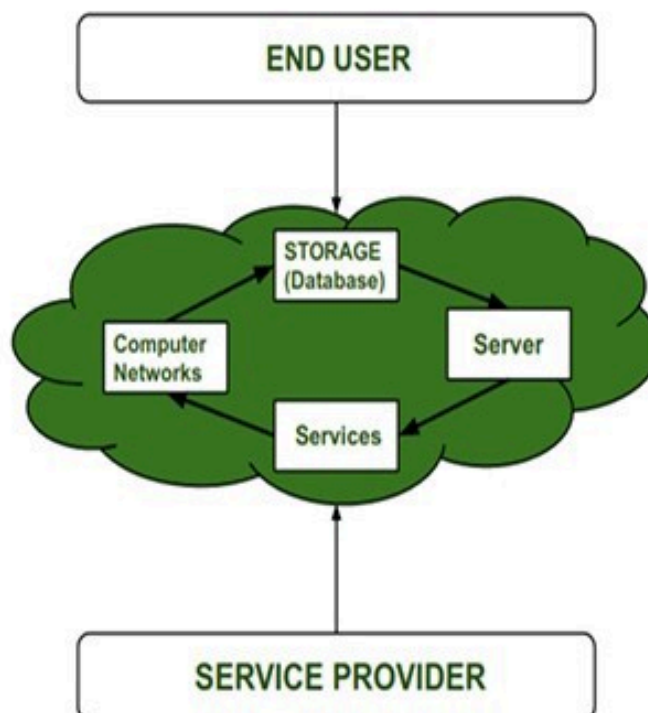


## Introduction to Cloud Computing

- 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 a virtualization-based technology that allows us to create, configure, and customize applications via an internet connection.
- Cloud Computing referred as the accessing and storing of data and provide services related to computing over the internet.
- It simply referred as it remote services on the internet manage and access data online rather than any local drives.
- The data can be anything like images, videos, audios, documents, files etc.

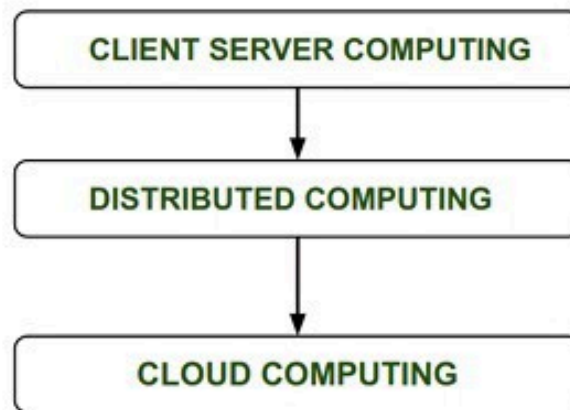
### Cloud Computing Service Provider:

Cloud computing is in huge demand so, big organization providing the service like Amazon AWS, Microsoft Azure, Google Cloud, Alibaba cloud etc. are some Cloud Computing service Provider.



## History of Cloud Computing

- Before Computing was come into existence, client Server Architecture was used where all the data and control of client resides in Server side.
- If a single user want to access some data, firstly user need to connect to the server and after that user will get appropriate access.
- But it has many disadvantages. So, After Client Server computing, Distributed Computing was come into existence, in this type of computing all computers are networked together with the help of this, user can share their resources when needed.
- It also has certain limitations. So in order to remove limitations faced in distributed system, cloud computing was emerged.



- During 1961, John MacCharty delivered his speech at MIT that "Computing Can be sold as a Utility, like Water and Electricity." According to John MacCharty it was a brilliant idea.
- But people at that time don't want to adopt this technology. They thought the technology they are using efficient enough for them. So, this concept of computing was not appreciated much so and very less will research on it.
- But as the time fleet the technology caught the idea after few years this idea is implemented. So, this is implemented by Salesforce.com in 1999.
- In 2002, Amazon started Amazon Web Services (AWS), Amazon will provide storage, computation over the internet.
- In 2006 Amazon will launch Elastic Compute Cloud Commercial Service which is open for Everybody to use.

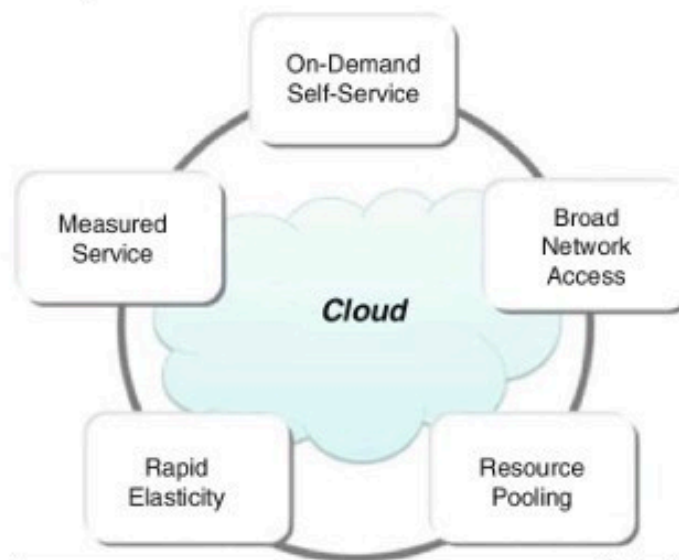
- After that in 2009, Google Play also started providing Cloud Computing Enterprise Application as other companies will see the emergence of cloud Computing they also started providing their cloud services.
- Thus, in 2009, Microsoft launch Microsoft Azure and after that other companies like Alibaba, IBM, Oracle, HP also introduces their Cloud Services. In today the Cloud Computing become very popular and important skill.

### Characteristics of Cloud Computing

There are many characteristics of Cloud Computing here are few of them :

1. **On-demand self-services:** The Cloud computing services does not require any human administrators, user themselves are able to provision, monitor and manage computing resources as needed.
2. **Broad network access:** The Computing services are generally provided over standard networks and heterogeneous devices.
3. **Rapid elasticity:** The Computing services should have IT resources that are able to scale out and in quickly and on as needed basis. Whenever the user require services it is provided to him and it is scale out as soon as its requirement gets over.
4. **Resource pooling:** The IT resource (e.g., networks, servers, storage, applications, and services) present are shared across multiple applications and occupant in an uncommitted manner. Multiple clients are provided service from a same physical resource.
5. **Measured service:** The resource utilization is tracked for each application and occupant, it will provide both the user and the resource provider with an account of what has been used. This is done for various reasons like monitoring billing and effective use of resource.
6. **Multi-tenancy:** Cloud computing providers can support multiple tenants (users or organizations) on a single set of shared resources.
7. **Virtualization:** Cloud computing providers use virtualization technology to abstract underlying hardware resources and present them as logical resources to users.
8. **Resilient computing:** Cloud computing services are typically designed with redundancy and fault tolerance in mind, which ensures high availability and reliability.

9. **Flexible pricing models:** Cloud providers offer a variety of pricing models, including pay-per-use, subscription-based, and spot pricing, allowing users to choose the option that best suits their needs.
10. **Security:** Cloud providers invest heavily in security measures to protect their users' data and ensure the privacy of sensitive information.
11. **Automation:** Cloud computing services are often highly automated, allowing users to deploy and manage resources with minimal manual intervention.
12. **Sustainability:** Cloud providers are increasingly focused on sustainable practices, such as energy-efficient data centers and the use of renewable energy sources, to reduce their environmental impact.



## Pros of Cloud Computing

**Pros :** These are the top 10 reasons to move your business to the cloud.

1. **Lower operational costs.** The cloud vendor assumes many equipment and software management tasks, from servers and networking gear to cloud storage. That includes applying software updates and security patches.
2. **Increased IT resources.** Enterprises can access more resources for internal service development and digital transformation projects that directly support business units for easier business experimentation and innovation.

3. **Convenient, rapid access to technology.** Enterprises can work with the latest hardware and software -- such as new CPUs and GPUs, machine learning and AI applications and network interfaces -- often before its available or affordable to enterprise buyers.
4. **Faster connectivity.** Cloud providers invest in the latest network interface cards and switches, along with multi-Gbps circuits to internet exchange points. This provides the fastest access to data and applications both within the data center and to customers.
5. **Greater scale.** The public cloud is engineered for massive scale. Providers can easily expand resource capacity for individual services to meet customers' workload demands.
6. **Greater expertise.** Few organizations possess the internal expertise in secure infrastructure and security engineering offered by cloud providers. This expertise allows for highly specialized services, such as powerful analytics and AI, which might be impossible to implement with local data center staff.

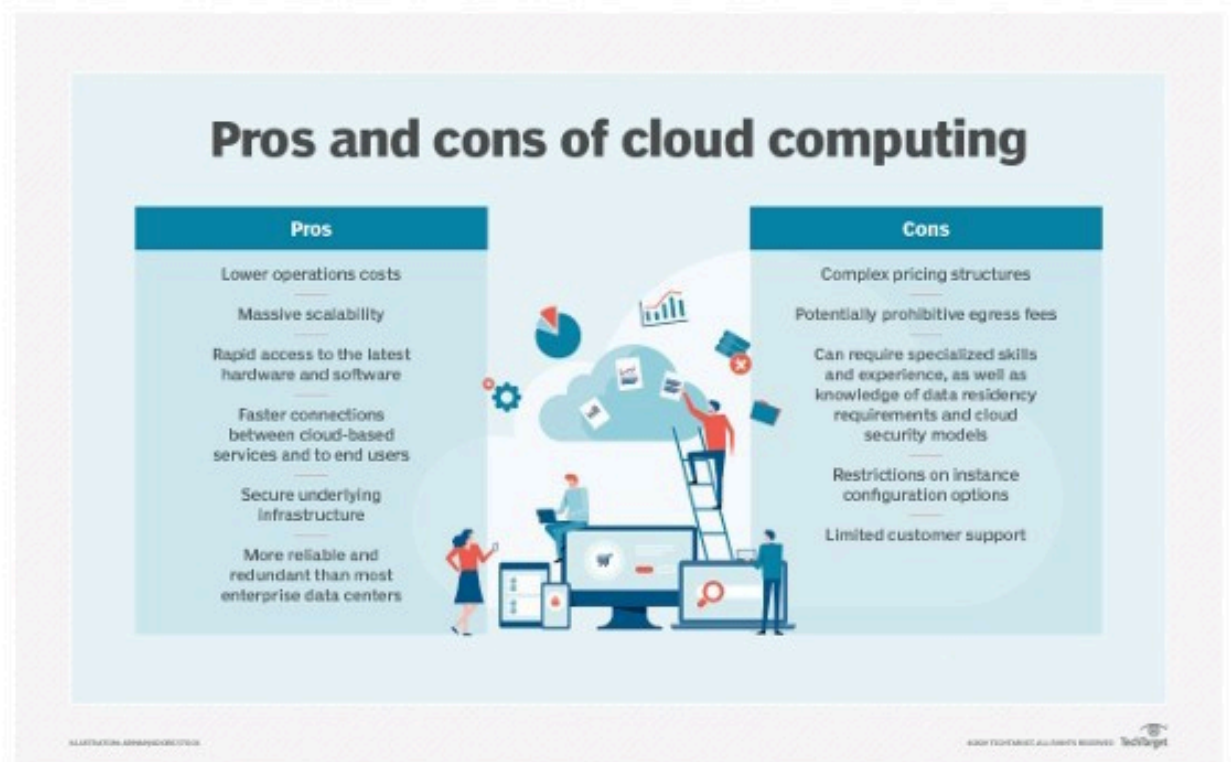
#### Cons of cloud computing

Although the cloud has been a boon for IT organizations, cloud services aren't a panacea for all IT operational problems. An organization must balance its many benefits with the following downsides.

1. **A complicated shared security model.** Security policies and management are split between the provider and user. Understanding the division in this shared responsibility is crucial as mistakes or neglect can expose vast amounts of sensitive data.
2. **Vendor lock-in.** Cloud vendors aren't ubiquitous. Cloud providers share many common service types, but access techniques -- such as APIs -- service levels and pricing can vary dramatically. It might not be possible to migrate a workload from one cloud provider to another without some amount of re-architecting of the new cloud environment.
3. **Complex pricing structures.** Some services, such as compute instances, have multiple subscription tiers and pricing schemes.
4. **Outbound data transfer costs.** It's expensive to egress large data sets from a cloud provider to the local data center or another cloud -- this also creates a disincentive for an organization to move from one cloud provider to another.



5. **Sketchy, inconsistent customer support.** Cloud services providers can be difficult to reach or slow to respond to technical issues or cost concerns. As a result, many organizations contract with a third-party cloud management and support partner.
6. **Cloud-specific skills.** Most internal IT organizations don't possess the cloud design and operations expertise found on a cloud provider's payroll. Such cloud-skilled staff can be hard to recruit and retain



## Types of Cloud

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

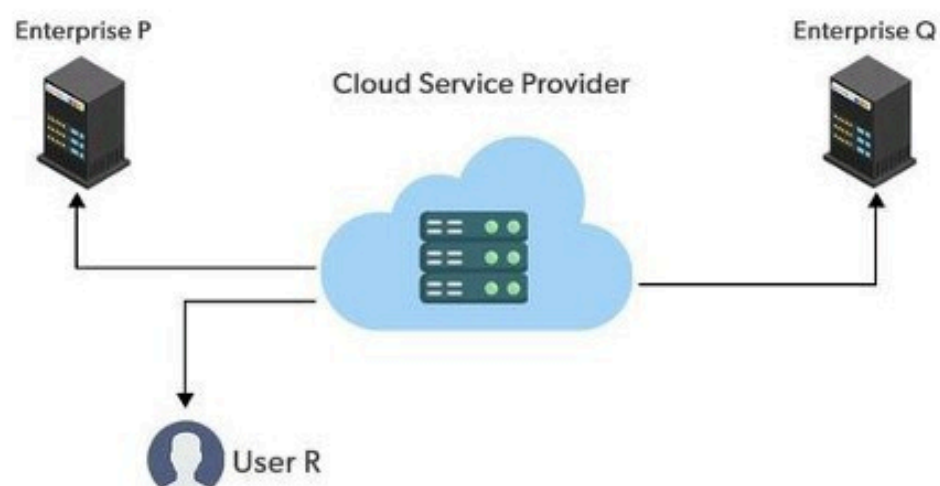
### 1.Public Cloud

- 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**.

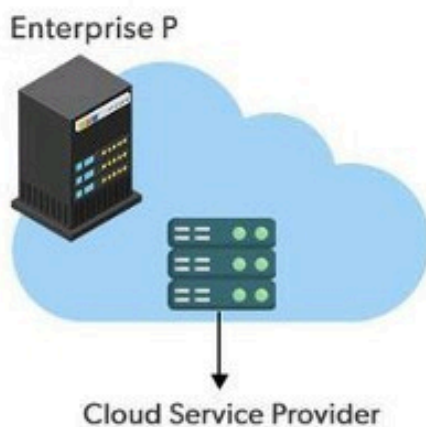
- A public cloud is meant to serve multiple users, not a single customer.
- A user requires a virtual computing environment that is separated, and most likely isolated, from other users.



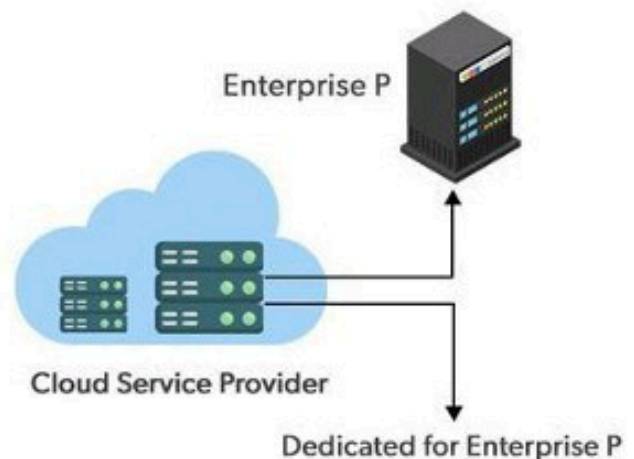
## 2.Private cloud

- 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.

### On premise Private cloud



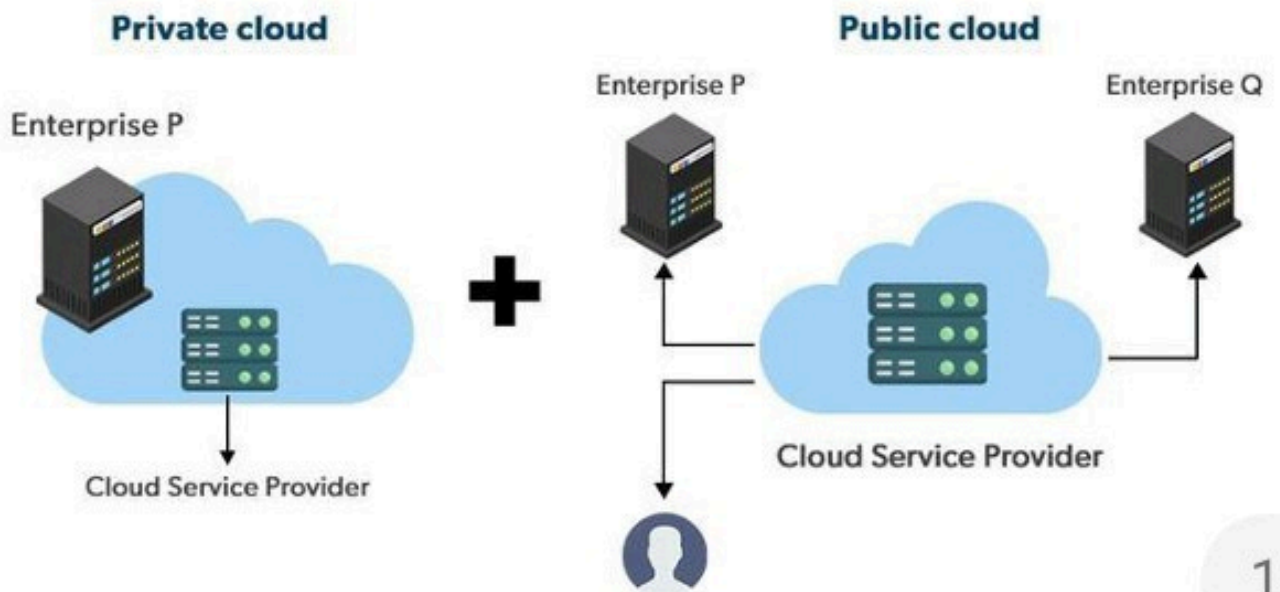
### Externally hosted Private cloud



## 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.

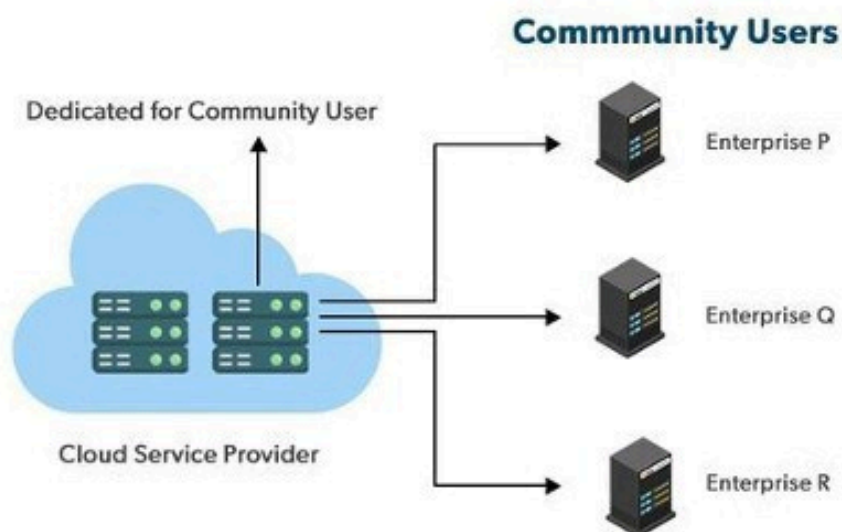




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#### 4. Community cloud:

- 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.
- 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.



## Cloud Computing Infrastructure

- Cloud Infrastructure which comes under the backend part of cloud architecture represents the hardware and software component such as server, storage, networking, management software, deployment software and virtualization software etc.
- In backend, cloud infrastructure enables the complete cloud computing system.

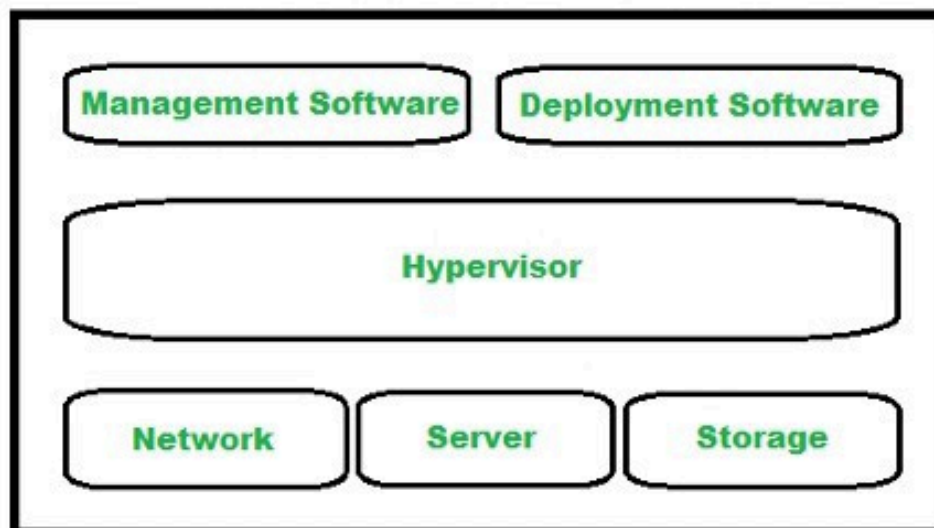
### Cloud Infrastructure Components :

Cloud infrastructure has number of key components but not limited to only server, software, network and storage devices.

Still cloud infrastructure is categorized into three parts in general i.e.

1. **Computing**
2. **Networking**
3. **Storage**

The below figure represents components of cloud infrastructure



**1. Hypervisor :**

- Hypervisor is a firmware(Firmware is a microcode or program that is embedded into the memory of hardware devices to help them operate.) or a low level program which is a key to enable virtualization.
- It is used to divide and allocate cloud resources between several customers.
- As it monitors and manages cloud services/resources that's why hypervisor is called as VMM (Virtual Machine Monitor) or (Virtual Machine Manager).

**2. Management Software :**

- Management software helps in maintaining and configuring the infrastructure.
- Cloud management software monitors and optimizes resources, data, applications and services.

**3. Deployment Software :**

- Deployment software helps in deploying and integrating the application on the cloud.
- So, typically it helps in building a virtual computing environment.

**4. Network :**

- It is one of the key component of cloud infrastructure which is responsible for connecting cloud services over the internet.
- For the transmission of data and resources externally and internally network is must required.

**5. Server :**

- Server which represents the computing portion of the cloud infrastructure is responsible for managing and delivering cloud services for various services and partners, maintaining security etc.

**6. Storage :**

- Storage represents the storage facility which is provided to different organizations for storing and managing data.

- It provides a facility of extracting another resource if one of the resource fails as it keeps many copies of storage.
- Along with this, virtualization is also considered as one of important component of cloud infrastructure. Because it abstracts the available data storage and computing power away from the actual hardware and the users interact with their cloud infrastructure through GUI (Graphical User Interface).

## Cloud Based Services

- Cloud Computing can be defined as the practice of using a network of remote servers hosted on the Internet to store, manage, and process data, rather than a local server or a personal computer.
- Companies offering such kinds of cloud computing services are called *cloud providers* and typically charge for cloud computing services based on usage.

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Most cloud computing services fall into four broad categories:

1. Software as a service (SaaS)
2. Platform as a service (PaaS)
3. Infrastructure as a service (IaaS)
4. Desktop as a Service (DaaS)

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

- Software-as-a-Service (SaaS) is a way of delivering services and applications over the Internet.
- Instead of installing and maintaining software, we simply access it via the Internet, freeing ourselves from the complex software and hardware management.
- It removes the need to install and run applications on our own computers or in the data centers eliminating the expenses of hardware as well as software maintenance.
- SaaS provides a complete software solution that you purchase on a **pay-as-you-go** basis from a cloud service provider.

- Most SaaS applications can be run directly from a web browser without any downloads or installations required.
- The SaaS applications are sometimes called Web-based software, on-demand software, or hosted software.

### Advantages of SaaS

1. **Cost-Effective:** Pay only for what you use.
2. **Reduced time:** Users can run most SaaS apps directly from their web browser without needing to download and install any software.
3. **Accessibility:** We can Access app data from anywhere.
4. **Automatic updates:** Rather than purchasing new software, customers rely on a SaaS provider to automatically perform the updates.
5. **Scalability:** It allows the users to access the services and features on-demand.

### Disadvantages of SaaS :

1. **Limited customization:** SaaS solutions are typically not as customizable as on-premises software, meaning that users may have to work within the constraints of the SaaS provider's platform
2. **Dependence on internet connectivity:** SaaS solutions are typically cloud-based, which means that they require a stable internet connection to function properly.
3. **Security concerns:** SaaS providers are responsible for maintaining the security of the data stored on their servers, but there is still a risk of data breaches or other security incidents.
4. **Limited control over data:** SaaS providers may have access to a user's data, which can be a concern for organizations that need to maintain strict control over their data for regulatory or other reasons.

## 2. Platform as a Service

- PaaS is a category of cloud computing that provides a platform and environment to allow developers to build applications and services over the internet.
- PaaS services are hosted in the cloud and accessed by users simply via their web browser.
- A PaaS provider hosts the hardware and software on its own infrastructure.



- As a result, PaaS frees users from having to install in-house hardware and software to develop or run a new application.
- Thus, the development and deployment of the application take place independent of the hardware.
- The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications .
- To make it simple, take the example of an annual day function, you will have two options either to create a venue or to rent a venue but the function is the same.

#### ***Advantages of PaaS:***

1. **Simple and convenient for users:** It provides much of the infrastructure and other IT services, which users can access anywhere via a web browser.
2. **Cost-Effective:** It charges for the services provided on a per-use basis thus eliminating the expenses one may have for on-premises hardware and software.
3. **Efficiently managing the lifecycle:** It is designed to support the complete web application lifecycle: building, testing, deploying, managing, and updating.
4. **Efficiency:** It allows for higher-level programming with reduced complexity thus, the overall development of the application can be more effective.

#### ***Disadvantages of PaaS:***

1. **Limited control over infrastructure:** PaaS providers typically manage the underlying infrastructure and take care of maintenance and updates, but this can also mean that users have less control over the environment and may not be able to make certain customizations.
2. **Dependence on the provider:** Users are dependent on the PaaS provider for the availability, scalability, and reliability of the platform, which can be a risk if the provider experiences outages or other issues.
3. **Limited flexibility:** PaaS solutions may not be able to accommodate certain types of workloads or applications, which can limit the value of the solution for certain organizations.

### 3. Infrastructure as a Service

- Infrastructure as a service (IaaS) is a service model that delivers computer infrastructure on an outsourced basis to support various operations.
- Typically IaaS is a service where infrastructure is provided as outsourcing to enterprises such as networking equipment, devices, database, and web servers. It is also known as **Hardware as a Service (HaaS)**.
- IaaS customers pay on a per-user basis, typically by the hour, week, or month.
- Some providers also charge customers based on the amount of virtual machine space they use.

#### Advantages of IaaS:

1. **Cost-Effective:** Eliminates capital expense and reduces ongoing cost and IaaS customers pay on a per-user basis, typically by the hour, week, or month.
2. **Website hosting:** Running websites using IaaS can be less expensive than traditional web hosting.
3. **Security:** The IaaS Cloud Provider may provide better security than your existing software.
4. **Maintenance:** There is no need to manage the underlying data center or the introduction of new releases of the development or underlying software. This is all handled by the IaaS Cloud Provider.

#### Disadvantages of IaaS :

1. **Limited control over infrastructure:** IaaS providers typically manage the underlying infrastructure and take care of maintenance and updates, but this can also mean that users have less control over the environment and may not be able to make certain customizations.
2. **Security concerns:** Users are responsible for securing their own data and applications, which can be a significant undertaking.
3. **Limited access:** Cloud computing may not be accessible in certain regions and countries due to legal policies.