UNIT V

CLOUD COMPUTING

Definition of Cloud Computing – Characteristics of Cloud – Cloud Deployment Models – Cloud Service Models – Driving Factors and Challenges of Cloud – Virtualization – Load Balancing – Scalability and Elasticity – Replication – Monitoring – Cloud Services and Platforms: Compute Services – Storage Services – Application Services

Definition of Cloud Computing

Cloud computing is on-demand access, via the internet, to computing resources applications, servers (physical servers and virtual servers), data storage, development tools, networking capabilities, and more—hosted at a remote data center managed by a cloud services provider (or CSP). The CSP makes these resources available for a monthly subscription fee or bills them according to usage.

Cloud computing is a virtualization-based technology that allows us to create, configure, and customize applications via an internet connection. The cloud technology includes a development platform, hard disk, software application, and database.

The term cloud refers to a network or the internet. It is a technology that uses remote servers on the internet to store, manage, and access data online rather than local drives. The data can be anything such as files, images, documents, audio, video, and more.

Cloud Computing is defined as storing and accessing of data and computing services over the internet. It doesn't store any data on your personal computer. It is the on-demand availability of computer services like servers, data storage, networking, databases, etc. The main purpose of cloud computing is to give access to data centers to many users. Users can also access data from a remote server.

Cloud computing decreases the hardware and software demand from the user's side. The only thing that user must be able to run is the cloud computing systems interface software, which can be as simple as Web browser, and the Cloud network takes care of the rest. We all have experienced cloud computing at some instant of time, some of the popular cloud services we have used or we are still using are mail services like gmail, hotmail or yahoo etc.

Examples of Cloud Computing Services: AWS, Azure,

Characteristics of Cloud

The characteristics of cloud computing are given below:

1) Agility

The cloud works in a distributed computing environment. It shares resources among users and works very fast.

2) High availability and reliability

The availability of servers is high and more reliable because the chances of infrastructure failure are minimum.

3) High Scalability

Cloud offers "on-demand" provisioning of resources on a large scale, without having engineers for peak loads.

4) Multi-Sharing

With the help of cloud computing, multiple users and applications can work more efficiently with cost reductions by sharing common infrastructure.

5) Device and Location Independence

Cloud computing enables the users to access systems using a web browser regardless of their location or what device they use e.g. PC, mobile phone, etc. As infrastructure is off-site (typically provided by a third-party) and accessed via the Internet, users can connect from anywhere.

6) Maintenance

Maintenance of cloud computing applications is easier, since they do not need to be installed on each user's computer and can be accessed from different places. So, it reduces the cost also.

7) Low Cost

By using cloud computing, the cost will be reduced because to take the services of cloud computing, IT company need not to set its own infrastructure and pay-as-per usage of resources.

8) Services in the pay-per-use mode

Application Programming Interfaces (APIs) are provided to the users so that they can access services on the cloud by using these APIs and pay the charges as per the usage of services.

Cloud Deployment Models

The cloud deployment model identifies the specific type of cloud environment based on ownership, scale, access, and the cloud's nature and purpose. There are various deployment models are based on the location and who manages the infrastructure.

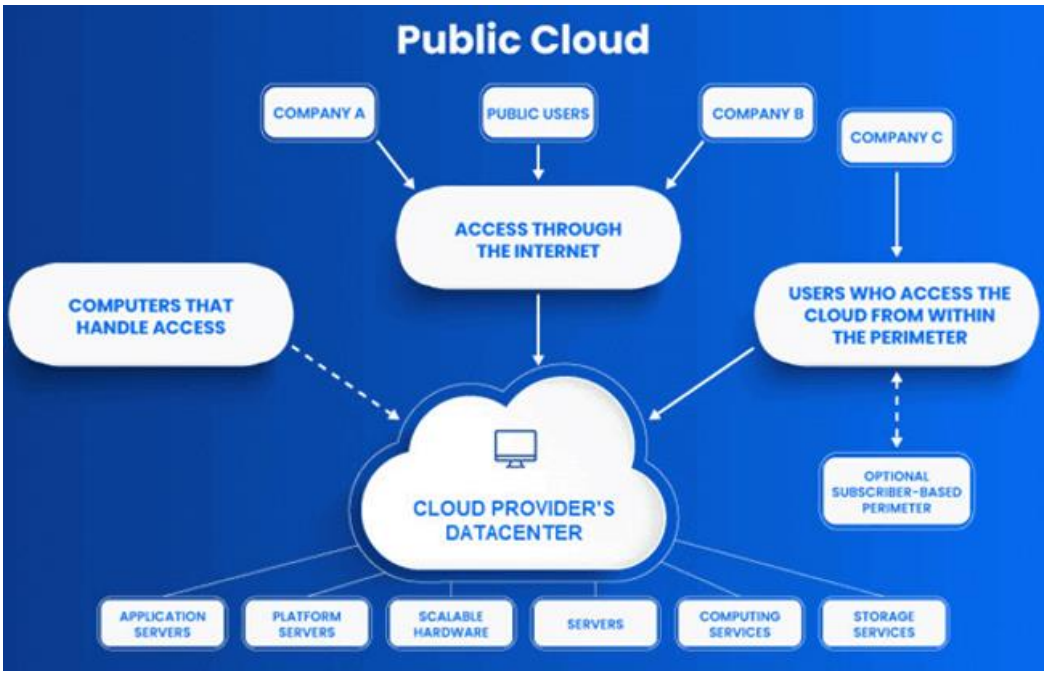
Type of Cloud Deployment Model

Here are some important types of Cloud Deployment models:

- **Private Cloud:** Resource managed and used by the organization.
- **Public Cloud:** Resource available for the general public under the Pay as you go model.
- **Community Cloud:** Resource shared by several organizations, usually in the same industry.
- **Hybrid Cloud:** This cloud deployment model is partly managed by the service provided and partly by the organization.

Public Cloud

The public cloud is available to the general public, and resources are shared between all users. They are available to anyone, from anywhere, using the Internet. The public cloud deployment model is one of the most popular types of cloud.



This computing model is hosted at the vendor's data center. The public cloud model makes the resources, such as storage and applications, available to the public over the WWW. It serves all the requests; therefore, resources are almost infinite.

Characteristics of Public Cloud

Here are the essential characteristics of the Public Cloud:

- Uniformly designed Infrastructure
- Works on the Pay-as-you-go basis
- Economies of scale
- SLA guarantees that all users have a fair share with no priority
- It is a multitenancy architecture, so data is highly likely to be leaked

Advantages of Public Cloud Deployments

Here are the pros/benefits of the Public Cloud Deployment Model:

- Highly available anytime and anywhere, with robust permission and authentication mechanism.
- There is no need to maintain the cloud.
- Does not have any limit on the number of users.
- The cloud service providers fully subsidize the entire Infrastructure. Therefore, you don't need to set up any hardware.
- Does not cost you any maintenance charges as the service provider does it.
- It works on the Pay as You Go model, so you don't have to pay for items you don't use.
- There is no significant upfront fee, making it excellent for enterprises that require immediate access to resources.

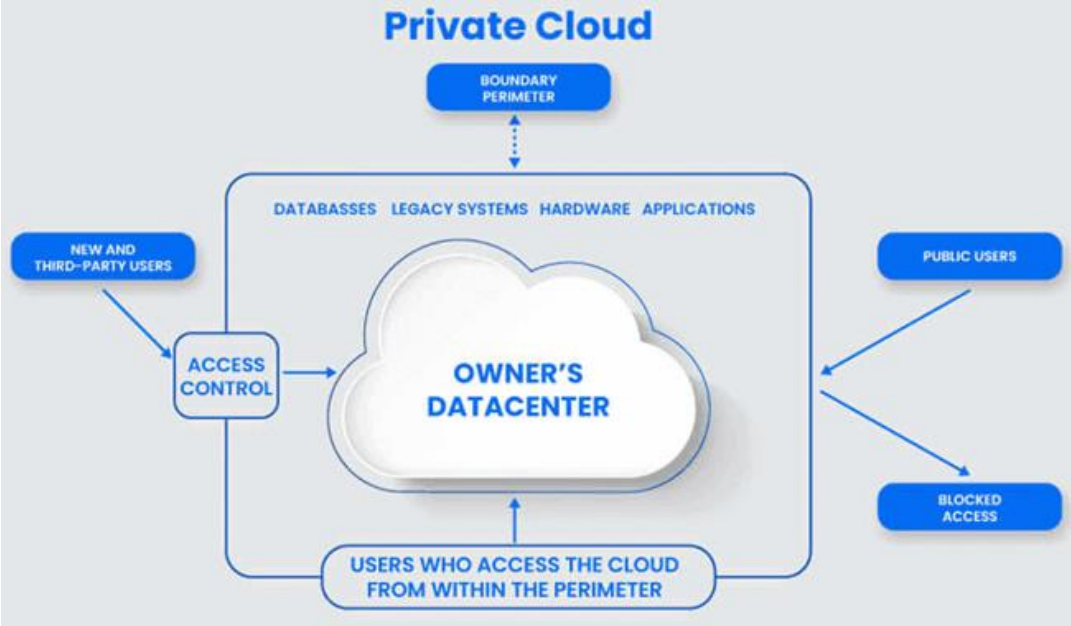
Disadvantages of Public Cloud Deployments

Here are the cons/drawbacks of the Public Cloud Deployment Model:

- It has lots of issues related to security.
- Privacy and organizational autonomy are not possible.
- You don't control the systems hosting your business applications.

Private Cloud Model

The private cloud deployment model is a dedicated environment for one user or customer. You don't share the hardware with any other users, as all the hardware is yours. It is a one-to-one environment for single use, so there is no need to share your hardware with anyone else. The main difference between private and public cloud deployment models is how you handle the hardware. It is also referred to as "internal cloud," which refers to the ability to access systems and services within an organization or border.



Characteristics of Private Cloud

Here are the essential characteristics of the Private Cloud:

- It has a non-uniformly designed infrastructure.
- Very low risk of data leaks.
- Provides End-to-End Control.
- Weak SLA, but you can apply custom policies.
- Internal Infrastructure to manage resources easily.

Advantages of Private Cloud Deployments

Here are the pros/benefits of the Private Cloud Deployment Model:

- You have complete command over service integration, IT operations, policies, and user behavior.
- Companies can customize their solution according to market demands.
- It offers exceptional reliability in performance.
- A private cloud enables the company to tailor its solution to meet specific needs.
- It provides higher control over system configuration according to the company's requirements.
- Private cloud works with legacy systems that cannot access the public cloud.
- This Cloud Computing Model is small, and therefore it is easy to manage.
- It is suitable for storing corporate information that only permitted staff can access.
- You can incorporate as many security services as possible to secure your cloud.

Disadvantages of Private Cloud Deployments

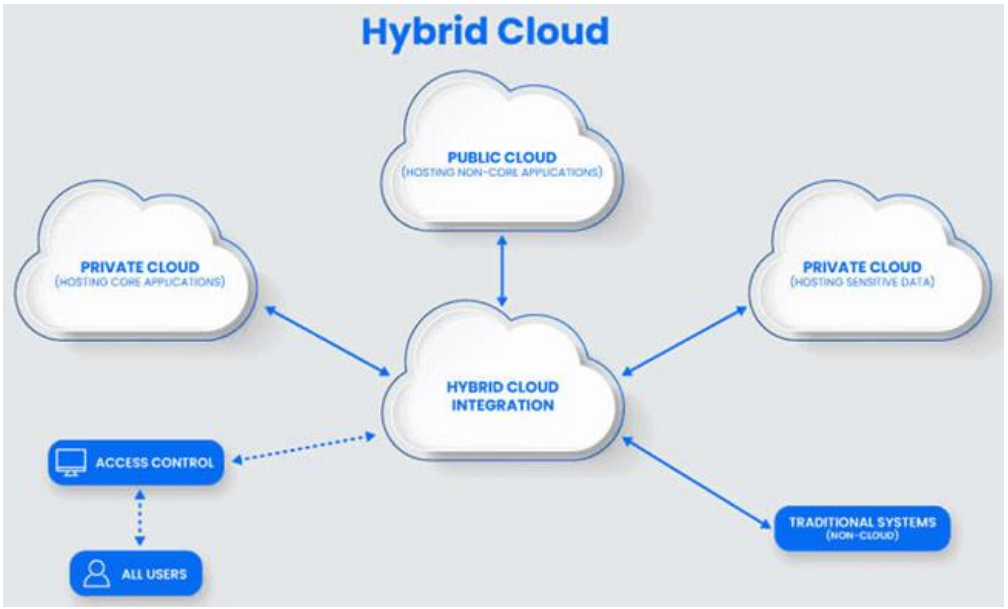
Here are the cons/drawbacks of the Private Cloud Deployment Model:

- It is a fully on-premises-hosted cloud that requires significant capital to purchase and maintain the necessary hardware.
- Companies that want extra computing power must take extra time and money to scale up their Infrastructure.
- Scalability depends on the choice of hardware.

Hybrid Cloud Model

A hybrid cloud deployment model combines public and private clouds. Creating a hybrid cloud computing model means that a company uses the public cloud but owns on-premises systems and provides a connection between the two. They work as one system, which is a beneficial model for a smooth transition into the public cloud over an extended period.

Some companies cannot operate solely in the public cloud because of security concerns or data protection requirements. So, they may select the hybrid cloud to combine the requirements with the benefits of a public cloud. It enables on-premises applications with sensitive data to run alongside public cloud applications.



Characteristics of Hybrid Cloud

Here are the Characteristics of the Hybrid Cloud:

- Provides betters security and privacy
- Offers improved scalability
- Cost-effective Cloud Deployment Model
- Simplifies data and application portability

Advantages of Hybrid Cloud Deployments

Here are the pros/benefits of the Hybrid Cloud Deployment Model:

- It gives the power of both public and private clouds.
- It offers better security than the Public Cloud.
- Public clouds provide scalability. Therefore, you can only pay for the extra capacity if required.
- It enables businesses to be more flexible and to design personalized solutions that meet their particular needs.
- Data is separated correctly, so the chances of data theft by attackers are considerably reduced.
- It provides robust setup flexibility so that customers can customize their solutions to fit their requirements.

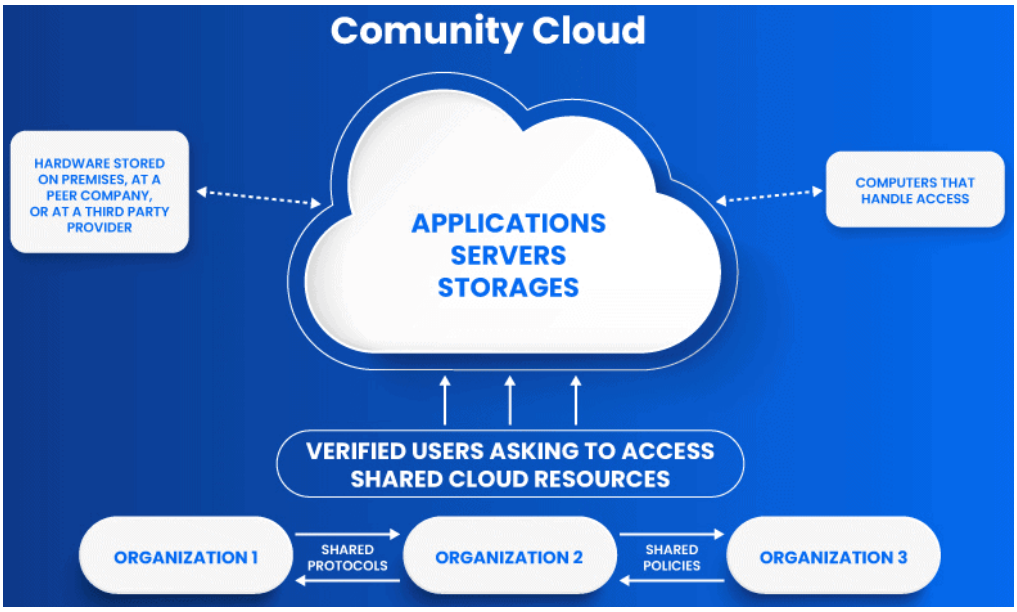
Disadvantages of Hybrid Cloud Deployments

Here are the cons/drawbacks of the Hybrid Cloud Deployment Model:

- It is applicable only when a company has varied use or demand for managing the workloads.
- Managing a hybrid cloud is complex, so if you use a hybrid cloud, you may spend too much.
- Its security features are not good as the Private Cloud.

Community Cloud Model

Community clouds are cloud-based infrastructure models that enable multiple organizations to share resources and services based on standard regulatory requirements. It provides a shared platform and resources for organizations to work on their business requirements. This Cloud Computing model is operated and managed by community members, third-party vendors, or both. The organizations that share standard business requirements make up the members of the community cloud.



Advantages of Community Cloud Deployments

Here are the pros/benefits of the Community Cloud Deployment Model:

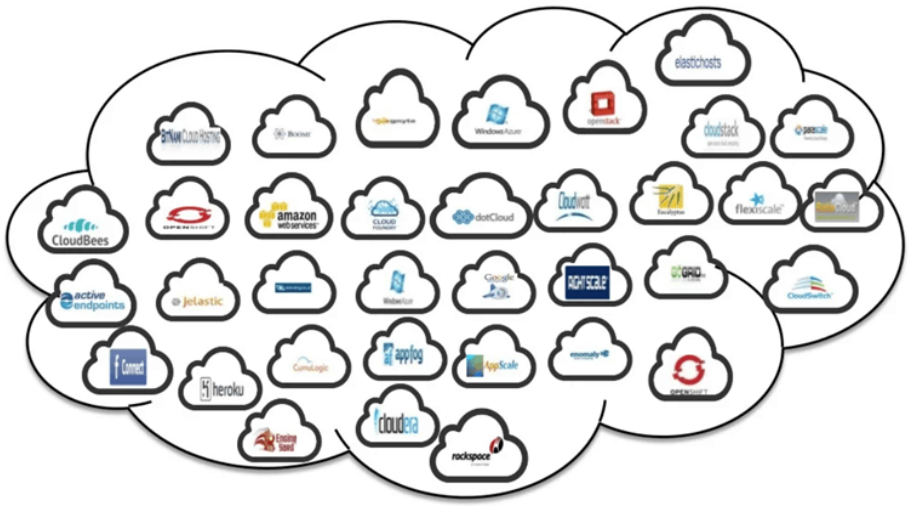
- You can establish a low-cost private cloud.
- It helps you to do collaborative work on the cloud.
- It is cost-effective, as multiple organizations or communities share the cloud.
- You can share resources, Infrastructure, etc., with multiple organizations.
- It is a suitable model for both collaboration and data sharing.
- Gives better security than the public cloud.
- It offers a collaborative space that allows clients to enhance their efficiency.

Disadvantages of Community Cloud Deployments

Here are the cons/drawbacks of the Community Cloud Deployment Model:

- Because of its restricted bandwidth and storage capacity, community resources often pose challenges.
- It is not a very popular and widely adopted cloud computing model.
- Security and segmentation are challenging to maintain.

Multi-cloud Model



Multi-cloud computing refers to using public cloud services from many cloud service providers. A company must run workloads on IaaS or PaaS in a multi-cloud configuration from multiple vendors, such as Azure, AWS, or Google Cloud Platform.

There are many reasons an organization selects a multi-cloud strategy. Some use it to avoid vendor lock-in problems, while others combat shadow IT through multi-cloud

deployments. So, employees can still benefit from a specific public cloud service if it does not meet strict IT policies.

Benefits of Multi-Cloud Deployment Model

Here are the pros/benefits of the Multi-Cloud Deployment Model:

- A multi-cloud deployment model helps organizations choose the specific services that work best for them.
- It provides a reliable architecture.
- With multi-cloud models, companies can choose the best Cloud service provider based on contract options, flexibility with payments, and customizability of capacity.
- It allows you to select cloud regions and zones close to your clients.

Disadvantages of Multi-Cloud Deployments

Here are the cons/drawbacks of the Multi-Cloud Deployment Model:

- Multi-cloud adoption increases the complexity of your business.
- Finding developers, engineers, and cloud security experts who know multiple clouds is difficult.
- **Comparison of Top Cloud Deployment Models**

Parameters	**Public**	**Private**	**Community**	**Hybrid**
Setup and use	Easy	Need help from a professional IT team.	Require a professional IT team.	Require a professional IT team.
Scalability and Elasticity	Very High	Low	Moderate	High
Data Control	Little to none	Very High	Relatively High	High
Security and privacy	Very low	Very high	High	Very high
Reliability	Low	High	Higher	High
Demand for in-house software	No	Very high in-house software requirement	No	In-house software is not a must.

How to select the suitable Cloud Deployment Models

Companies are extensively using these cloud computing models all around the world. Each of them solves a specific set of problems. So, finding the right Cloud Deployment Model for you or your company is important.

Here are points you should remember for selecting the right Cloud Deployment Model:

- **Scalability:** You need to check if your user activity is growing quickly or unpredictably with spikes in demand.
- **Privacy and security:** Select a service provider that protects your privacy and the security of your sensitive data.
- **Cost:** You must decide how many resources you need for your cloud solution. Then calculate the approximate monthly cost for those resources with different cloud providers**.**
- **Ease of use:** You must select a model with no steep learning curve.
- **Legal Compliance:** You need to check whether any relevant low stop you from selecting any specific cloud deployment model.