownership	Third-party provider (e.g., AWS, Azure)	Single organization	Combination of public + private	Shared by multiple organizations
Infrastructure Location	Off-premises	On-premises or hosted	Both on- and off-premises	Shared, often hosted externally
Cost Model	Pay-as-you-go	High CapEx, lower OpEx after setup	Variable, depending on usage	Shared among members
Scalability	High, virtually unlimited	Limited by internal resources	High (via public cloud component)	Moderate

Feature	Public Cloud	Private Cloud	Hybrid Cloud	Community Cloud
Security & Privacy	Moderate (provider-managed)	High (org-controlled)	High if managed properly	High, with shared standards
Customization	Limited	Extensive	Moderate	Some customization possible
Maintenance	Handled by provider	Handled internally or by third party	Split between public/private parties	Shared or managed by hosting provider
Best For	Startups, SaaS apps, web services	Banks, governments, regulated industries	Enterprises with mixed needs	Research groups, government alliances
Examples	AWS, Google Cloud, Microsoft Azure	VMware vSphere, OpenStack private clouds	Azure Stack, AWS Outposts	Government clouds (e.g., FedRAMP), GENI

7. CONCLUSION

Cloud computing has been defined as "everything that we currently do". Many technologies that have been branded as "cloud computing" have existed for a long time before the "cloud" label came into existence. Examples include databases, load balanced on-demand web hosting services, network storage, real time online services, hosted services in general. Understanding cloud computing architecture, service models, and deployment models is crucial for organizations seeking to leverage the benefits of cloud technology. By carefully selecting the appropriate services and deployment strategies, businesses can optimize their IT operations, enhance agility, and drive innovation in today's competitive landscape.

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