

## Cloud Computing-An Emerging Technology and Review of Hybrid Models

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### ABSTRACT

The cloud heralds a new era of computing where application services are provided through the Internet. Cloud computing enhances the computing capability of mobile systems. It is an emerging technology and all the organizations (be it large or small) are thinking about deploying their applications on the cloud. Today this technology is widely adoptable as it provides integration of software and resources which are dynamically scalable. This paper presents an overview of cloud computing, advantages/disadvantages of various cloud computing deployment models, viz. private, public, hybrid and community clouds. Comparison of private, public and hybrid cloud has been done along with pros and cons of using one over the other.

**Keywords--** Cloud Computing, QOS, VPC, GAE

## I. INTRODUCTION

Cloud computing is a type of computing that use the internet for sharing of information, software and resources to computer and other devices upon demand. Resources on the cloud can be deployed by the vendor, and used by the client. This enables the end user to access the cloud computing resource anytime from any platform such as cell phone, mobile computing platform or the desktop.

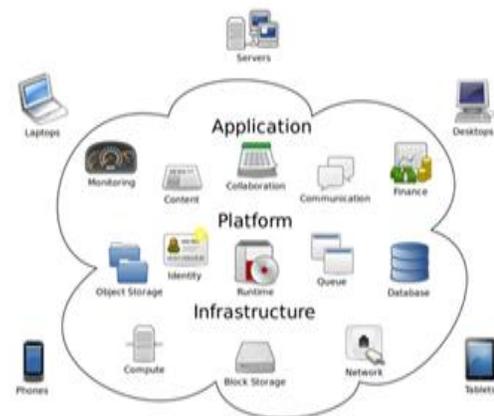
It makes *computing* and *storage* available to the end-users as *services*. We can share the resources along with the costs. Based on 'pay-per-use'[2] basis i.e. users pay as they go and only use what they need at any given time, keeping cost to the user down. It aims to provide reliable, and quality of service and guaranteed computing lively environments for end-users. The increasing demand for flexibility in obtaining and releasing computing resources in a cost-effective manner has resulted in a wide adoption of the Cloud computing paradigm[1].

The cloud is classified into three domains:

(a) Applications (or software)

(b) Platform

(c) Infrastructure.



**Fig.1. Basic Cloud Infrastructure**

Amazon is the first company to look into the growing importance of Cloud computing very seriously followed by Google and IBM. Cloud computing emerges as a new computing paradigm which aims to provide reliable, and quality of service guaranteed computing lively environments for end-users. The increasing demand for flexibility in obtaining and releasing computing resources in a cost-effective manner has resulted in a wide adoption of the Cloud computing paradigm.

## II. CLOUD COMPONENTS[6]

Cloud computing is made up of several elements. Each element has a purpose which plays specific roles which can be classified as clients, Distributed servers, data centers[3].

A. Clients: These are typically the computers which are used by the end users i.e. the devices which can be used by the end user to manage the information on cloud (laptops, mobile phones, PDAs etc.)

B. Data center: These are collection of servers where the service is hosted. In order to create number of virtual server on one physical server in data center, virtualization is used.

C. Distributed servers: These are servers which are located in different geographical place. It provides better accessibility, security to the user.

### III. CHARACTERISTICS OF CLOUD COMPUTING

There are ten characteristics of cloud computing in their sum up: device and location independence, scalability, on-demand services, guaranteed Quality of Service (QOS), pricing, virtualization, multi-tenancy, security and fault tolerant[3] [4][5].

A. Scalability and on-demand services: users are given on-demand resources and services over cloud. Moreover the resources provided are scalable over several data centers

B. User-centric interface: cloud interfaces are not dependent on location of user. They can be accessed by well-established interfaces such as web services and internet browsers.

C. Guaranteed Quality of Service (QOS): Cloud computing assures Quality of service for users by guaranteed performance, bandwidth and memory capacity.

D. Autonomous system: users can reconfigure and combine software and information according to their requirements.

E. Cost: No capital expenditure or any up-form investment is required in cloud. Payment for services is made on the basis of need.

F. Virtualization: Utilization of resources is increased by sharing the server and storage devices

G. Multi-tenancy: Sharing of resource and cost among large number of users increase efficiency

H. Loose coupling: The resources are loosely coupled as one resource functionality hardly affects the functioning of another resource.

I. Reliable Delivery: TCP/IP is used for delivery of information between resources. Private network protocols are used within the cloud infrastructure but most of the user are connected using HTTP protocol.

J. High Security: This is maintained on the above discussed characteristics. Loose coupling enables the jobs to execute run well, even if part of cloud is destroyed. Virtualization and abstraction of cloud provider avoid exposing the detailing of implementation.

### IV. CLOUD DEPLOYMENT MODELS

On the bases of access to clouds, they can be classified into following types [6]:

A. *Public Cloud*: The public cloud, offer applications, storage and other services to the general public by a service provider. This is based on “pay-as-you-go” model. A public cloud is constructed to offer unlimited storage space and increased bandwidth via Internet to all business organizations. Public clouds are owned, hosted and operated by third-party service providers. All customers share the same infrastructure pool with limited configuration, security protections, and availability variances.

Popular examples of public clouds include Amazon Elastic Cloud Compute, Google App Engine(GAE), Blue Cloud by IBM and Azure services Platform by Windows.



Fig.2. Public Cloud[7]

Advantages [5]:

1. Low Cost
2. Reduced Time
3. No maintenance
4. No contracts
5. Reliability

Disadvantages

1. Lack of control
2. Slow speed
3. Lack of investment
4. Weaker security

B. *Private Cloud*: A private cloud in an organization is specific and limited access to a particular group. It can be referred as computing services delivered exclusively for the use of a particular organization. It is managed by a group internally or by a third-party and hosted internally or externally. It utilizes the same architecture for scalability and availability as the public cloud but it is limited to a single organization. Popular examples of private cloud include Amazon Virtual Private Cloud (Amazon VPC), IBM Smart Cloud Foundation and Microsoft Private Cloud.

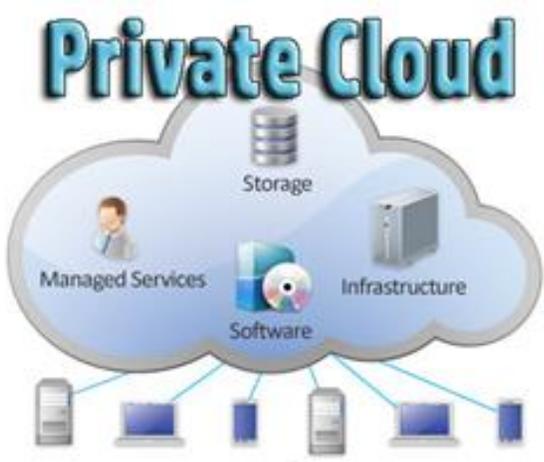


Fig.3. Private Cloud[7]

There are two variations of private clouds:  
 1) *On-Premise Private Cloud*: it is hosted within an organization’s own data centre. It is often limited in size and scalability. These are best used for applications that require complete control and configurability of the infrastructure and security.

2) *Externally-Hosted Private Cloud*: This private cloud model is hosted by an external cloud computing provider. The service provider facilitates an exclusive cloud environment with full guarantee of privacy.

- |                       |                             |
|-----------------------|-----------------------------|
| Advantages[5]:        | Disadvantages:              |
| 1. Greater Control    | 1. Higher Cost              |
| 2. More security      | 2. On-site maintenance      |
| 3. Higher performance | 3. Capacity ceiling         |
| 4. Customizable       | 4. Higher security required |

C. *Hybrid Cloud*: Hybrid clouds combine the advantages of private and public clouds, offer flexibility, control and security of multiple deployment models. With a Hybrid Cloud, service providers can expand the adaptability of computing by utilizing other Cloud Providers. The Hybrid cloud environment is capable for providing on-demand, externally provisioned scale with the capacity to enlarge a private cloud to deal with any sudden variations in workload.

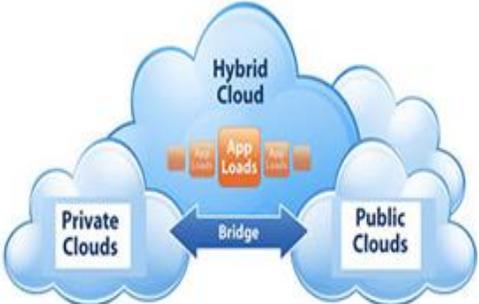


Fig.4. Hybrid Cloud[7]

- |                       |                               |
|-----------------------|-------------------------------|
| Advantages:           | Disadvantages:                |
| 1. Higher Performance | 1. Infrastructural dependency |
| 2. Security           | 2. Complex SLAs               |
| 3. Scalability        | 3. Data protection            |
| 4. Provisioning       | 4. Complex networking         |

D. *Community Cloud*: The cloud infrastructure is shared between the organizations having similar interests and requirements 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 cost savings potential of cloud computing are realized. This may help limit the capital expenditure costs for its establishment as the costs are shared among the organizations [6]. For example, all the government agencies in a city can share the same cloud but not the non government agencies.

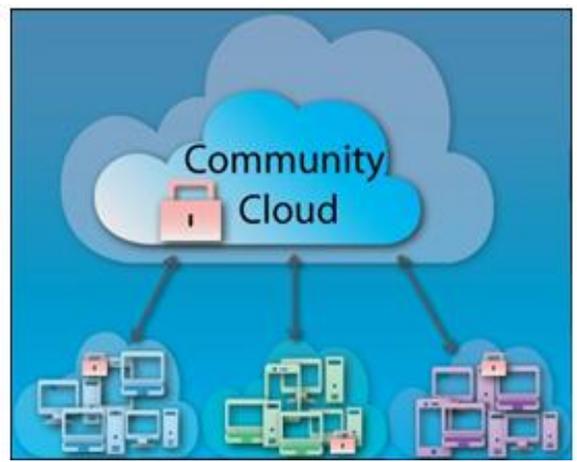


Fig.5. Community Cloud[7]

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|---------------------------|--------------------------------|
| Advantages[5]:            | Disadvantages:                 |
| 1. Effective Cost savings | 1. Latency and Security issues |
| 2. Shared Resources       | 2. Slow Speed                  |

Comparison of Public, Private and Hybrid cloud has been done [4] to get a clear understanding of advantages of using one cloud over the other.

	Parameters	Public	Private	Hybrid
1.	Scalability	Very high	Limited	Very high, burst able
2.	Security	Low; depends on encryption techniques used by service providers	High	Moderate
3.	Performance	Low to medium	Very good	Good
4.	Reliability	Medium, it depends on the service	High, as many of the equipments	Medium to high, as replicated

		provider availability and connection to internet	are within the organization	content is kept within enterprises
5.	Cost of use	Pay-as-you-use	High cost of initial set up	Pay-as-you-use
6.	Data & Application Integration	Easy	Easy	Difficult due to change in cloud platforms
7.	System Management	Easier as compared to hybrid cloud	Easier as compared to hybrid cloud	Difficult as compared to public and private cloud
8.	Portability	Easy	Easy	Difficult
9.	Data Security Solutions	Better encryption techniques, authentication of user by the provider	Encryption of data on private servers	Encryption of personal data, Sensitive data should not be stored in public cloud
10.	Accountability Solutions	Moderate chances of privacy violation	Less chances of privacy violation	Audit needed in each step, Data loss, leakage or privacy violation may be dangerous
11.	Data Handling	All the data is on public platform	All the data is on private platform	Confidential data is stored on private servers
12.	Workload	Normal workload with short-term spikes in demand	Mission-critical workload with security concerns or management demands	Highly dynamic or changeable
13.	Capital Expense	Low	High	Reduced, as the increase in demand is outsourced to public cloud
14.	Cloud bursting	Not supported	Not supported	Supported

## V. FUTURE SCOPE

Cloud computing continues to experience rapid proliferation because of its potential advantages with respect to ease of usage and its availability at a much lower cost than running an owned computing infrastructure.

According to Gartner Inc., it is estimated that ~50% of large enterprises are expected to choose hybrid cloud deployments by the end of 2017. Right Scale's "2014 State of the Cloud Survey" also showed that 48% of the organizations plan to adopt the hybrid cloud by 2017. All this data implies the huge growth that hybrid cloud is expected to witness in the future.

With arrival of cloud computing the traditional way of computing has gone for a vast sea change. And this new addition in the computing is going to rule in the future. Hybrid cloud is going to be the face of future cloud computing which seems to be very promising.

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