# UNIT - 1

## CLOUD COMPUTING

Cloud computing is a transforming way of business operations by offering scalable and flexible computing resources over the Internet. It facilitates organizations to access data, applications, and services from anywhere, at any time, resulting in increased efficiency and cost-effectiveness. Cloud computing makes free from the need for on-premises infrastructure and lets to empowers businesses to focus on innovation and growth rather than managing IT hardware.

Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.

### Essential Characteristics:-

**On-demand self-service** : A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.

**Broad network access** : Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations).

**Resource pooling** : The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of

location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter). Examples of resources include storage, processing, memory, and network bandwidth.

**Rapid elasticity** : Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be appropriated in any quantity at any time.

**Measured service** : Cloud systems automatically control and optimize resource use by leveraging a metering capability1 at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service.

## Deployment Models:-

**Private cloud :** The cloud infrastructure is provisioned for exclusive use by a single organization comprising multiple consumers (e.g., business units). It may be owned, managed, and operated by the organization, a third party, or some combination of them, and it may exist on or off premises.

**Community cloud :** The cloud infrastructure is provisioned for exclusive use by a specific community of consumers from organizations that have shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be owned, managed, and operated by one or more of the organizations

in the community, a third party, or some combination of them, and it may exist on or off premises.

**Public cloud :** The cloud infrastructure is provisioned for open use by the general public. It may be owned, managed, and operated by a business, academic, or government organization, or some combination of them. It exists on the premises of the cloud provider.

**Hybrid cloud :** The cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load balancing between clouds).

## What are the different types of Cloud Computing?

Cloud Computing includes the cloud types such as Infrastructure as a Service ( IaaS ), Platform as a Service ( PaaS ), and Software as a Service ( SaaS ). In this IaaS provides virtualized computing resources, PaaS provides development and deployment platforms and SaaS provides software applications over the internet. These services are complemented by various deployment models such as public, private, hybrid and multicloud diverse business needs and preferences.

## Types Of Cloud Computing Models

In general, Cloud Computing Models are widely classified into 4 types. They are as follows:

1. **IaaS (Infrastructure as a Service)**

- It provides scalable and virtualized computing resources like servers, storage, and networking over the internet.

- In this service, users can have full control over the infrastructure, having customization and management access of virtual machines, storage, and networking components.

### 2. PaaS (Platform as a Service)

- It provides a platform and a environment for developers to build, deploy, and manage applications without dealing with the underlying infrastructure.
- It offers tools and services such as development frameworks, databases, and middleware, streamlining the application development lifecycle.

### 3. SaaS (Software as a Service)

- SaaS elivers software applications over the internet on a subscription basis. It eliminating the need for users to install, maintain, or update the software locally.
- With this service users can access the applications from any device with an internet connection, enabling flexibility and accessibility.

### 4. Serverless Computing

- Serverless computing provides abstracts for server management, facilitating developers to focus completely on developing and deploying code without managing servers.
- It automatically scales the resources based on demand, reducing the operational overhead and costs, and enabling rapid development and deployment of applications.

## Difference Between IaaS, PaaS, SaaS And Serverless

| Aspect | IaaS | PaaS | SaaS | Serverless Computing |
|---|---|---|---|---|
| **Infrastructure** | It provides virtualized computing resources | It provides the platform for application development | It is used for fully developed software applications | It provides an abstracted server management |
| **Management** | Users manage virtual machines, storage, networking | Platform provider manages underlying infrastructure | Vendor fully manages and maintains the software | Developers focus only on writing code |
| **Customization** | High level of customization | Limited customization options | Minimal customization | Focuses on code, less on infrastructure |
| **Flexibility** | High | Moderate | Low | High |
| **Scalability** | Scalable at infrastructure level | Scalable at application level | Scalable at user level | Automatically scales based on demand |
| **Examples** | Amazon Web Services (AWS), Microsoft Azure | Google App Engine, Heroku | Salesforce, Google Workspace | AWS Lambda, Azure Functions, Google Cloud Functions |

## Cloud Computing Deployment Models

They are different approaches in managing and setting up the cloud services including cloud computing deployment models such as Public, private, hybrid, community and mulit-cloud deployments. These deployments provides scalability, control and flexibility with fulfilling special benefits meeting to various goals and demands of a business. In the below section we are discussing the types of cloud deployment models in more detail.

### What are the types of Cloud Services?

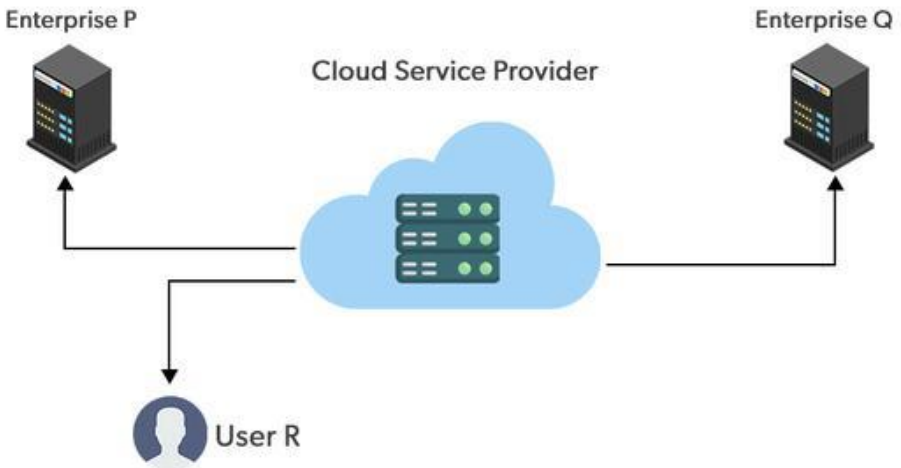
The following are the types of cloud also known as cloud deployment models as follows:

1. Public cloud
2. Private cloud
3. Hybrid cloud
4. Community cloud
5. Multicloud

## 1. PUBLIC CLOUD

- Public clouds are managed by third parties which provide cloud services over the internet to the public, these services are available as pay-as-you-go billing models.
- They offer solutions for minimizing IT infrastructure costs and become a good option for handling peak loads on the local infrastructure. Public clouds are the go-to option for small enterprises, which can start their businesses without large upfront investments by completely relying on public infrastructure for their IT needs.
- The fundamental characteristics of public clouds are **multitenancy**. A public cloud is meant to serve multiple users, not a single customer. A user requires a virtual computing environment that is separated, and most likely isolated, from other users.

**Examples:** Amazon EC2, IBM, Azure, GCP



**Advantages of Public Cloud**

The following are the advantages of public cloud:

- Public cloud is easily able to scale up and down resources as per the demand of traffic and workload. It facilitates with performance optimization and cost efficiency.
- It works on pay-as-you-go cloud model and helps in resolving the investments needs in hardware and infrastructure reducing overall costs.

**Disadvantages of using Public Cloud**

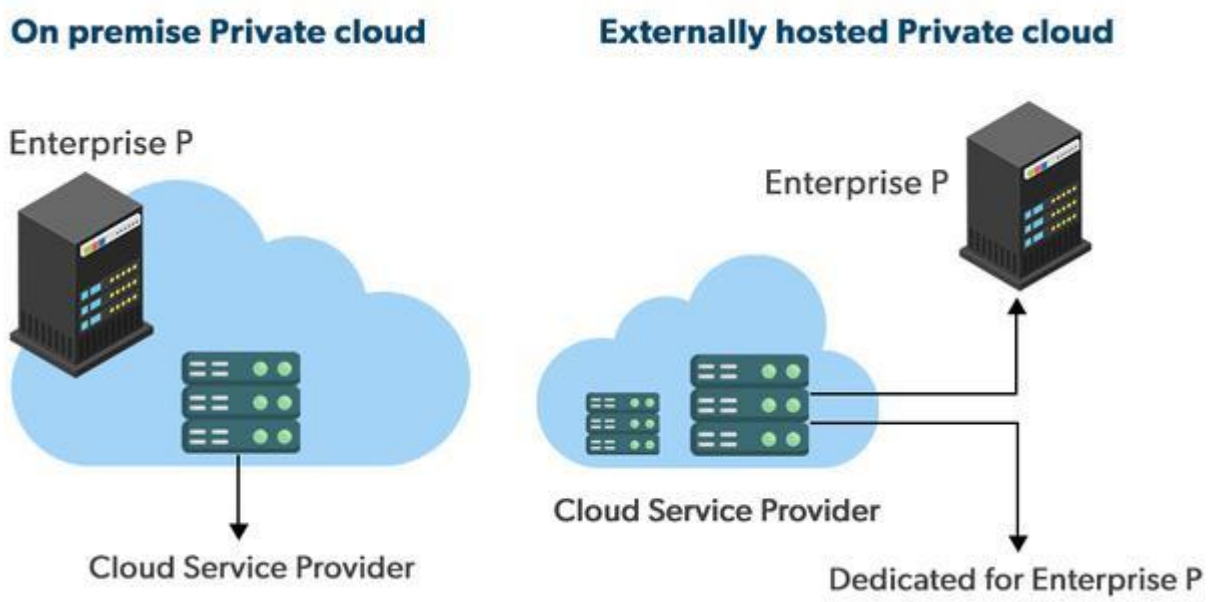
The following are the disadvantages of Public Cloud:

- It is difficult to trust and maintain data to a third-party provider may raise concerns about control and ownership
- The shared infrastructure of public cloud resources increases the risk of data breaches and unauthorized access. It raises security and privacy concerns.
- Public cloud comes with limited transparency about the underlying infrastructure which may make it challenging to monitor and manage performance effectively.

## 2. PRIVATE CLOUD

- Private clouds are distributed systems that work on private infrastructure and provide the users with dynamic provisioning of computing resources. Instead of a pay-as-you-go model in private clouds, there could be other schemes that manage the usage of the cloud and proportionally billing of the different departments or sections of an enterprise. Private cloud providers are HP Data Centers, Ubuntu, Elastic-Private cloud, Microsoft, etc.

**Examples:** VMware vCloud Suite, OpenStack, Cisco Secure Cloud, Dell Cloud Solutions, HP Helion Eucalyptus




## Advantages Of Private Cloud

- **Customer information protection:** In the private cloud security concerns are less since customer data and other sensitive information do not flow out of private infrastructure.
- **Infrastructure ensuring SLAs:** Private cloud provides specific operations such as appropriate clustering, data replication, system monitoring, and maintenance, disaster recovery, and other uptime services.
- **Compliance with standard procedures and operations:** Specific procedures have to be put in place when deploying and executing applications according to third-party compliance standards. This is not possible in the case of the public cloud.

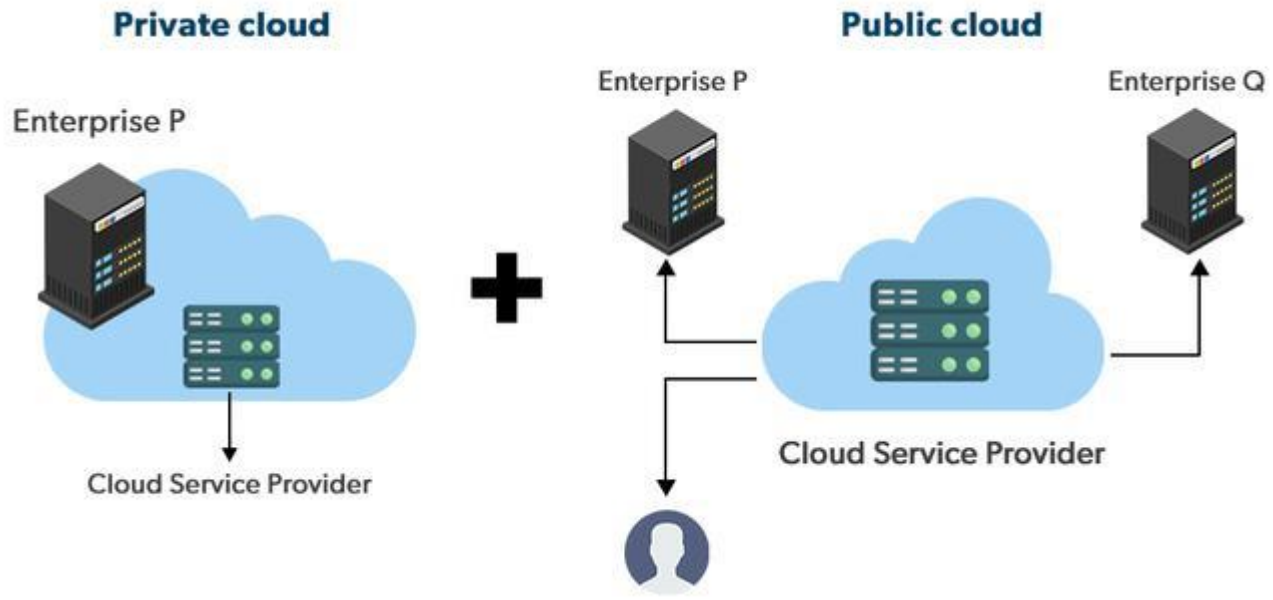
## Disadvantages Of Private Cloud

- **The restricted area of operations:** Private cloud is accessible within a particular area. So the area of accessibility is restricted.

- **Expertise requires:** In the private cloud security concerns are less since customer data and other sensitive information do not flow out of private infrastructure. Hence skilled people are required to manage & operate cloud services.

## 3. HYBRID CLOUD

- A hybrid cloud is a heterogeneous distributed system formed by combining facilities of the public cloud and private cloud. For this reason, they are also called **heterogeneous clouds**.
- A major drawback of private deployments is the inability to scale on-demand and efficiently address peak loads. Here public clouds are needed. Hence, a hybrid cloud takes advantage of both public and private clouds.
- **Examples:** AWS Outposts, Azure Stack, Google Anthos, IBM Cloud Satellite, Oracle Cloud at Customer




### Advantages of using Hybrid cloud

The following are the advantages of using Hybrid Cloud:

- Hybrid cloud is available at a cheap cost than other clouds because it is formed by a distributed system.

- It works comes up with working fast with lower cost and facilitates in reducing the latency of the data transfer process.
- Most important thing is security. A hybrid cloud is totally safe and secure because it works on the distributed system network.

**Disadvantages of Using Hybrid Cloud**

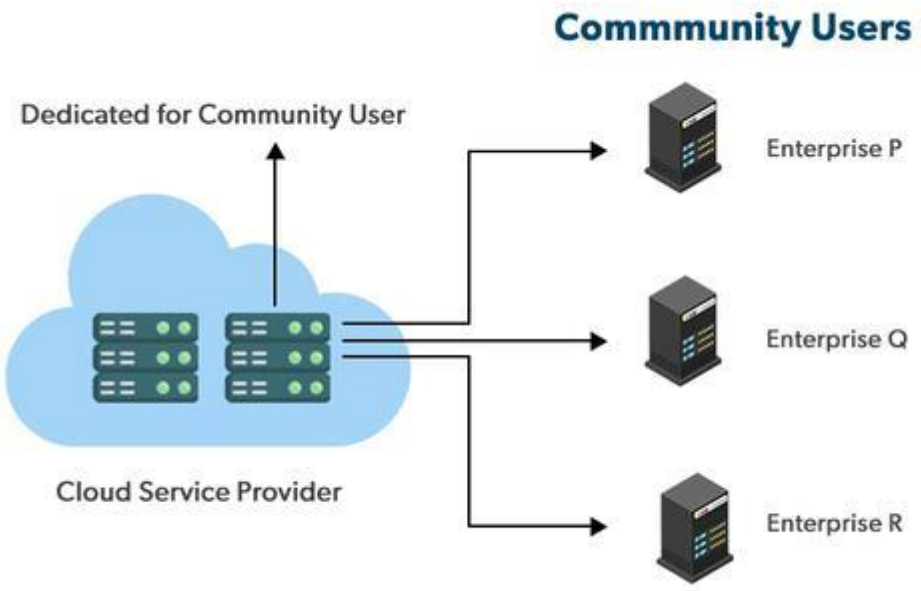
The following are the disadvantages of using Hybrid Cloud:

- It's possible that businesses lack the internal knowledge necessary to create such a hybrid environment. Managing security may also be more challenging. Different access levels and security considerations may apply in each environment.
- Managing a hybrid cloud may be more difficult. With all of the alternatives and choices available today, not to mention the new PaaS components and technologies that will be released every day going forward, public cloud and migration to public cloud are already complicated enough. It could just feel like a step too far to include hybrid.

## 4. COMMUNITY CLOUD

- Community clouds are distributed systems created by integrating the services of different clouds to address the specific needs of an industry, a community, or a business sector. But sharing responsibilities among the organizations is difficult.
- In the community cloud, the infrastructure is shared between organizations that have shared concerns or tasks. An organization or a third party may manage the cloud.

- **Examples:** CloudSigma, Nextcloud, Synology C2, OwnCloud, Stratoscale




## Advantages of Using Community Cloud

The following are the advantages of using Community Cloud:

- Because the entire cloud is shared by numerous enterprises or a community, community clouds are cost-effective.
- Because it works with every user, the community cloud is adaptable and scalable. Users can alter the documents according to their needs and requirements.
- Public cloud is less secure than the community cloud, which is more secure than private cloud.
- Thanks to community clouds, we may share cloud resources, infrastructure, and other capabilities between different enterprises.

## Disadvantages of using Community Cloud

The following are the disadvantages of using Community Cloud:

- Not all businesses should choose community cloud.
- Gradual adoption of data

- It's challenging for corporations to share duties.

**Applications Of Community clouds**

The following are the applications of community clouds:

- **Media industry:** Media companies are looking for quick, simple, low-cost ways for increasing the efficiency of content generation. Most media productions involve an extended ecosystem of partners. In particular, the creation of digital content is the outcome of a collaborative process that includes the movement of large data, massive compute-intensive rendering tasks, and complex workflow executions.
- **Healthcare industry:** In the healthcare industry community clouds are used to share information and knowledge on the global level with sensitive data in the private infrastructure.
- **Energy and core industry:** In these sectors, the community cloud is used to cluster a set of solution which collectively addresses the management, deployment, and orchestration of services and operations.
- **Scientific research:** In this organization with common interests in science share a large distributed infrastructure for scientific computing.

## 5. MULTICLOUD

- Multicloud is the use of multiple cloud computing services from different providers, which allows organizations to use the best-suited services for their specific needs and avoid vendor lock-in.
- This allows organizations to take advantage of the different features and capabilities offered by different cloud providers.

- **Examples:** Cloud Foundry, Kubernetes, Apache Mesos, Red Hat OpenShift, Docker Swarm

**Advantages of using Multi-Cloud**

The following are the advantages of using multi-cloud:

- **Flexibility:** Using multiple cloud providers allows organizations to choose the best-suited services for their specific needs, and avoid vendor lock-in.
- **Cost-effectiveness:** Organizations can take advantage of the cost savings and pricing benefits offered by different cloud providers for different services.
- **Improved performance**: By distributing workloads across multiple cloud providers, organizations can improve the performance and availability of their applications and services.
- **Increased security:** Organizations can increase the security of their data and applications by spreading them across multiple cloud providers and implementing different security strategies for each.

**Disadvantages of using Multi-Cloud**

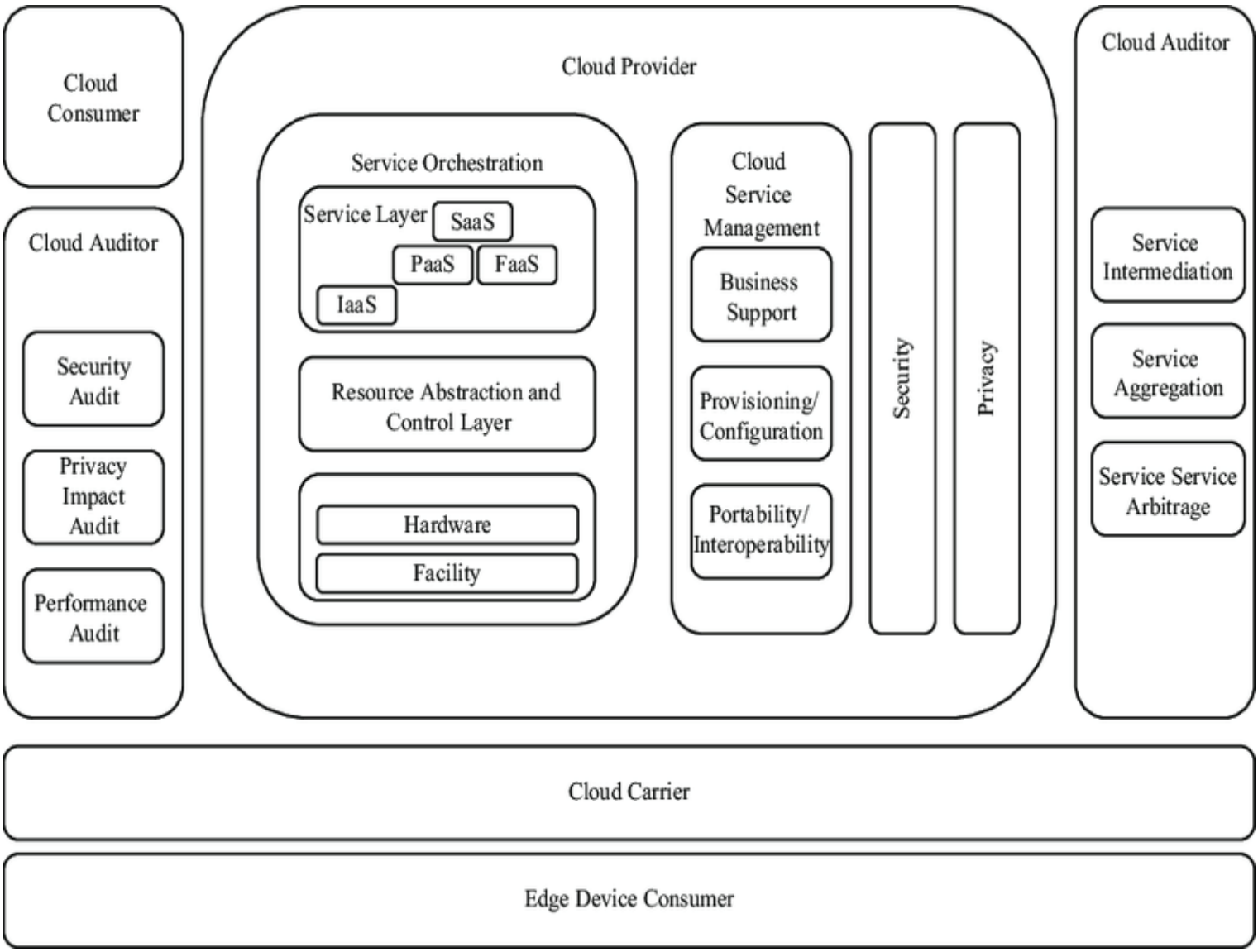
The following are the disadvantages of using Multi-Cloud:

- **Complexity**: Managing multiple cloud providers and services can be complex and require specialized knowledge and expertise.
- **Increased costs:** The cost of managing multiple cloud providers and services can be higher than using a single provider.
- **Compatibility issues**: Different cloud providers may use different technologies and standards, which can cause

compatibility issues and require additional resources to resolve.

- **Limited interoperability:** Different cloud providers may not be able to interoperate seamlessly, which can limit the ability to move data and applications between them.

# CLOUD REFERENCE MODEL

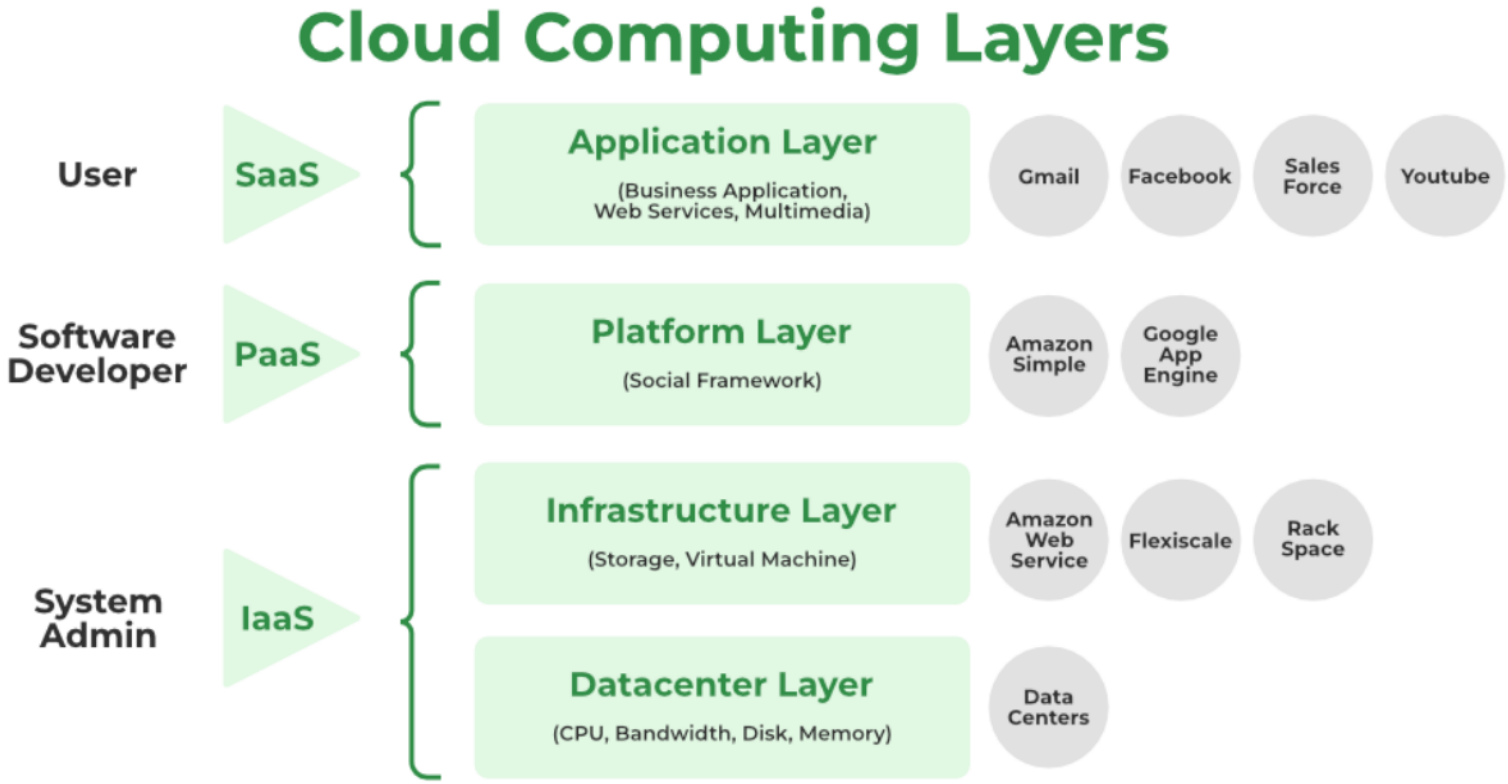


# DIFFERENCE BETWEEN PUBLIC CLOUD, PRIVATE CLOUD AND HYBRID CLOUD

| Factors | Public Cloud | Private Cloud | Community Cloud | Hybrid Cloud |
|---|---|---|---|---|
| Initial Setup | Easy | Complex, requires a professional team to setup | Complex, requires a professional team to setup | Complex, requires a professional team to setup |
| Scalability and Flexibility | High | High | Fixed | High |
| Cost-Comparison | Cost-Effective | Costly | Distributed cost among members | Between public and private cloud |
| Reliability | Low | Low | High | High |
| Data Security | Low | High | High | High |
| Data Privacy | Low | High | High | High |

| Aspect | Public Cloud | Private Cloud | Hybrid Cloud |
|---|---|---|---|
| **Infrastructure** | It shares the resources among multiple organizations | It is dedicated to a single organization | It is combination of both public and private clouds |
| **Cost** | It costs as per Pay-as-you-go model being cost-effective | Its Initial investment for infrastructure, potentially higher operational costs | It varies depending on usage of public and private resources |
| **Control** | It have less control over infrastructure | It has full control over infrastructure | It varies, but typically more control than public cloud alone |
| **Scalability** | It is highly scalable, resources available on-demand | It is scalable, but may require additional investment for scaling | It is scalable and facilitates with enhancing both public and private resources |
| **Security** | Security is managed by cloud provider, varying levels of security measures | Higher level of control over security measures | Security concerns must be addressed for both public and private components |
| **Flexibility** | Offers flexibility in resource allocation and usage | Flexible, but may require additional setup and management | Provides flexibility to leverage best of both public and private clouds |
| **Examples** | Amazon Web Services (AWS), Microsoft Azure | Private clouds hosted on-premises or by third-party providers | Organizations using a combination of public and private clouds, such as AWS Outposts or Azure Stack |

# LAYERS OF CLOUD COMPUTING




## APPLICATION LAYER

1. The application layer, which is at the top of the stack, is where the actual cloud apps are located. Cloud applications, as opposed to traditional applications, can take advantage of the automatic-scaling functionality to gain greater performance, availability, and lower operational costs.
2. This layer consists of different Cloud Services which are used by cloud users. Users can access these applications according to their needs. Applications are divided into Execution layers and Application layers.
3. In order for an application to transfer data, the application layer determines whether communication partners are available. Whether enough cloud resources are accessible for the required communication is decided at the application layer. Applications must cooperate in order to communicate, and an application layer is in charge of this.

4. The application layer, in particular, is responsible for processing IP traffic handling protocols like Telnet and FTP. Other examples of application layer systems include web browsers, SNMP protocols, HTTP protocols, or HTTPS, which is HTTP's successor protocol.

## PLATFORM LAYER

1. The operating system and application software make up this layer.
2. Users should be able to rely on the platform to provide them with Scalability, Dependability, and Security Protection which gives users a space to create their apps, test operational processes, and keep track of execution outcomes and performance. SaaS application implementation's application layer foundation.
3. The objective of this layer is to deploy applications directly on virtual machines.
4. Operating systems and application frameworks make up the platform layer, which is built on top of the infrastructure layer. The platform layer's goal is to lessen the difficulty of deploying programmers directly into VM containers.
5. By way of illustration, Google App Engine functions at the platform layer to provide API support for implementing storage, databases, and business logic of ordinary web apps.

## INFRASTRUCTURE LAYER

1. It is a layer of virtualization where physical resources are divided into a collection of virtual resources using virtualization technologies like Xen, KVM, and VMware.

2. This layer serves as the Central Hub of the Cloud Environment, where resources are constantly added utilizing a variety of virtualization techniques.
3. A base upon which to create the platform layer. constructed using the virtualized network, storage, and computing resources. Give users the flexibility they want.
4. Automated resource provisioning is made possible by virtualization, which also improves infrastructure management.
5. The infrastructure layer sometimes referred to as the virtualization layer, partitions the physical resources using virtualization technologies like Xen, KVM, Hyper-V, and VMware to create a pool of compute and storage resources.
6. The infrastructure layer is crucial to cloud computing since virtualization technologies are the only ones that can provide many vital capabilities, like dynamic resource assignment.

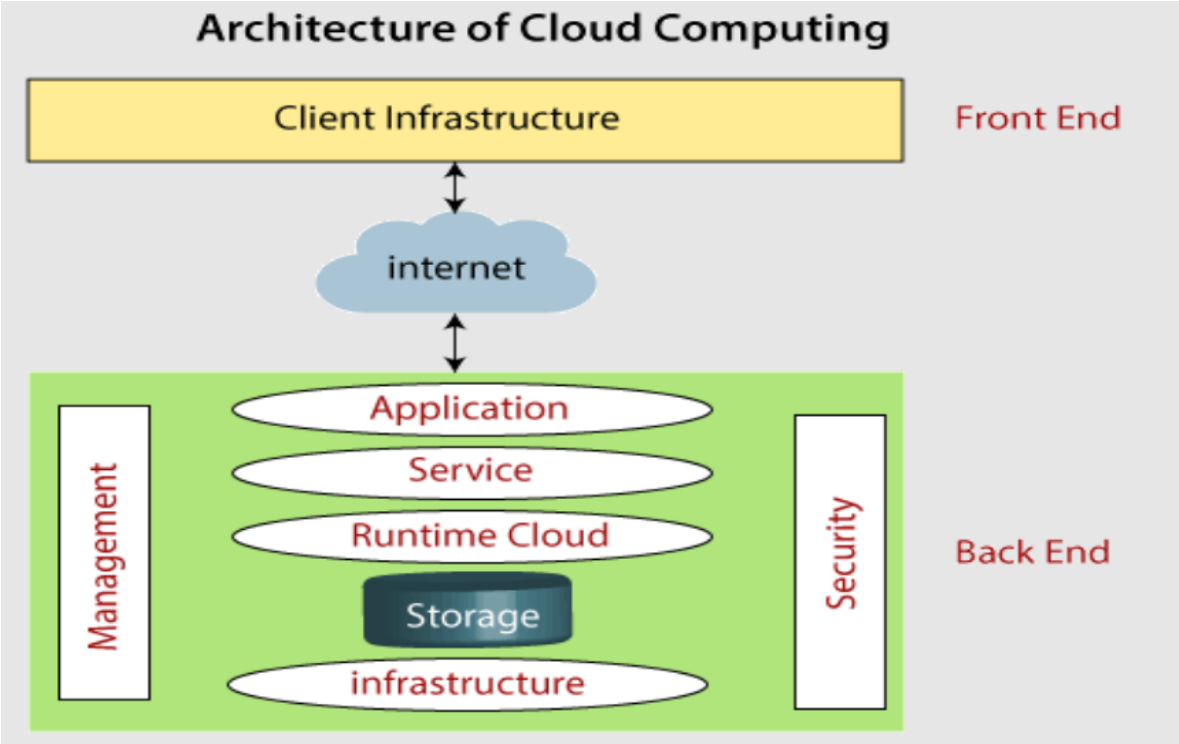
## DATACENTER LAYER

1. In a cloud environment, this layer is responsible for Managing Physical Resources such as servers, switches, routers, power supplies, and cooling systems.
2. Providing end users with services requires all resources to be available and managed in data centers.
3. Physical servers connect through high-speed devices such as routers and switches to the data center.
4. In software application designs, the division of business logic from the persistent data it manipulates is well-established. This is due to the fact that the same data cannot be incorporated into a single application because it can be used in numerous ways to support numerous use cases. The requirement for this data to

become a service has arisen with the introduction of microservices.

5. A single database used by many microservices creates a very close coupling. As a result, it is hard to deploy new or emerging services separately if such services need database modifications that may have an impact on other services. A data layer containing many databases, each serving a single microservice or perhaps a few closely related microservices, is needed to break complex service interdependencies.

## CLOUD COMPUTING ARCHITECTURE




Architecture of cloud computing is the combination of both SOA (Service Oriented Architecture) and EDA (Event Driven Architecture). Client infrastructure, application, service, runtime cloud, storage, infrastructure, management and security all these are the components of cloud computing architecture.

The cloud architecture is divided into 2 parts :-

1. **Frontend**

Frontend of the cloud architecture refers to the client side of cloud computing system. Means it contains all the user interfaces and applications which are used by the client to access the cloud computing services/resources. For example, use of a web browser to access the cloud platform.

**2. Backend**

Backend refers to the cloud itself which is used by the service provider. It contains the resources as well as manages the resources and provides security mechanisms. Along with this, it includes huge storage, virtual applications, virtual machines, traffic control mechanisms, deployment models, etc.

## Components of Cloud Computing Architecture

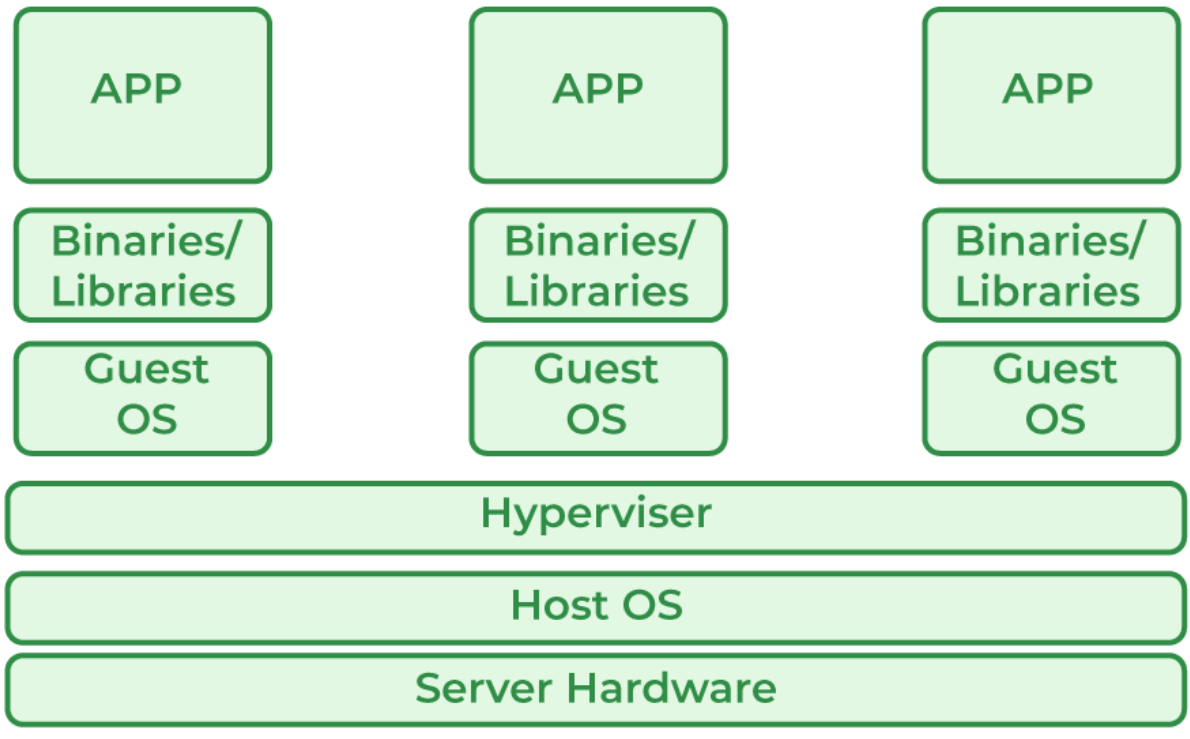
- **Client Infrastructure** – Client Infrastructure is a part of the frontend component. It contains the applications and user interfaces which are required to access the cloud platform. In other words, it provides a GUI( Graphical User Interface ) to interact with the cloud.
- **Application** : Application is a part of backend component that refers to a software or platform to which client accesses. Means it provides the service in backend as per the client requirement.
- **Service**: Service in backend refers to the major three types of cloud based services like SaaS, PaaS and IaaS. Also manages which type of service the user accesses.
- **Runtime Cloud**: Runtime cloud in backend provides the execution and Runtime platform/environment to the Virtual machine.
- **Storage**: Storage in backend provides flexible and scalable storage service and management of stored data.

- **Infrastructure:** Cloud Infrastructure in backend refers to the hardware and software components of cloud like it includes servers, storage, network devices, virtualization software etc.
- **Management:** Management in backend refers to management of backend components like application, service, runtime cloud, storage, infrastructure, and other security mechanisms etc.
- **Security:** Security in backend refers to implementation of different security mechanisms in the backend for secure cloud resources, systems, files, and infrastructure to end-users.
- **Internet:** Internet connection acts as the medium or a bridge between frontend and backend and establishes the interaction and communication between frontend and backend.
- **Database:** Database in backend refers to provide database for storing structured data, such as SQL and NOSQL databases. Example of Databases services include Amazon RDS, Microsoft Azure SQL database and Google CLoud SQL.
- **Networking:** Networking in backend services that provide networking infrastructure for application in the cloud, such as load balancing, DNS and virtual private networks.
- **Analytics:** Analytics in backend service that provides analytics capabilities for data in the cloud, such as warehousing, business intelligence and machine learning.

# VIRTUALIZATION

**Virtualization** is used to create a virtual version of an underlying service. With the help of Virtualization, multiple operating systems and applications can run on the same machine and its same hardware at the same time, increasing the utilization and flexibility of hardware. It was initially developed during the mainframe era.

It is one of the main cost-effective, hardware-reducing, and energy-saving techniques used by cloud providers. Virtualization allows sharing of a single physical instance of a resource or an application among multiple customers and organizations at one time. It does this by assigning a logical name to physical storage and providing a pointer to that physical resource on demand. The term virtualization is often synonymous with hardware virtualization, which plays a fundamental role in efficiently delivering Infrastructure-as-a-Service (IaaS) solutions for cloud computing. Moreover, virtualization technologies provide a virtual environment for not only executing applications but also for storage, memory, and networking.




Virtualization

- **Host Machine**: The machine on which the virtual machine is going to be built is known as Host Machine.
- **Guest Machine**: The virtual machine is referred to as a Guest Machine.

## Work of Virtualization in Cloud Computing

Virtualization has a prominent impact on Cloud Computing. In the case of cloud computing, users store data in the cloud, but with the help of Virtualization, users have the extra benefit of sharing the infrastructure. Cloud Vendors take care of the required physical resources, but these cloud providers charge a huge amount for these services which impacts every user or organization. Virtualization helps Users or Organisations in maintaining those services which are required by a company through external (third-party) people, which helps in reducing costs to the company. This is the way through which Virtualization works in Cloud Computing.

## Benefits of Virtualization

- More flexible and efficient allocation of resources.
- Enhance development productivity.
- It lowers the cost of IT infrastructure.
- Remote access and rapid scalability.
- High availability and disaster recovery.
- Pay peruse of the IT infrastructure on demand.
- Enables running multiple operating systems.

## Drawback of Virtualization

- **High Initial Investment:** Clouds have a very high initial investment, but it is also true that it will help in reducing the cost of companies.
- **Learning New Infrastructure:** As the companies shifted from Servers to Cloud, it requires highly skilled staff who have skills to work with the cloud easily, and for this, you have to hire new staff or provide training to current staff.

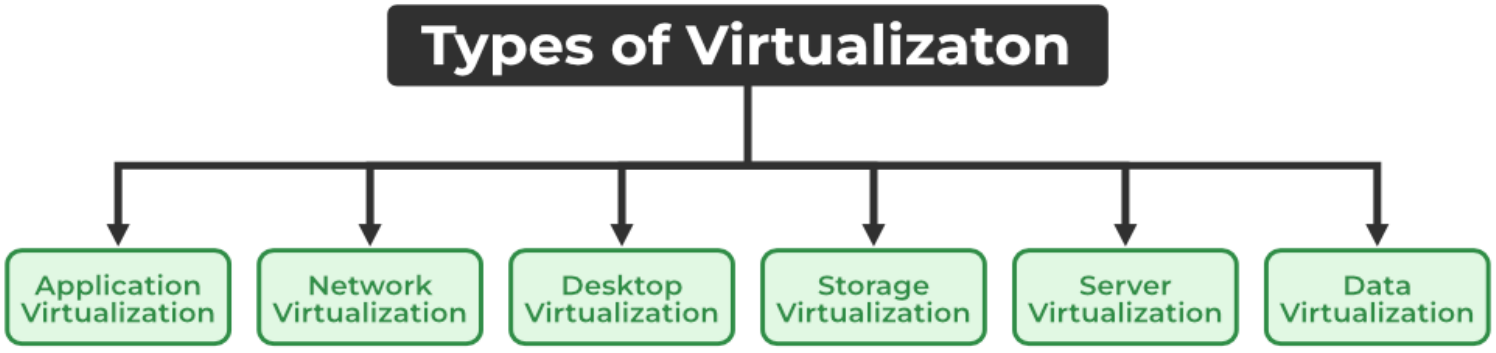
- **Risk of Data:** Hosting data on third-party resources can lead to putting the data at risk, it has the chance of getting attacked by any hacker or cracker very easily.

## Characteristics of Virtualization

- **Increased Security:** The ability to control the execution of a guest program in a completely transparent manner opens new possibilities for delivering a secure, controlled execution environment. All the operations of the guest programs are generally performed against the virtual machine, which then translates and applies them to the host programs.
- **Managed Execution:** In particular, sharing, aggregation, emulation, and isolation are the most relevant features.
- **Sharing:** Virtualization allows the creation of a separate computing environment within the same host.
- **Aggregation:** It is possible to share physical resources among several guests, but virtualization also allows aggregation, which is the opposite process.

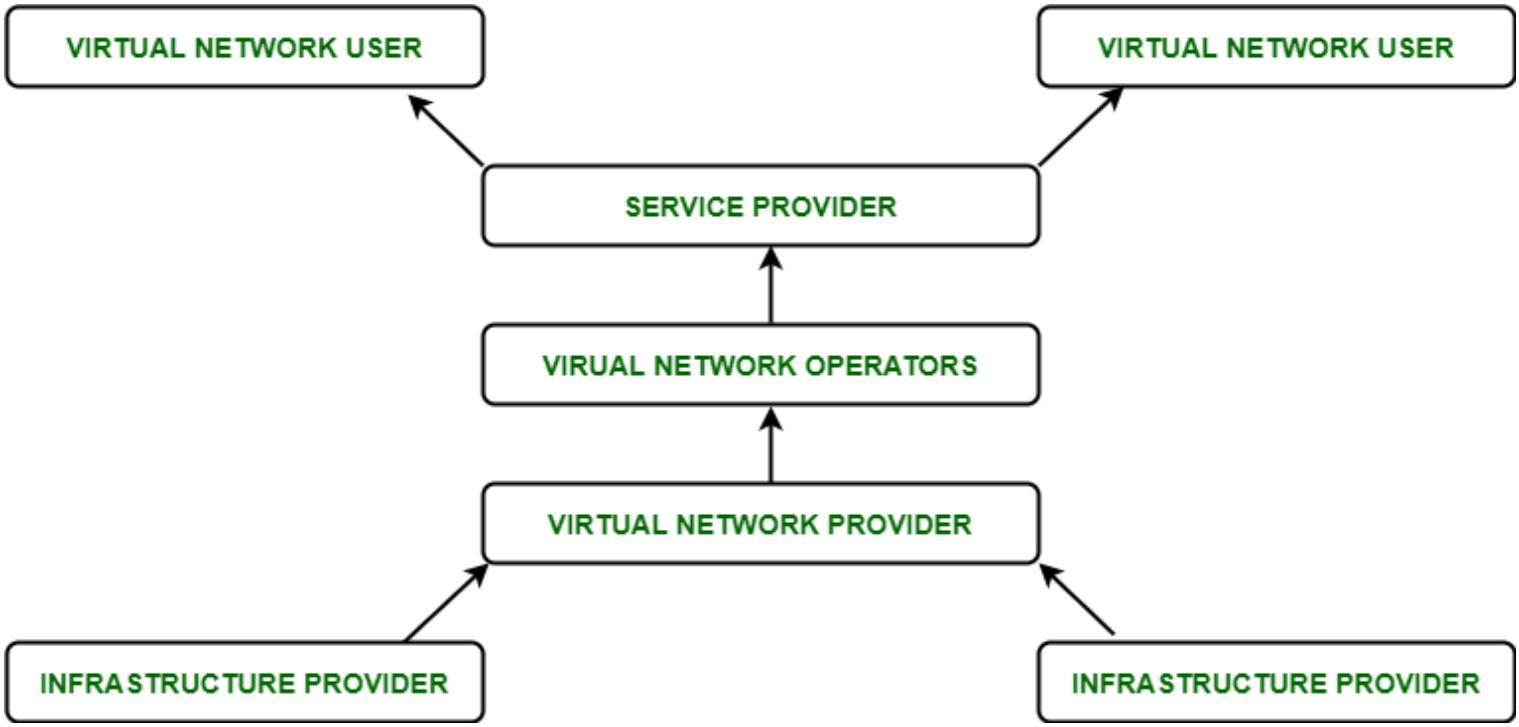
## Types of Virtualization

1. Application Virtualization
2. Network Virtualization
3. Desktop Virtualization
4. Storage Virtualization
5. Server Virtualization
6. Data Virtualization



**1. Application Virtualization:** Application virtualization helps a user to have remote access to an application from a server. The server stores all personal information and other characteristics of the application but can still run on a local workstation through the internet. An example of this would be a user who needs to run two different versions of the same software. Technologies that use application virtualization are hosted applications and packaged applications.

**2. Network Virtualization:** The ability to run multiple virtual networks with each having a separate control and data plan. It co-exists together on top of one physical network. It can be managed by individual parties that are potentially confidential to each other. Network virtualization provides a facility to create and provision virtual networks, logical switches, routers, firewalls, load balancers, Virtual Private Networks (VPN), and workload security within days or even weeks.



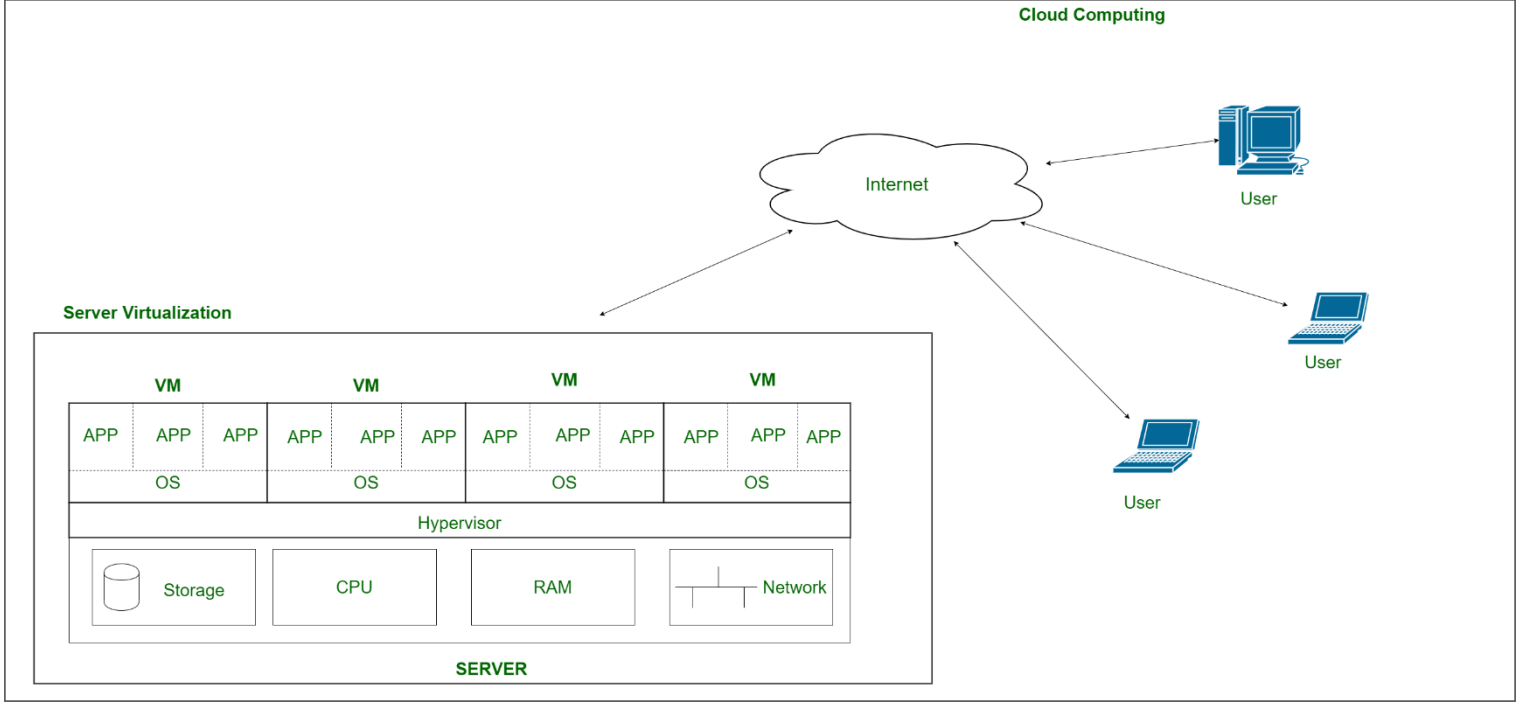

*Network Virtualization*

**3. Desktop Virtualization:** Desktop virtualization allows the users' OS to be remotely stored on a server in the data center. It allows the user to access their desktop virtually, from any location by a different machine. Users who want specific operating systems

other than Windows Server will need to have a virtual desktop. The main benefits of desktop virtualization are user mobility, portability, and easy management of software installation, updates, and patches.

**4. Storage Virtualization:** Storage virtualization is an array of servers that are managed by a virtual storage system. The servers aren't aware of exactly where their data is stored and instead function more like worker bees in a hive. It makes managing storage from multiple sources be managed and utilized as a single repository. storage virtualization software maintains smooth operations, consistent performance, and a continuous suite of advanced functions despite changes, breaks down, and differences in the underlying equipment.

**5. Server Virtualization:** This is a kind of virtualization in which the masking of server resources takes place. Here, the central server (physical server) is divided into multiple different virtual servers by changing the identity number, and processors. So, each system can operate its operating systems in an isolated manner. Where each sub-server knows the identity of the central server. It causes an increase in performance and reduces the operating cost by the deployment of main server resources into a sub-server resource. It's beneficial in virtual migration, reducing energy consumption, reducing infrastructural costs, etc.




*Server Virtualization*

**6. Data Virtualization:** This is the kind of virtualization in which the data is collected from various sources and managed at a single place without knowing more about the technical information like how data is collected, stored & formatted then arranged that data logically so that its virtual view can be accessed by its interested people and stakeholders, and users through the various cloud services remotely. Many big giant companies are providing their services like Oracle, IBM, At scale, Cdata, etc.

**Uses of Virtualization**

- Data-integration
- Business-integration
- Service-oriented architecture data-services
- Searching organizational data

## Hypervisor

A hypervisor is a form of virtualization software used in Cloud hosting to divide and allocate the resources on various pieces of hardware. The program which provides partitioning, isolation, or abstraction is called a virtualization hypervisor. The hypervisor is a hardware virtualization technique that allows multiple guest operating systems (OS) to run on a single host system at the same time. A hypervisor is sometimes also called a virtual machine manager(VMM).

## Types of Hypervisor –

- **TYPE-1 Hypervisor:**
  The hypervisor runs directly on the underlying host system. It is also known as a "Native Hypervisor" or "Bare metal hypervisor". It does not require any base server operating system. It has direct access to hardware resources. Examples of Type 1 hypervisors include VMware ESXi, Citrix XenServer, and Microsoft Hyper-V hypervisor.

**Pros & Cons of Type-1 Hypervisor:**

**Pros:** Such kinds of hypervisors are very efficient because they have direct access to the physical hardware resources(like Cpu, Memory, Network, and Physical storage). This causes the empowerment of the security because there is nothing any kind of the third party resource so that attacker couldn't compromise with anything.

**Cons:** One problem with Type-1 hypervisors is that they usually need a dedicated separate machine to perform their operation and to instruct different VMs and control the host hardware resources.

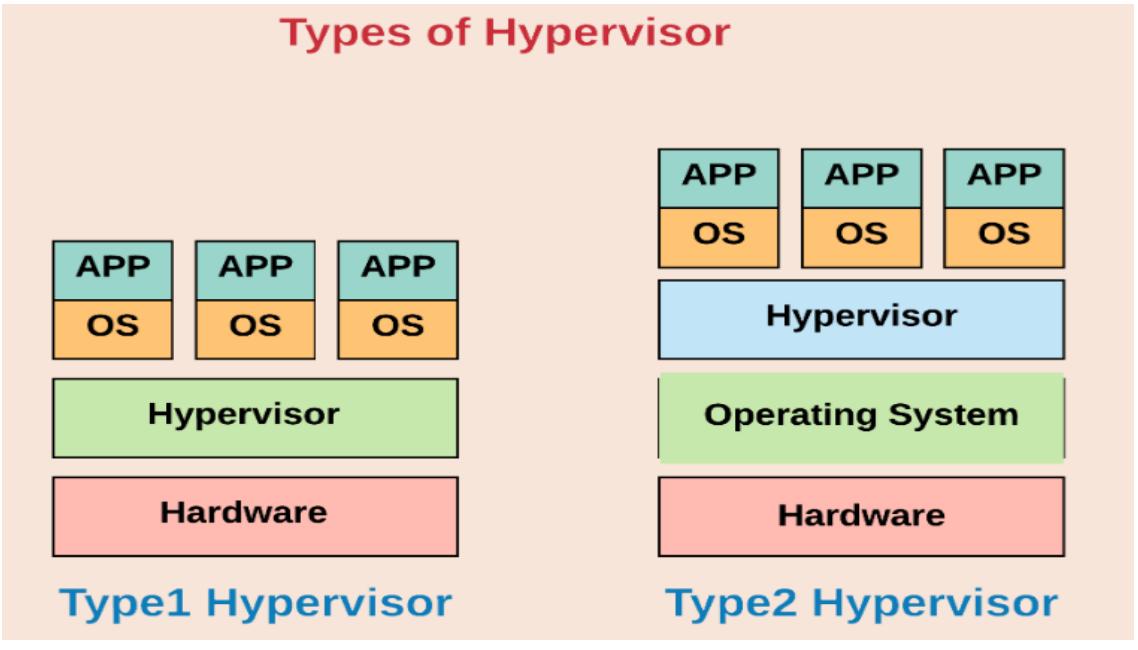
- **TYPE-2 Hypervisor:**
  A Host operating system runs on the underlying host system. It

is also known as 'Hosted Hypervisor". Such kind of hypervisors doesn't run directly over the underlying hardware rather they run as an application in a Host system(physical machine). Basically, the software is installed on an operating system. Hypervisor asks the operating system to make hardware calls. An example of a Type 2 hypervisor includes VMware Player or Parallels Desktop. Hosted hypervisors are often found on endpoints like PCs. The type-2 hypervisor is very useful for engineers, and security analysts (for checking malware, or malicious source code and newly developed applications).

**Pros & Cons of Type-2 Hypervisor:**

**Pros:** Such kind of hypervisors allows quick and easy access to a guest Operating System alongside the host machine running. These hypervisors usually come with additional useful features for guest machines. Such tools enhance the coordination between the host machine and the guest machine.

**Cons:** Here there is no direct access to the physical hardware resources so the efficiency of these hypervisors lags in performance as compared to the type-1 hypervisors, and potential security risks are also there an attacker can compromise the security weakness if there is access to the host operating system so he can also access the guest operating system.



## HYPERVISOR REFERENCE MODEL :

There are 3 main modules coordinates in order to emulate the underlying hardware:

1. **DISPATCHER**:
   The dispatcher behaves like the entry point of the monitor and reroutes the instructions of the virtual machine instance to one of the other two modules.
2. **ALLOCATOR**:
   The allocator is responsible for deciding the system resources to be provided to the virtual machine instance. It means whenever a virtual machine tries to execute an instruction that results in changing the machine resources associated with the virtual machine, the allocator is invoked by the dispatcher.
3. **INTERPRETER**:
   The interpreter module consists of interpreter routines. These are executed, whenever a virtual machine executes a privileged instruction.