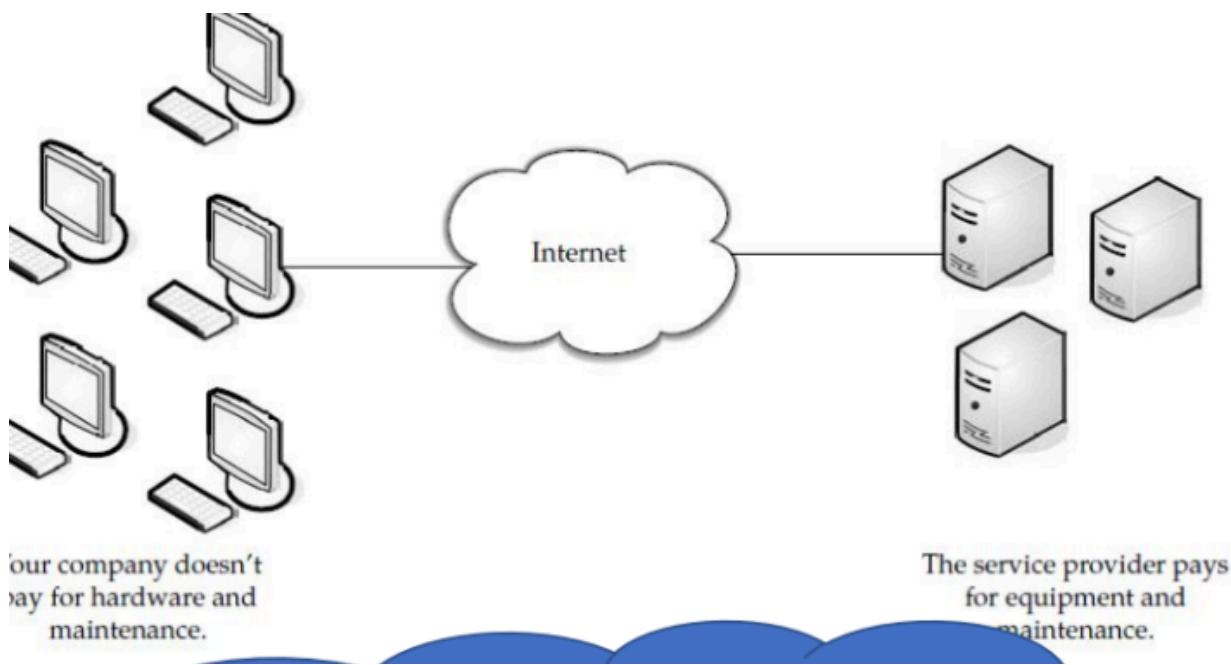


What does the term hosting refer to in cloud computing?

Cloud hosting is the ability to make applications and websites available on the internet using the cloud

CLOUD COMPUTING COMPONENTS

- **Remotely hosted:** Services or data are hosted on remote infrastructure.
- **Ubiquitous (found Everywhere):** Services or data are available from anywhere.
- **Commodified:** The result is a utility computing model similar to traditional that of traditional utilities, like gas and electricity - you pay for what you want!



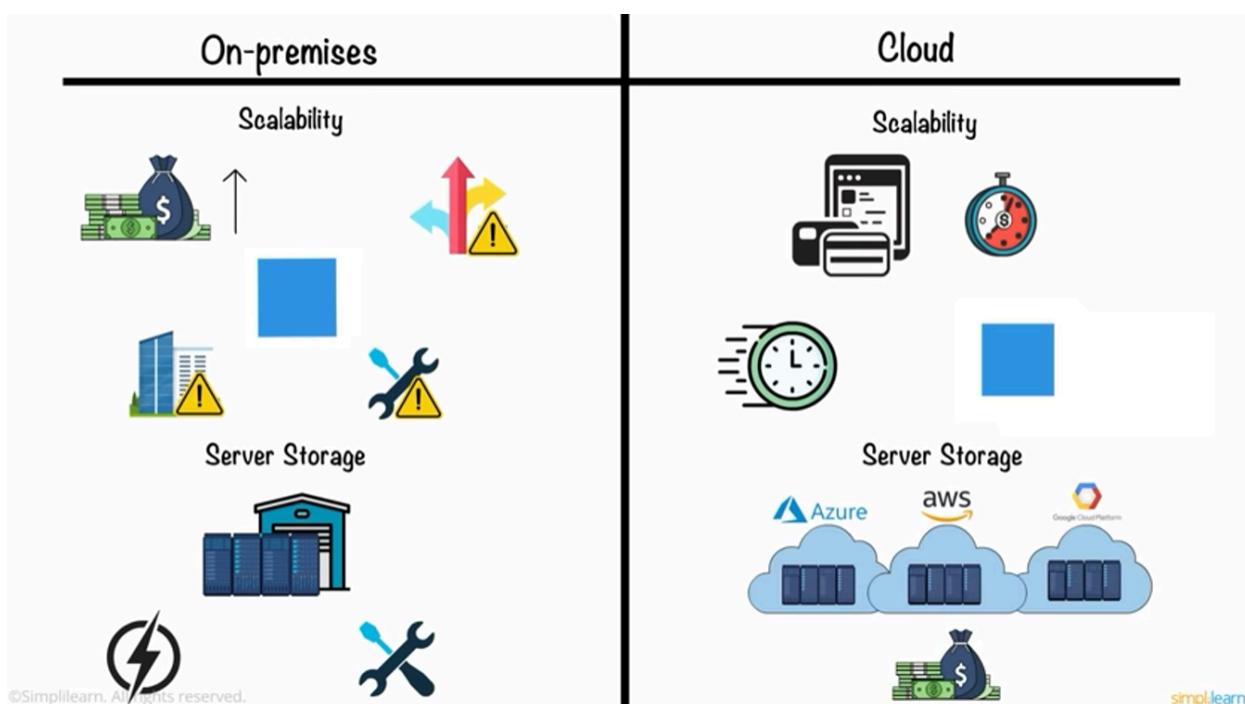
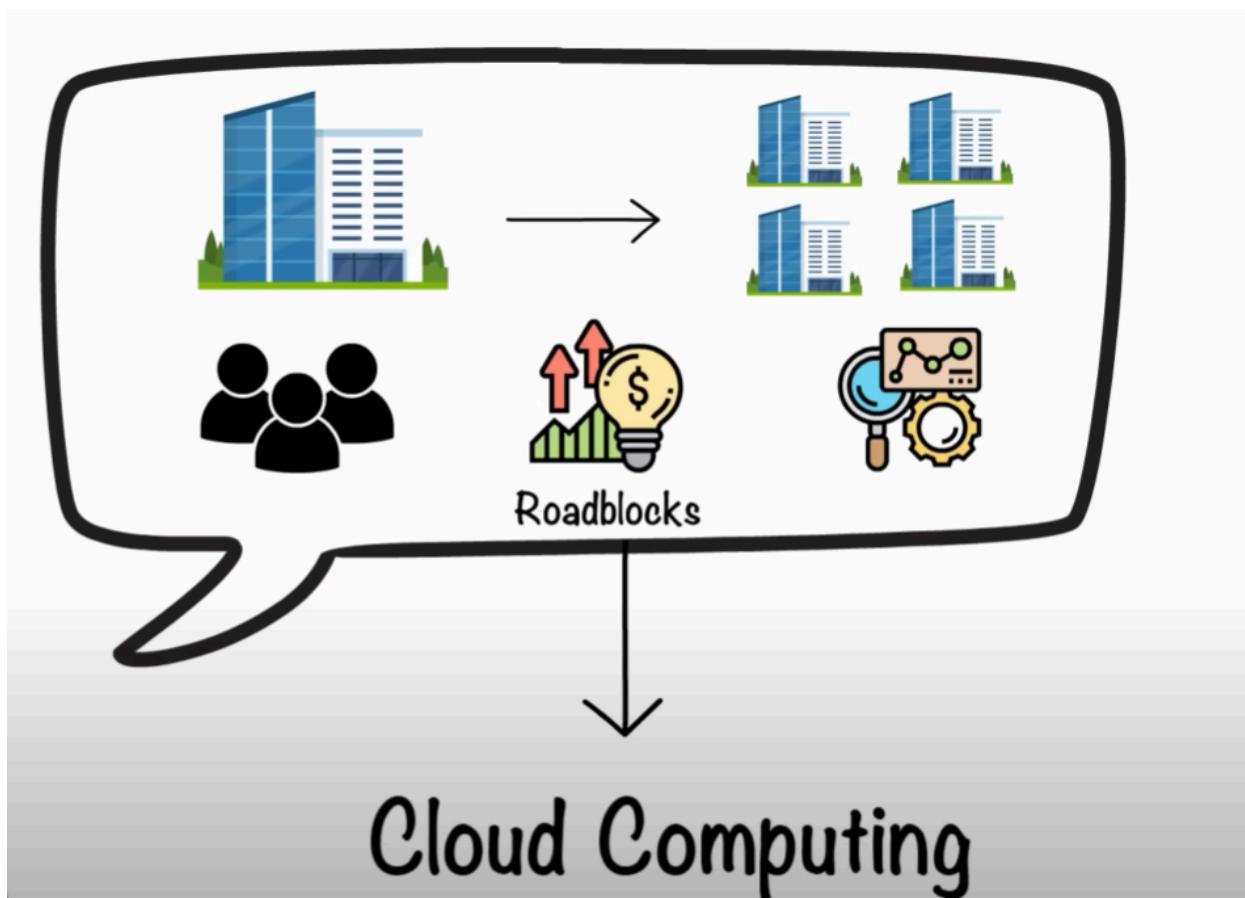
What does cloud computing mean?

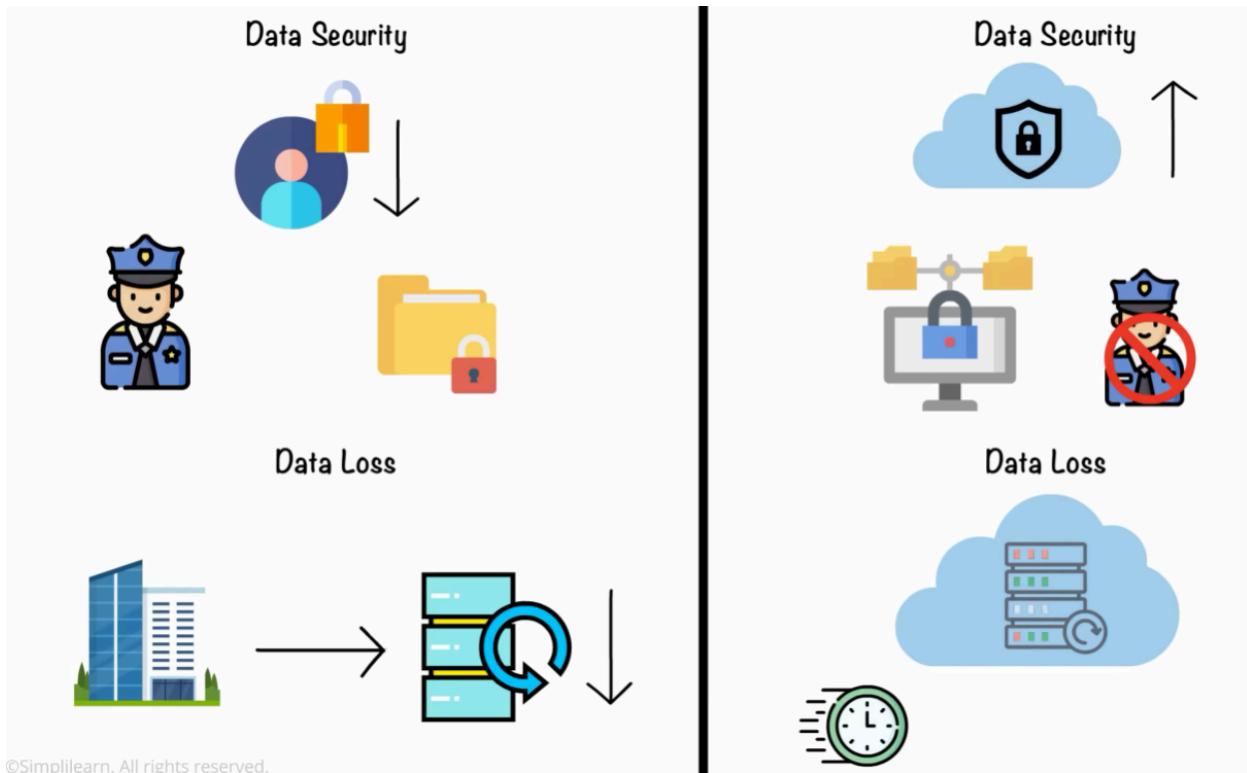
Cloud computing is the delivery of computing services—including servers, storage, databases, networking, software, analytics, and intelligence—over the Internet (“the cloud”) to offer faster innovation, flexible resources, and economies of scale.

What does cloud mean?

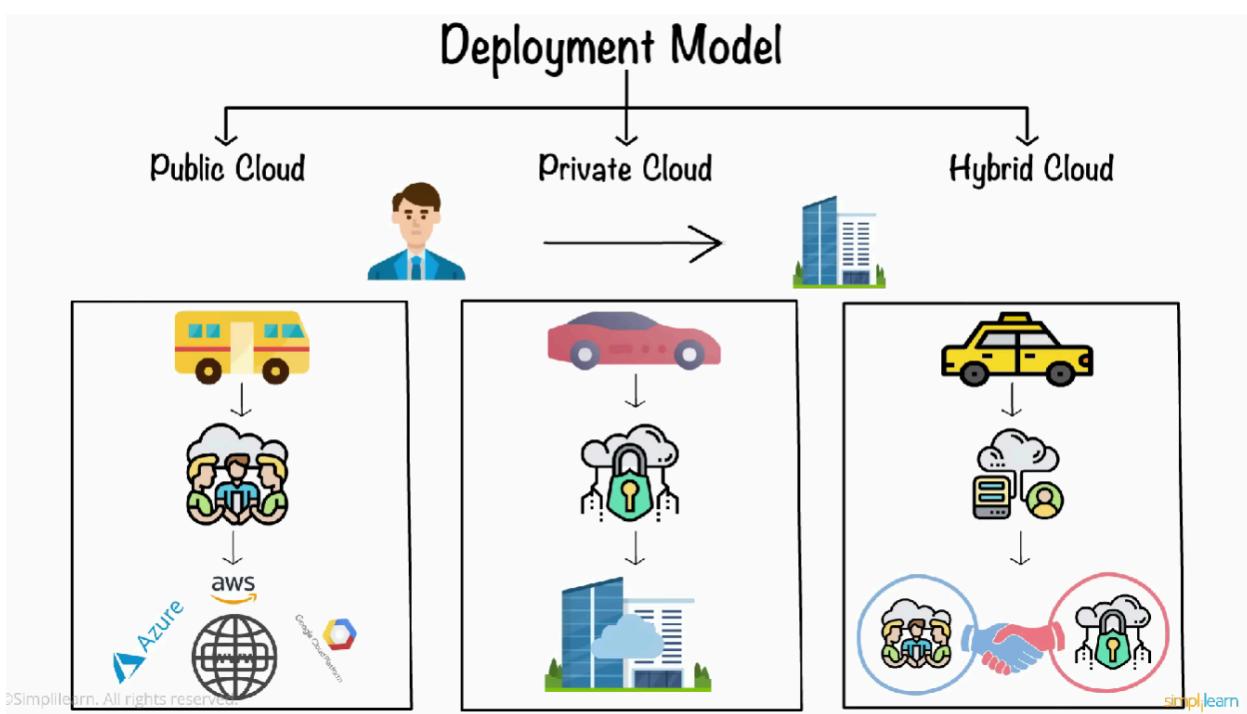
Term used to describe a global network of servers

Layer	Description
Software-Defined Data Center	Cloud API – Enables the creation of virtualized assets tied to resource pools or users.
HYPERVISOR	Virtualization – Provides virtualized compute, storage, and networking.
INFRASTRUCTURE	Hardware – Physical devices in a data center providing a foundation for the model.





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Roles	Responsibilities
Cloud stakeholders	The three primary stakeholders of the cloud include the end users, the cloud users and the cloud providers
Cloud service providers	It provide and render on-demand, pay-as-you-go utility computing services to cloud users
The cloud users	The provisioned services are used by the cloud users to develop personalized products and web
The end users	The direct consumers of the products developed by the cloud users
Cloud service brokers	Influencers, professional service organizations, technology consultants, registered brokers and agents that assist cloud users to choose appropriate cloud computing solutions that best suit their organizational needs
Cloud resellers	Expansion of cloud service provisioning business globally a reality in the cloud market
Cloud consumers	The main stakeholders of the cloud ecosystem. End users, customers of cloud resellers, providers or brokers are the major cloud consumers. The cloud consumer could be a person, a group of people or an organization that subscribes to and uses cloud service(s)

Roles	Responsibilities
Cloud carrier	<ul style="list-style-type: none"> The intermediate communication medium between the cloud provider and the consumer. It makes cloud services accessible to cloud consumers through network connectivity and network access devices like mobile phones, laptops and other internet-enabled digital devices
Cloud brokers	Cloud brokers are entities that facilitate efficient and effective use of cloud services while ensuring peak performance and seamless delivery of such services
Service intermediation	Cloud broker enhances a given service by improving some specific capabilities of a cloud service like access management, performance reporting, and identity management and providing rewards or value-added services to the cloud consumers
Service aggregation	A cloud broker consolidates a number of fixed cloud services into one or new services
Service arbitrage	This is similar to service aggregation except that the services being aggregated are not fixed

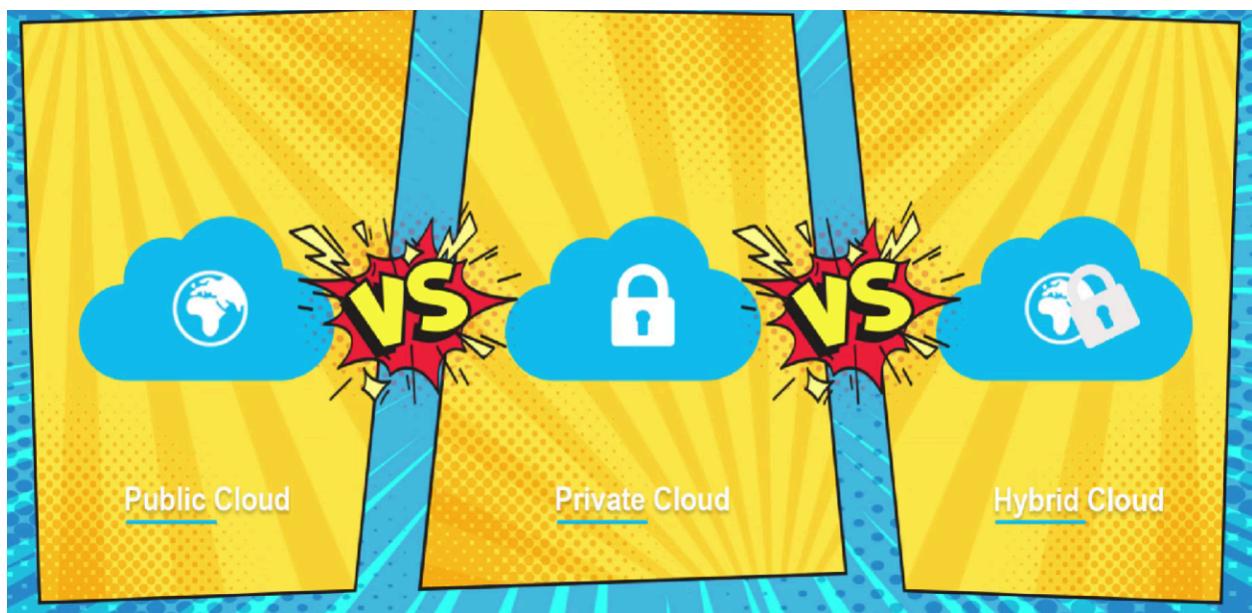
In cloud computing, we have access to a shared pool of computer resources (servers, storage, programs, and so on) in the cloud. You simply need to request additional resources when you require them. Getting resources up and running quickly is a breeze thanks to the clouds. It is possible to release resources that are no longer necessary. This method allows you to just pay for what you use. Your cloud provider is in charge of all upkeep.

What is a Cloud Deployment Model?

Cloud Deployment Model functions as a virtual computing environment with a deployment architecture that varies depending on the amount of data you want to store and who has access to the infrastructure.

Types of Cloud Computing Deployment Models

The cloud deployment model identifies the specific type of cloud environment based on ownership, scale, and access, as well as the cloud's nature and purpose. The location of the servers you're utilizing and who controls them are defined by a cloud deployment model. It specifies how your cloud infrastructure will look, what you can change, and whether you will be given services or will have to create everything yourself. Relationships between the infrastructure and your users are also defined by cloud deployment types. [Different types of cloud](#) computing deployment models are described below.



Public

Problem

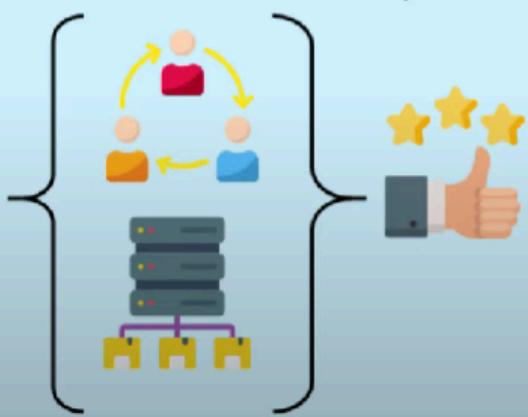
Insufficient data storage and duplication



Public

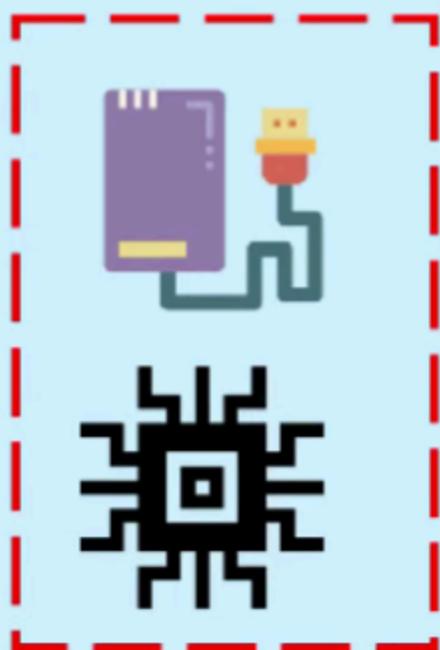
Result

Using the public cloud, expands the sharing and syncing capacities, making it more accessible and backup of data is much simpler



Private

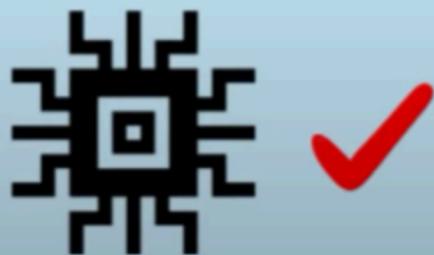
Problem - Special hardware configurations or specifications



Private

Result

Private cloud fetches hardware as per
the requirements of an application



Hybrid

Result

Hybrid cloud manages traffic levels during peak usage periods



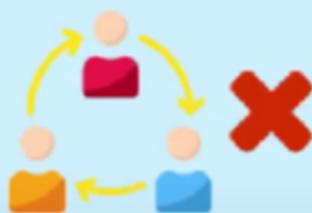
Public

The cloud computing infrastructure is located on the premises of the company that offers the services



Private

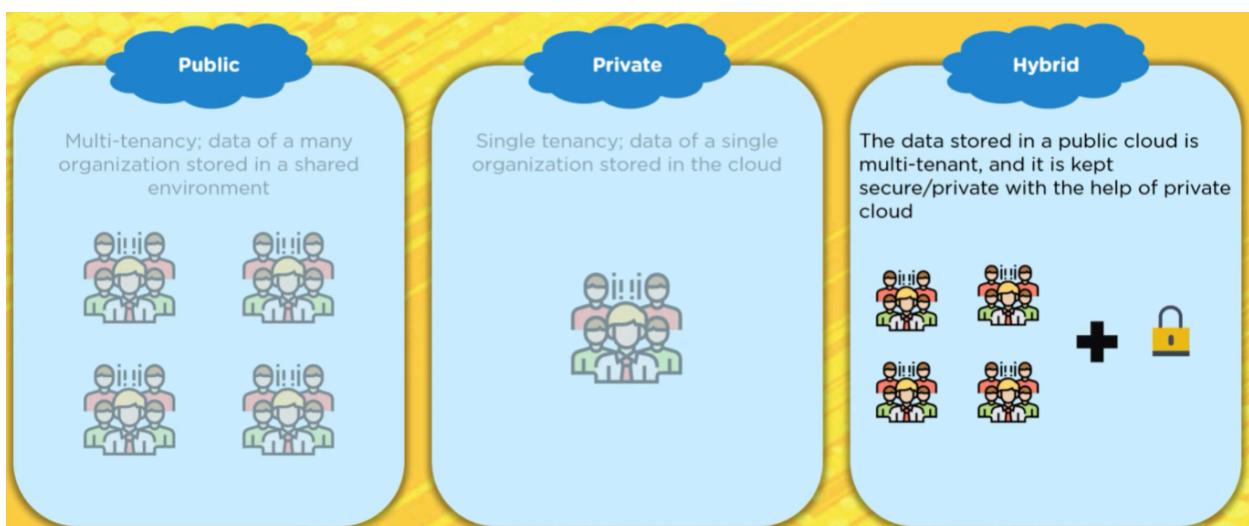
Private cloud means using a cloud infrastructure only by one customer/organization, and it is not shared with others

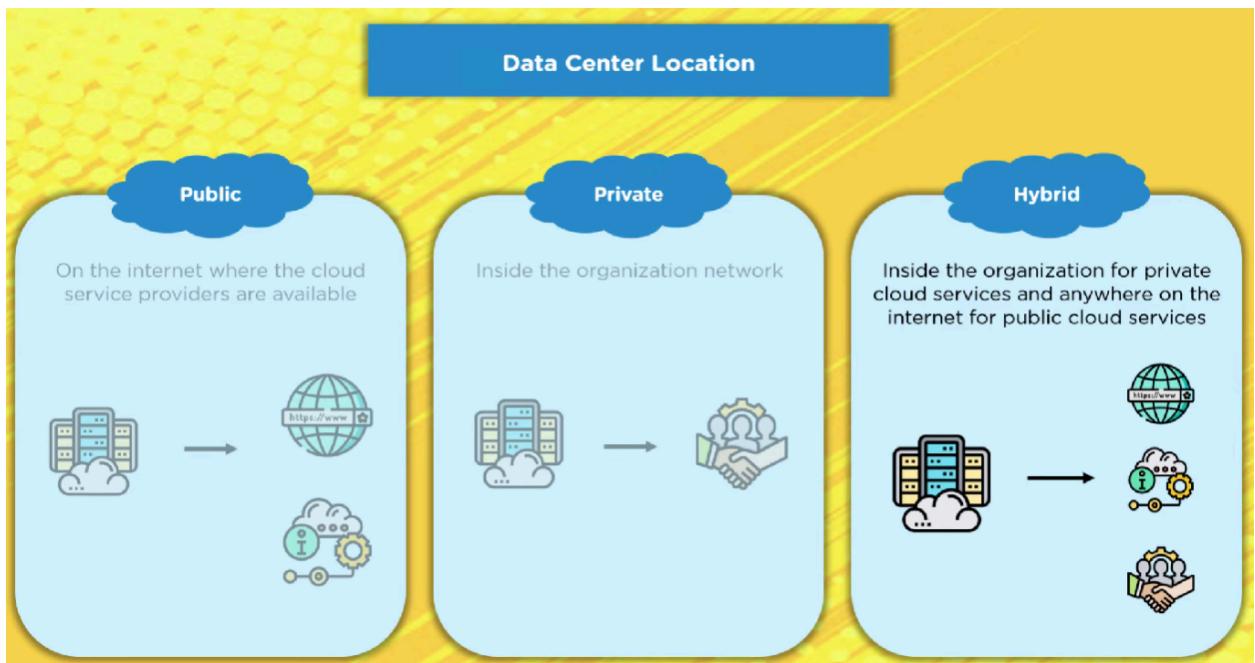
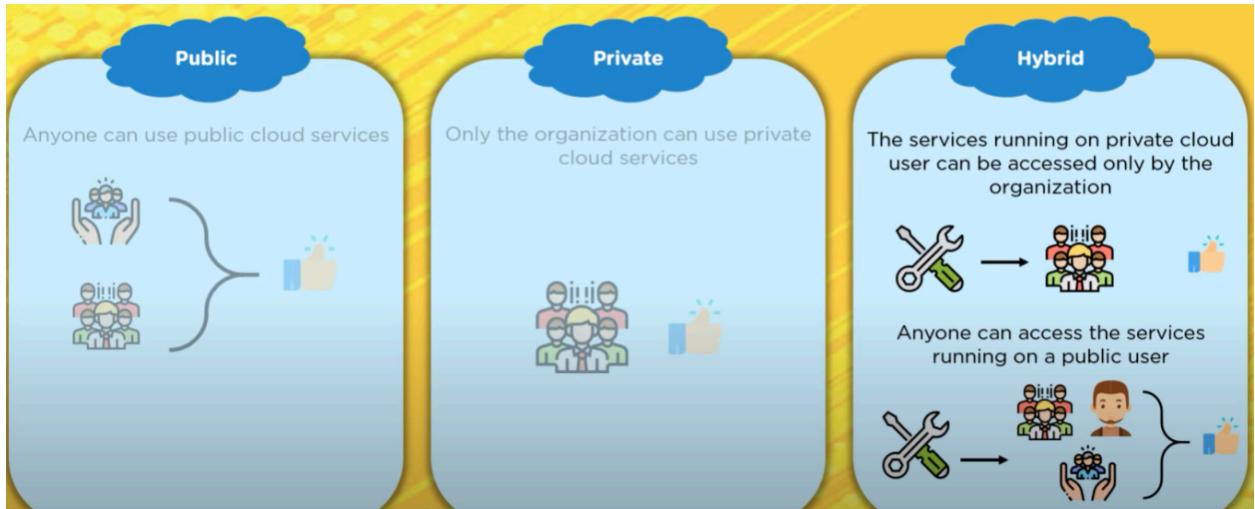


Hybrid

A Hybrid cloud uses both public and private clouds based on the purpose and requirements







Cloud Service Providers

Public

The Cloud service provider manages the services whereas the organization uses them



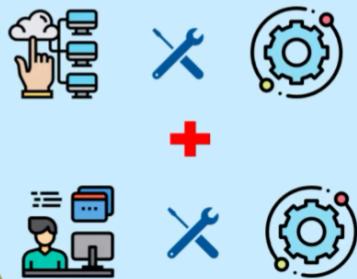
Private

The organizations need to have their administrators to manage private cloud services



Hybrid

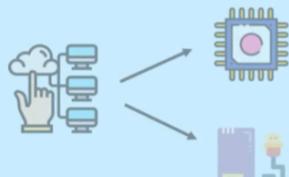
The organization operates the private cloud whereas cloud service providers manage the public cloud



Hardware Components

Public

The Cloud service provider provides all the hardware's and ensures its working properly



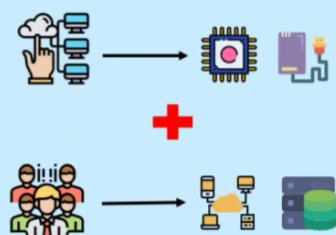
Private

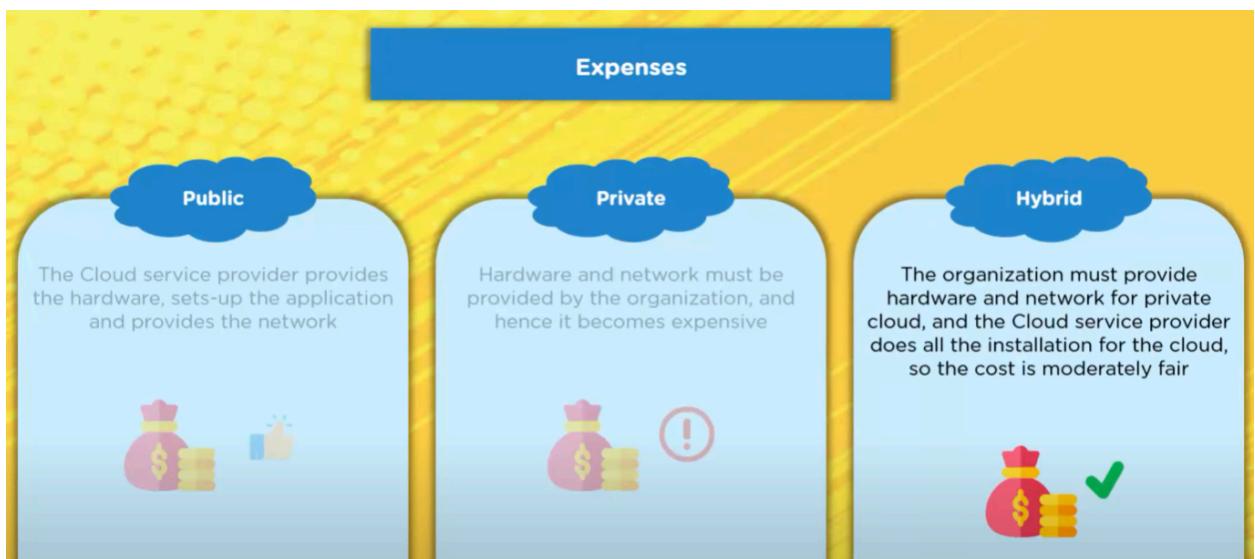
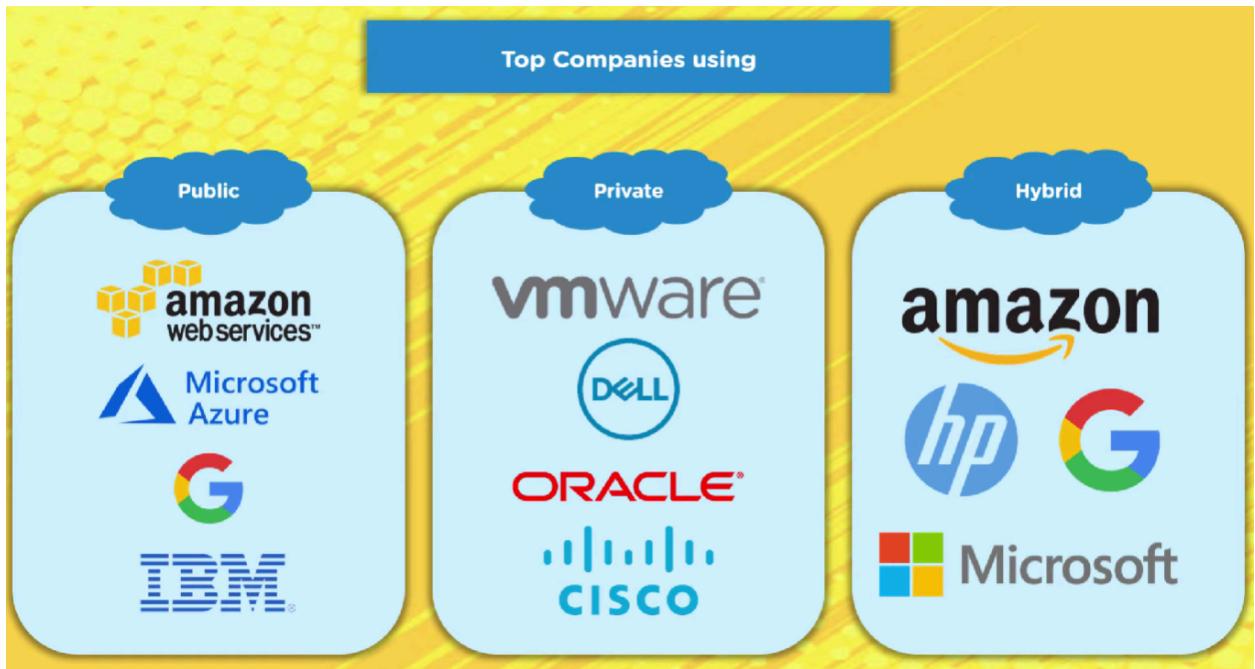
The organization offers hardware, it buys all physical servers on which the cloud is built



Hybrid

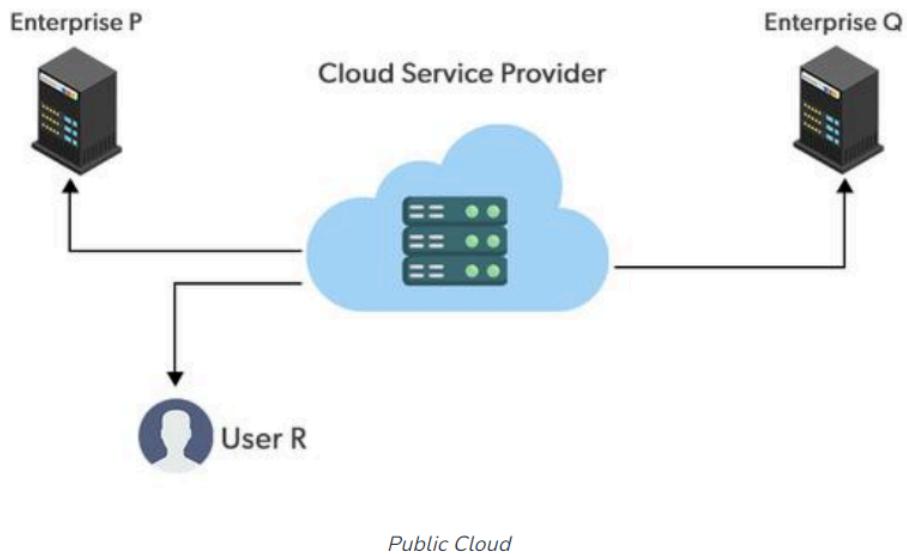
The organization provides hardware for private cloud whereas the Cloud service provider provides all the hardware for the public cloud





Public Cloud

The public cloud makes it possible for anybody to access systems and services. The public cloud may be less secure as it is open to everyone. The public cloud is one in which cloud infrastructure services are provided over the internet to the general people or major industry groups. The infrastructure in this cloud model is owned by the entity that delivers the cloud services, not by the consumer. It is a type of cloud hosting that allows customers and users to easily access systems and services. This form of cloud computing is an excellent example of cloud hosting, in which service providers supply services to a variety of customers. In this arrangement, storage backup and retrieval services are given for free, as a subscription, or on a per-user basis. For example, Google App Engine etc.



Advantages of the Public Cloud Model

- **Minimal Investment:** Because it is a pay-per-use service, there is no substantial upfront fee, making it excellent for enterprises that require immediate access to resources.
- **No setup cost:** The entire infrastructure is fully subsidized by the cloud service providers, thus there is no need to set up any hardware.
- **Infrastructure Management is not required:** Using the public cloud does not necessitate infrastructure management.
- **No maintenance:** The maintenance work is done by the service provider (not users).
- **Dynamic Scalability:** To fulfill your company's needs, on-demand resources are accessible.

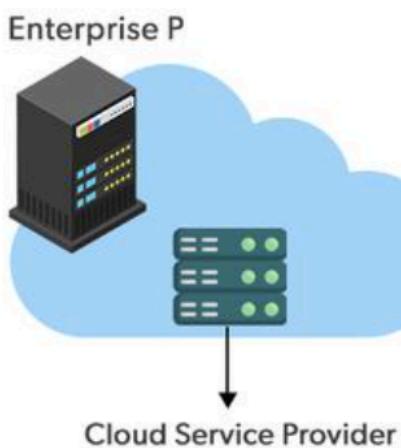
Disadvantages of the Public Cloud Model

- **Less secure:** Public cloud is less secure as resources are public so there is no guarantee of high-level security.
- **Low customization:** It is accessed by many public so it can't be customized according to personal requirements.

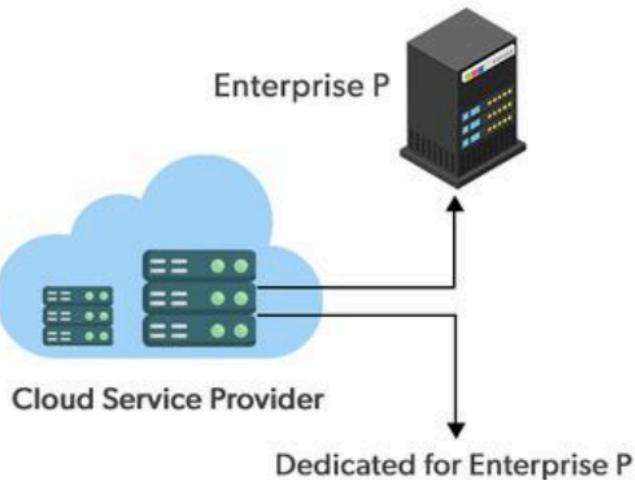
Private Cloud

The private cloud deployment model is the exact opposite of the public cloud deployment model. It's a one-on-one environment for a single user (customer). There is no need to share your hardware with anyone else. The distinction between [private and public clouds](#) is in how you handle all of the hardware. It is also called the "internal cloud" & it refers to the ability to access systems and services within a given border or organization. The cloud platform is implemented in a cloud-based secure environment that is protected by powerful firewalls and under the supervision of an organization's IT department. The private cloud gives greater flexibility of control over cloud resources.

On premise Private cloud



Externally hosted Private cloud



Private Cloud

Advantages of the Private Cloud Model

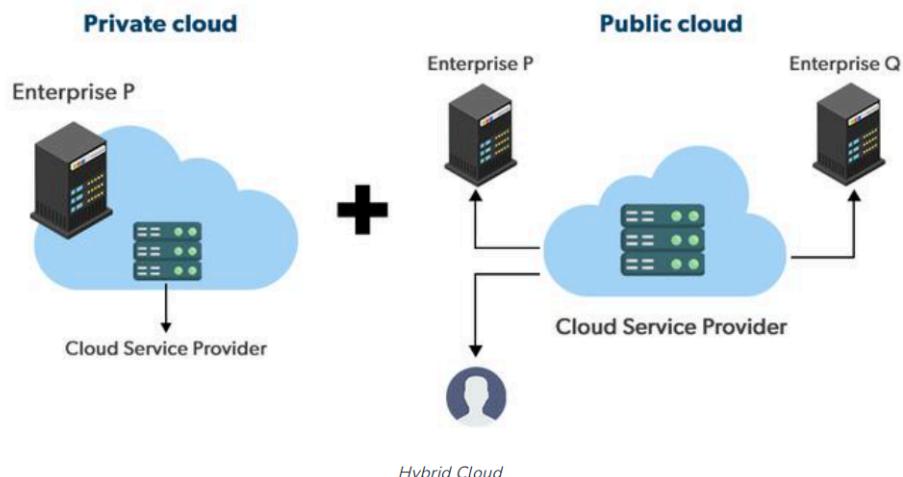
- **Better Control:** You are the sole owner of the property. You gain complete command over service integration, IT operations, policies, and user behavior.
- **Data Security and Privacy:** It's suitable for storing corporate information to which only authorized staff have access. By segmenting resources within the same infrastructure, improved access and security can be achieved.
- **Supports Legacy Systems:** This approach is designed to work with legacy systems that are unable to access the public cloud.
- **Customization:** Unlike a public cloud deployment, a private cloud allows a company to tailor its solution to meet its specific needs.

Disadvantages of the Private Cloud Model

- **Less scalable:** Private clouds are scaled within a certain range as there is less number of clients.
- **Costly:** Private clouds are more costly as they provide personalized facilities.

Hybrid Cloud

By bridging the public and private worlds with a layer of proprietary software, hybrid cloud computing gives the best of both worlds. With a hybrid solution, you may host the app in a safe environment while taking advantage of the public cloud's cost savings. Organizations can move data and applications between different clouds using a combination of two or more cloud deployment methods, depending on their needs.



Advantages of the Hybrid Cloud Model

- **Flexibility and control:** Businesses with more flexibility can design personalized solutions that meet their particular needs.
- **Cost:** Because public clouds provide scalability, you'll only be responsible for paying for the extra capacity if you require it.
- **Security:** Because data is properly separated, the chances of data theft by attackers are considerably reduced.

Disadvantages of the Hybrid Cloud Model

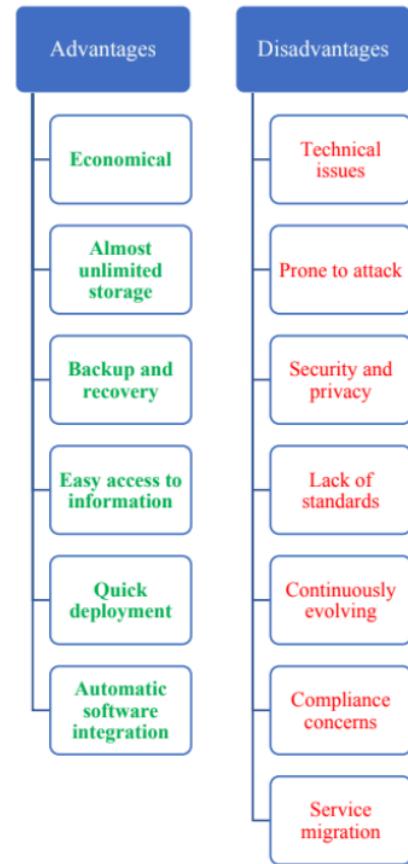
- **Difficult to manage:** Hybrid clouds are difficult to manage as it is a combination of both public and private cloud. So, it is complex.
- **Slow data transmission:** Data transmission in the hybrid cloud takes place through the public cloud so latency occurs.

Overall Analysis of Cloud Deployment Models

The overall Analysis of these models with respect to different factors is described below.

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

Advantages and disadvantages of cloud computing



Cluster Computing

Cluster computing is a collection of tightly or loosely connected computers that work together so that they act as a single entity. The connected computers execute operations all together thus creating the idea of a single system. The clusters are generally connected through fast local area networks (LANs)

- Performance improvement, fault tolerance, scalability, huge cost savings, throughput, redundancy, high memory, enormous speed, load balancing and high availability

Cluster Computing:

A Computer Cluster is a local network of two or more homogeneous computers. A computation process on such a computer network i.e. cluster is called [Cluster Computing](#).

Grid Computing:

[Grid Computing](#) can be defined as a network of homogeneous or heterogeneous computers working together over a long distance to perform a task that would rather be difficult for a single machine.

Difference between Cluster and Grid Computing:

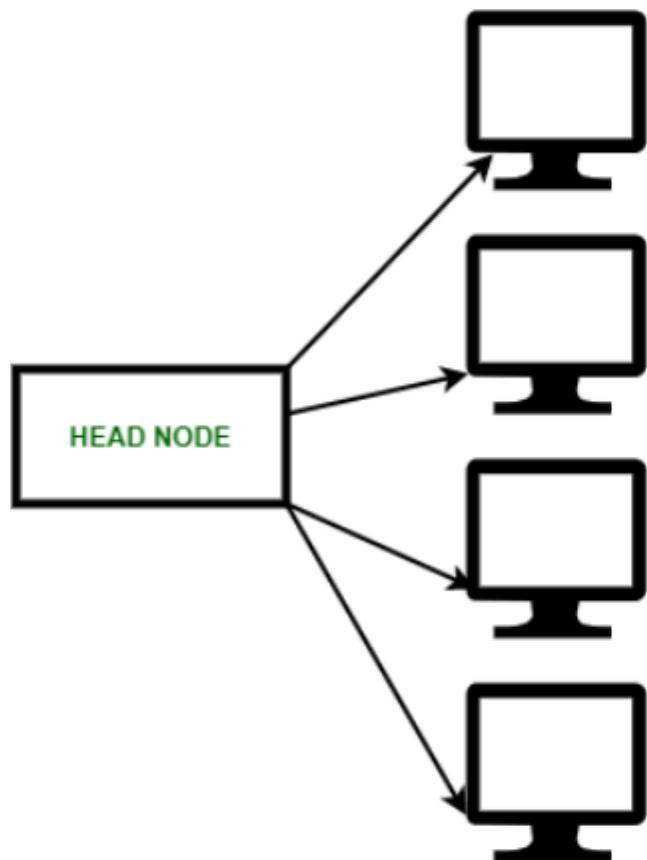
Cluster Computing	Grid Computing
Nodes must be homogeneous i.e. they should have same type of hardware and operating system.	Nodes may have different Operating systems and hardwares. Machines can be homogeneous or heterogeneous.
Computers in a cluster are dedicated to the same work and perform no other task.	Computers in a grid contribute their unused processing resources to the grid computing network.
Computers are located close to each other.	Computers may be located at a huge distance from one another.
Computers are connected by a high speed local area network bus.	Computers are connected using a low speed bus or the internet .
Computers are connected in a centralized network topology .	Computers are connected in a distributed or de-centralized network topology.
Scheduling is controlled by a central server.	It may have servers , but mostly each node behaves independently.
Whole system has a centralized resource manager.	Every node manages its resources independently.
Whole system functions as a single system.	Every node is autonomous , and anyone can opt out anytime.

Cluster computing is used in areas such as [WebLogic](#) Application Servers, [Databases](#), etc.

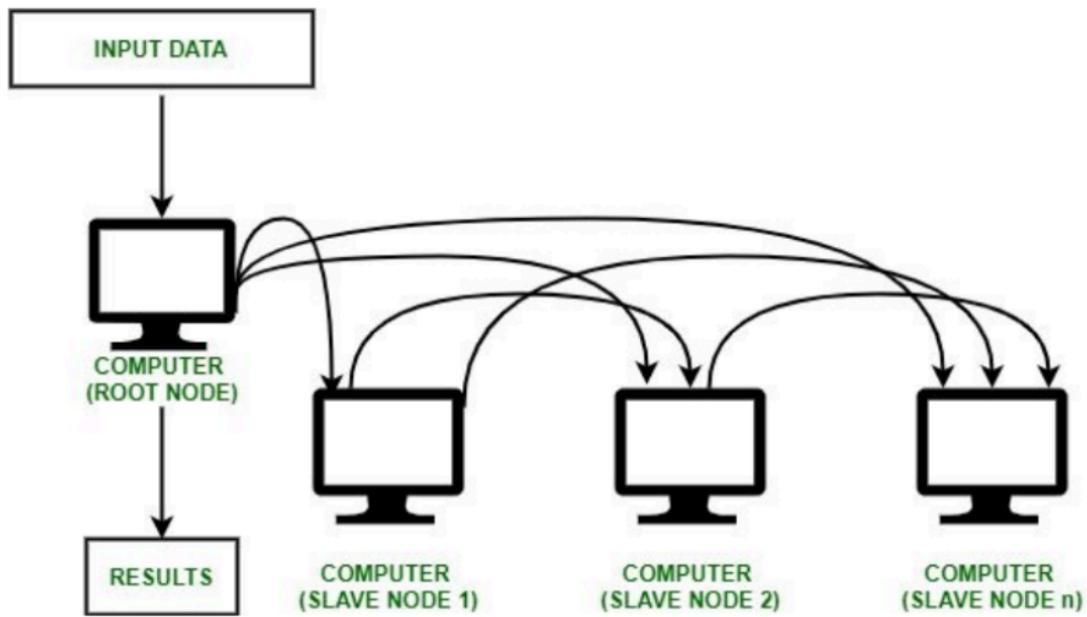
It has Centralized Resource management.

Grid computing is used in areas such as [predictive modeling](#), [Automation](#), [simulations](#), etc.

It has Distributed Resource Management.



Cluster Computing



- All the connected computers are the same kind of machines
- They are tightly connected through dedicated network connections
- All the computers share a common home directory.

It ensures that computational power is always available.

It provides a single general strategy for the implementation and application of parallel high-performance systems independent of certain hardware vendors and their product decisions.

Types of Cluster computing :

1. High performance (HP) clusters :

HP clusters use computer clusters and supercomputers to solve advance computational problems. They are used to performing functions that need nodes to communicate as they perform their jobs. They are designed to take benefit of the parallel processing power of several nodes.

2. Load-balancing clusters :

Incoming requests are distributed for resources among several nodes running similar programs or having similar content. This prevents any single node from receiving a disproportionate amount of task. This type of distribution is generally used in a web-hosting environment.

3. High Availability (HA) Clusters :

HA clusters are designed to maintain redundant nodes that can act as backup systems in case any failure occurs. Consistent computing services like business activities, complicated databases, customer services like e-websites and network file distribution are provided. They are designed to give uninterrupted data availability to the customers.

1. CLUSTER LOAD BALANCING

2. HIGH-AVAILABILITY CLUSTERS

3. HIGH-PERFORMANCE CLUSTERS

- | | |
|--|---|
| <ul style="list-style-type: none">• Cost efficiency• Processing speed• Extended resource availability• Expandability• Flexibility | <ul style="list-style-type: none">• Difficult to manage and organize a large number of computers• Poor performance in the case of non-parallelizable applications• Physical space needed is considerably greater than that of a single server• Increased power consumption compared to a single server |
|--|---|

Advantages of Cluster Computing :

1. High Performance :

The systems offer better and enhanced performance than that of mainframe computer networks.

2. Easy to manage :

Cluster Computing is manageable and easy to implement.

3. Scalable :

Resources can be added to the clusters accordingly.

4. Expandability :

Computer clusters can be expanded easily by adding additional computers to the network. Cluster computing is capable of combining several additional resources or the networks to the existing computer system.

5. Availability :

The other nodes will be active when one node gets failed and will function as a proxy for the failed node.

This makes sure for enhanced availability.

6. Flexibility :

It can be upgraded to the superior specification or additional nodes can be added.

Disadvantages of Cluster Computing :

1. High cost :

It is not so much cost-effective due to its high hardware and its design.

2. Problem in finding fault :

It is difficult to find which component has a fault.

3. More space is needed :

Infrastructure may increase as more servers are needed to manage and monitor.

Applications of Cluster Computing :

- Various complex computational problems can be solved.
- It can be used in the applications of aerodynamics, astrophysics and in data mining.
- Weather forecasting.
- Image Rendering.
- Various e-commerce applications.
- Earthquake Simulation.
- Petroleum reservoir simulation.

Grid computing



- Grid computing is defined as a **distributed architecture of multiple computers connected** by networks that work together to accomplish a joint task.

Grid Computing can be defined as a network of computers working together to perform a task that would rather be difficult for a single machine. All machines on that network work under the same protocol to act as a virtual supercomputer. The task that they work on may include analyzing huge datasets or simulating situations that require high computing power. Computers on the network contribute resources like processing power and storage capacity to the network.

Grid Computing is a subset of distributed computing, where a virtual supercomputer comprises machines on a network connected by some bus, mostly Ethernet or sometimes the Internet. It can also be seen as a form of [Parallel Computing](#) where instead of many CPU cores on a single machine, it contains multiple cores spread across various locations. The concept of grid computing isn't new, but it is not yet perfected as there are no standard rules and protocols established and accepted by people.

Working:

A Grid computing network mainly consists of these three types of machines

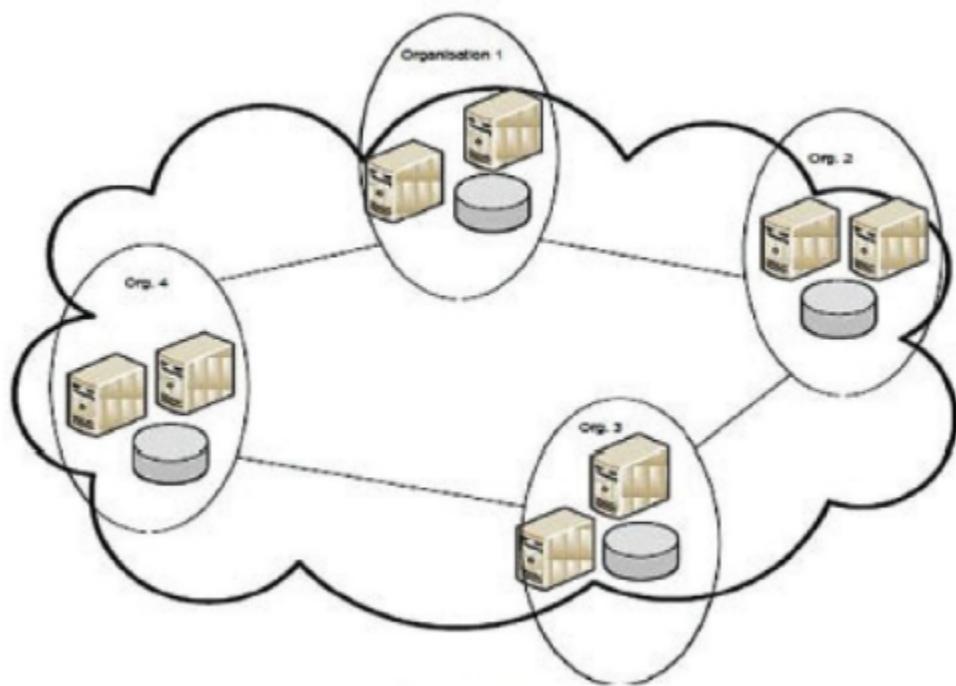
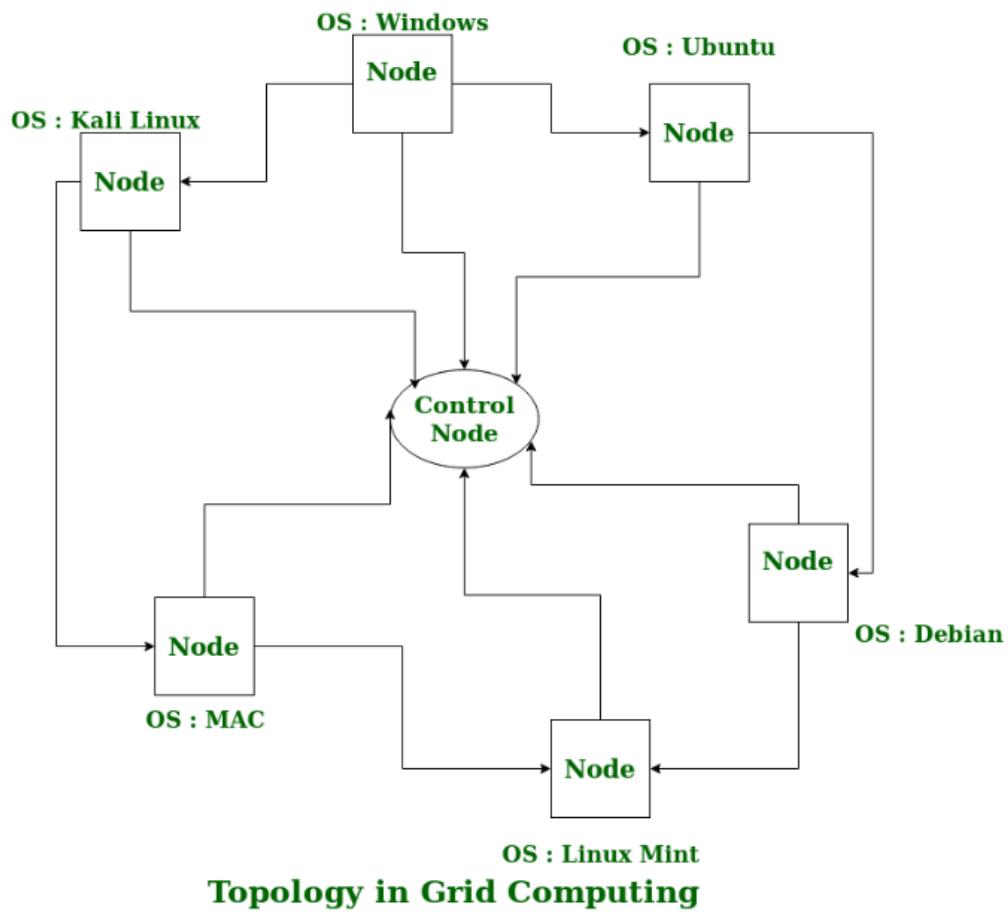
1. **Control Node:** A computer, usually a server or a group of servers which administers the whole network and keeps the account of the resources in the network pool.
2. **Provider:** The computer contributes its resources to the network resource pool.
3. **User:** The computer that uses the resources on the network.

Optimal Resource Load Balancing

When a computer makes a request for resources to the control node, the control node gives the user access to the resources available on the network. When it is not in use it should ideally contribute its resources to the network. Hence a normal computer on the node can swing in between being a user or a provider based on its needs. The nodes may consist of machines with similar platforms using the same OS called homogeneous networks, else machines with different platforms running on various different OSs called heterogeneous networks. This is the distinguishing part of grid computing from other distributed computing architectures.

For controlling the network and its resources a software/networking protocol is used generally known as **Middleware**. This is responsible for administrating the network and the control nodes are merely its executors. As a grid computing system should use only unused resources of a computer, it is the job of the control node that any provider is not overloaded with tasks.

Another job of the middleware is to authorize any process that is being executed on the network. In a grid computing system, a provider gives permission to the user to run anything on its computer, hence it is a huge security threat to the network. Hence a middleware should ensure that there is no unwanted task being executed on the network.



It is not centralized, as there are **no servers** required, except the **control node** which is just used for controlling and not for processing.

Multiple heterogeneous machines

Tasks can be performed parallelly across various physical locations.

It guarantees optimal resource balancing

If a node on the grid is down, a single point of failure occurs.

A super fast interconnect between computer resources is the need of hour.

Licensing across many servers may make it prohibitive for some applications.

Many groups are unwilling with sharing resources .

Advantages of Grid Computing:

1. It is not centralized, as there are no servers required, except the control node which is just used for controlling and not for processing.
2. Multiple heterogeneous machines i.e. machines with different Operating Systems can use a single grid computing network.
3. Tasks can be performed parallelly across various physical locations and the users don't have to pay for them (with money).

Disadvantages of Grid Computing:

1. The software of the grid is still in the involution stage.
2. A super-fast interconnect between computer resources is the need of the hour.
3. Licensing across many servers may make it prohibitive for some applications.
4. Many groups are reluctant with sharing resources.
5. Trouble in the control node can come to halt in the whole network.

What is Cloud Computing?

Cloud computing refers to the use of remote servers to store, manage, and process data instead of using a local server or personal computer. Cloud computing provides a flexible and cost-effective way to access and manage data. Cloud computing can be categorized into three main types:

1. Infrastructure as a Service (IaaS) - provides virtualized computing resources like servers, storage, and network infrastructure.
2. Platform as a Service (PaaS) - provides a platform on which developers can build and deploy applications.
3. Software as a Service (SaaS) - provides software applications that are hosted and maintained by the service provider.

Cloud computing services are provided by companies like Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform (GCP). These companies provide a range of services like virtual machines, storage, databases, and analytics tools.

What is Cluster Computing?

Cluster computing refers to the use of multiple computers connected to a local network to work together on a single problem. Cluster computing is often used for high-performance computing (HPC) applications that require a large amount of computing power. Cluster computing can be categorized into two main types:

1. High Availability Cluster - provides a highly available computing system for mission-critical applications.
2. High-Performance Cluster - provides a distributed computing system for parallel processing.

Cluster computing is often used in applications like financial modeling, oil and gas exploration, and molecular dynamics simulations.

What is Grid Computing?

Grid computing refers to the use of multiple computers connected to a network to work together on a single problem. Grid computing is often used for scientific and research applications that require a large amount of computing power. Grid computing can be categorized into two main types:

1. Data Grid - provides a distributed storage system for large datasets.
2. Compute Grid - provides a [distributed computing](#) system for parallel processing.

Grid computing is often used in scientific applications like particle physics, weather forecasting, and drug discovery.

Differences between Cloud, Grid, and Cluster

The main differences between Cloud, Grid, and Cluster are:

1. **Infrastructure:** Cloud computing provides virtualized computing resources, while Grid and Cluster computing use physical hardware.
2. **Scalability:** Cloud computing is highly scalable, while Grid and Cluster computing have limited scalability.
3. **Cost:** Cloud computing is cost-effective for small to medium-sized workloads, while Grid and Cluster computing are cost-effective for large workloads.
4. **Availability:** Cloud computing is highly available, while Grid and Cluster computing have limited availability.

When to use Cloud, Grid, or Cluster?

When deciding which computing environment to use, you need to consider the size and complexity of your workload, as well as your budget and availability requirements.

Use Cloud computing when:

- You have a small to medium-sized workload.
- You need a cost-effective solution.
- You need high availability.

Use Grid computing when:

- You have a large workload that requires distributed storage or computing.
- You need a highly specialized computing environment.
- You have a limited budget and can manage the infrastructure yourself.

Use Cluster computing when:

- You have a large workload that requires high-performance computing.
- You need a highly specialized computing environment.
- You have a limited budget and can manage the infrastructure yourself.

Cluster Computing:

A Computer Cluster is a local network of two or more homogeneous computers. A computation process on such a computer network i.e. cluster is called [Cluster Computing](#).

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Scheduling is controlled by a central server.	It may have servers , but mostly each node behaves independently.
Whole system has a centralized resource manager.	Every node manages its resources independently.
Whole system functions as a single system.	Every node is autonomous , and anyone can opt out anytime.
Cluster computing is used in areas such as WebLogic Application Servers, Databases , etc.	Grid computing is used in areas such as predictive modeling , Automation , simulations , etc.
It has Centralized Resource management.	It has Distributed Resource Management.

Models of Cloud Computing

Cloud Computing helps in rendering several services according to roles, companies, etc. Cloud computing models are explained below.

- Infrastructure as a service (IaaS)
- Platform as a service (PaaS)
- Software as a service (SaaS)

Advantages of IaaS

- The resources can be deployed by the provider to a customer's environment at any given time.
- Its ability to offer the users to scale the business based on their requirements.
- The provider has various options when deploying resources including virtual machines, applications, storage, and networks.
- It has the potential to handle an immense number of users.
- It is easy to expand and saves a lot of money. Companies can afford the huge costs associated with the implementation of advanced technologies.
- Cloud provides the architecture.
- Enhanced scalability and quite flexible.
- Dynamic workloads are supported.

Disadvantages of IaaS

- Security issues are there.
- Service and Network delays are quite a issue in IaaS.

2. Platform as a service (PaaS)

Platform as a Service (PaaS) is a type of cloud computing that helps developers to build applications and services over the Internet by providing them with a platform.

PaaS helps in maintaining control over their business applications.

Advantages of PaaS

- PaaS is simple and very much convenient for the user as it can be accessed via a web browser.
- PaaS has the capabilities to efficiently manage the lifecycle.

Disadvantages of PaaS

- PaaS has limited control over infrastructure as they have less control over the environment and are not able to make some customizations.
- PaaS has a high dependence on the provider.

3. Software as a service (SaaS)

Software as a Service (SaaS) is a type of cloud computing model that is the work of delivering services and applications over the Internet. The SaaS applications are called Web-Based Software or Hosted Software.

SaaS has around 60 percent of cloud solutions and due to this, it is mostly preferred by companies.

Advantages of SaaS

- SaaS can access app data from anywhere on the Internet.
- SaaS provides easy access to features and services.

Disadvantages of SaaS

- SaaS solutions have limited customization, which means they have some restrictions within the platform.
- SaaS has little control over the data of the user.
- SaaS are generally cloud-based, they require a stable internet connection for proper working.

1. List the disadvantages of the public cloud model?

Answer:

The disadvantages of the public cloud model are:

- *Data Security and Privacy Concerns: Because it is open to the public, it does not provide complete protection against cyber-attacks and may expose weaknesses.*
- *Issues with Reliability: Because the same server network is accessible to a wide range of users, it is susceptible to failure and outages.*
- *Limitation on Service/License: While there are numerous resources that you may share with renters, there is a limit on how much you can use.*

2. List the disadvantages of the hybrid cloud model?

Answer:

The disadvantages of the hybrid cloud model are:

- *Maintenance: A hybrid cloud computing strategy may necessitate additional maintenance, resulting in a greater operational expense for your company.*
- *Difficult Integration: When constructing a hybrid cloud, data, and application integration might be difficult. It's also true that combining two or more infrastructures will offset a significant upfront cost.*

3. List the disadvantages of the private cloud model?

Answer:

The disadvantages of the private cloud model are

- *Restricted Scalability: Private clouds have restricted scalability because they are scaled within the confines of internally hosted resources. The choice of underlying hardware has an impact on scalability.*
- *Higher Cost: Due to the benefits you would receive, your investment will be higher than the public cloud(pay for software, hardware, staffing, etc).*

What is the Right Choice for Cloud Deployment Model?

As of now, no such approach fits picking a cloud deployment model. We will always consider the best cloud deployment model as per our requirements. Here are some factors which should be considered before choosing the best deployment model.

- Cost: Cost is an important factor for the cloud deployment model as it tells how much amount you want to pay for these things.
- Scalability: Scalability tells about the current activity status and how much we can scale it.
- Easy to use: It tells how much your resources are trained and how easily can you manage these models.
- Compliance: Compliance tells about the laws and regulations which impact the implementation of the model.
- Privacy: Privacy tells about what data you gather for the model.

Each model has some advantages and some disadvantages, and the selection of the best is only done on the basis of your requirement. If your requirement changes, you can switch to any other model.

Difference between IAAS, PAAS and SAAS

1. IAAS: Infrastructure As A Service (IAAS) is means of delivering computing infrastructure as on-demand services. It is one of the three fundamental cloud service models. The user purchases servers, software data center space, or network equipment and rent those resources through a fully outsourced, on-demand service model. It allows dynamic scaling and the resources are distributed as a service. It generally includes multiple-user on a single piece of hardware.

It totally depends upon the customer to choose its resources wisely and as per need. Also, it provides billing management too.

IAAS Provides?

IaaS provides all the infrastructure to support web apps, including **storage, web and application servers, and networking resources**. Your organization can quickly deploy web apps on IaaS and easily scale infrastructure up and down when demand for the apps is unpredictable.

Infrastructure as a Service (IaaS) is a business model that delivers IT infrastructure like compute, storage, and network resources on a pay-as-you-go basis over the internet.

2. PAAS: Platform As A Service (PAAS) is a cloud delivery model for applications composed of services managed by a third party. It provides elastic scaling of your application which allows developers to build applications and services over the internet and the deployment models include public, private and hybrid.

Basically, it is a service where a third-party provider provides both software and hardware tools to the cloud computing. The tools which are provided are used by developers. PAAS is also known as Application PAAS. It helps us to organize and maintain useful applications and services. It has a well-equipped management system and is less expensive compared to IAAS.

What does PAAS provide?

PaaS provides a framework that **developers can build upon to develop or customize cloud-based applications**. Similar to the way you create an Excel macro, PaaS lets developers create applications using built-in software components.

A PaaS vendor will provide and maintain the operating system that developers work on and the application runs on.

PaaS provides all the infrastructure needed to develop and run applications over the Internet. Users can access custom apps built in the cloud, just like their SaaS apps

3. SAAS: Software As A Service (SAAS) allows users to run existing online applications and it is a model software that is deployed as a hosting service and is accessed over Output Rephrased/Re-written Text the internet or software delivery model during which software and its associated data are hosted centrally and accessed using their client, usually an online browser over the web. SAAS services are used for the development and deployment of modern applications.

It allows software and its functions to be accessed from anywhere with good internet connection device and a browser. An application is hosted centrally and also provides access to multiple users across various locations via the internet.

What does SAAS provide?

Software as a service (SaaS) allows users to connect to and use cloud-based apps over the Internet. Common examples are **email, calendaring, and office tools (such as Microsoft Office 365)**.

SaaS provides a complete software solution that you purchase on a pay-as-you-go basis from a cloud service provider.

The SaaS model is a plan in which a business profits by offering cloud-based programs to clients. Customers can access SaaS applications over an internet network or remotely from any device or place, which can have more benefits than traditional software business models.

The service is purchased on a user subscription basis.

Difference between IAAS, PAAS and SAAS :

Basis Of	IAAS	PAAS	SAAS
Stands for	Infrastructure as a service.	Platform as a service.	Software as a service.
Uses	IAAS is used by network architects.	PAAS is used by developers.	SAAS is used by the end user.

Access	IAAS gives access to the resources like virtual machines and virtual storage.	PAAS gives access to run time environment to deployment and development tools for application.	SAAS gives access to the end user.
Model	It is a service model that provides virtualized computing resources over the internet.	It is a cloud computing model that delivers tools that are used for the development of applications.	It is a service model in cloud computing that hosts software to make it available to clients.

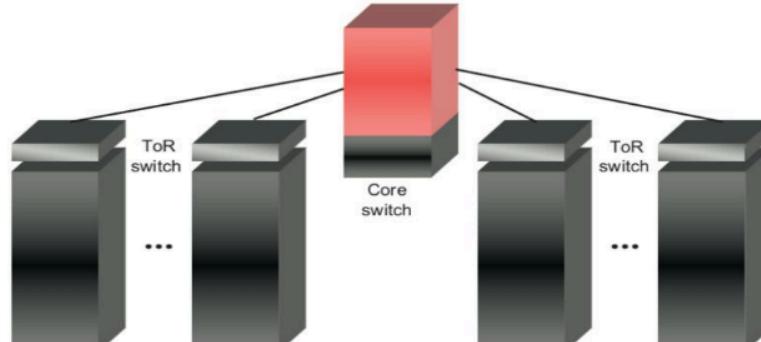
Technical understanding.	It requires technical knowledge.	Some knowledge is required for the basic setup.	There is no requirement about technicalities company handles everything.
Popularity	It is popular among developers and researchers.	It is popular among developers who focus on the development of apps and scripts.	It is popular among consumers and companies, such as file sharing, email, and networking.
Percentage rise	It has around a 12% increment.	It has around 32% increment.	It has about a 27 % rise in the cloud computing model.
Usage	Used by the skilled developer to develop unique applications.	Used by mid-level developers to build applications.	Used among the users of entertainment.
Cloud services.	Amazon Web Services, sun, vCloud Express.	Facebook, and Google search engine.	MS Office web, Facebook and Google Apps.
User Controls	Operating System, Runtime, Middleware, and Application data	Data of the application	Nothing
Others	It is highly scalable and flexible.	It is highly scalable to suit the different businesses according to resources.	It is highly scalable to suit the small, mid and enterprise level business

Characteristics	Clusters	Grids	Clouds
Ownership	Single ownership	Multiple ownership	Single ownership
Service pricing	Limited	Private or public assigned	Utility /large user discount
Virtualization	Half	Half	Yes
Resource management	Centralized resource	Distributed resource	Both
Scalable size	100s	1000s	100 to 1000s
Standardized	Yes	Yes	No
Interoperability	Yes	Yes	Not full
Speed/ Interconnected network	Dedicated high end with low latency and high bandwidth	Mostly internet with high latency and low bandwidth	Dedicated high end with low latency and high bandwidth
Self-service	No	Yes	Yes
Single system image	Yes	No	Yes/optional included
Multi-tenancy	No	Yes	Yes
Service negotiation	Limited	Yes, SLA-based	Yes, SLA-based
Membership discovery	Membership service discovery	Decentralized information services and centralized indexing	Membership service discovery
Operating system	Windows/Linux	Any standard but dominated by Unix	Uses a hypervisor
Application drivers	Business, data centres, enterprise computing	Collaborative scientific and high-throughput applications	Web App. content delivery, dynamic provisioning
Standards/ interoperability	Virtual Interface Architecture (VIA)	Some open grid forum	Web services (SOAP and REST)
Scalable	No	Half	Yes

Characteristics	Clusters	Grids	Clouds
Failure management	Limited (often failed task / application and restarted)	Limited (often failed task/application restarted)	Failover, content replication, virtual machine migration from one node to another supported
Capacity	Stable and guaranteed capacity	Varies, but high capacity	Provisioned on-demand capacity
Security	Traditional login/ password-based	Public/private pair -based authentication and mapping of a user to an account	Each user and / or application is provided with a virtual machine
Privacy	Medium level of privacy depends on user privileges	Limited support for privacy	High security / privacy is guaranteed. There is support for file Access Control List (ACL) settings.
Population	Commodity computers	High-end computing systems (including clusters and servers)	Commodity PCs, high-end servers' network, attached storage
End-user presentation	Presented as a dynamic and diversified system	Presented as a single system image	Presented as a self-services-based usage model

Datacenter

- The *datacenter* is the collection of servers where the application to which you subscribe is housed.
- It could be a large room in **the basement of your building or a room full of servers on the other side of the world that you access via the Internet.**
- A growing trend in the IT world is virtualizing servers.
- That is, software can be installed allowing multiple instances of virtual servers to be used.
- In this way, you can have half a dozen virtual servers running on one physical server.



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Distributed Servers

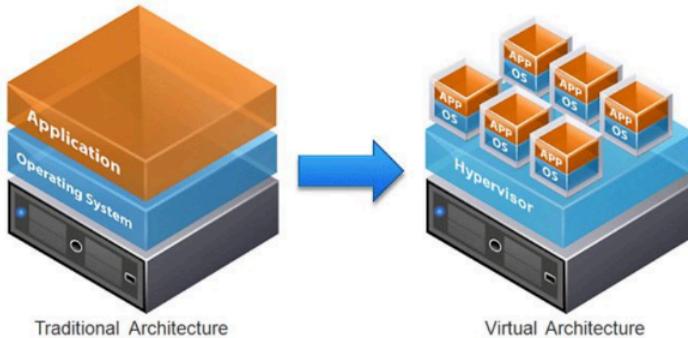
- But the servers don't all have to be **retained in the same location**.
- Often, servers are in geographically disparate locations.
- But to you, the **cloud subscriber**, these servers act as if they're humming away right next to each other.
- This gives the **service provider more flexibility in options and security**.
- For instance, Amazon has their cloud solution in servers all over the world.*
- If something were to happen at one site, causing a failure, the service would still be accessed through another site.*
- Also, if the cloud needs more hardware, they need not throw more servers in the safe room—they can add them at another site and simply make it part of the cloud.*

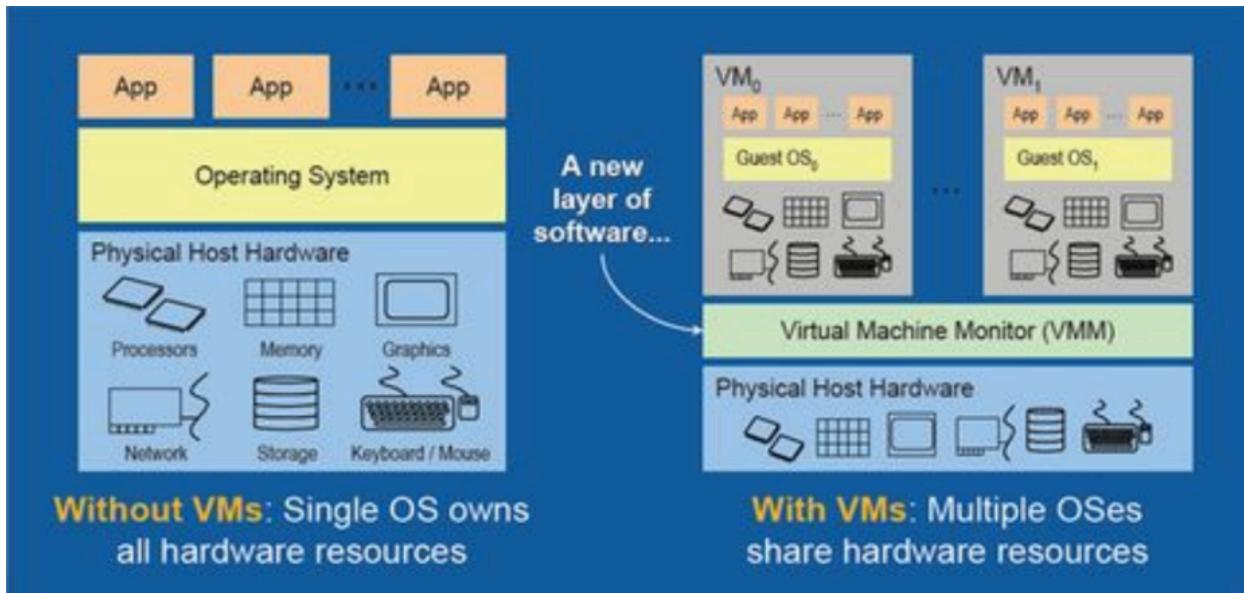
Virtualization

- Virtualization is the "*creation of a virtual (rather than actual) version of something*, such as a server, a desktop, a storage device, an operating system or network resources".

- “**BEING ON OR SIMULATED ON A COMPUTER OR COMPUTER NETWORK**”

- Creation of a virtual machine over **existing operating system and hardware** is known as **Hardware Virtualization**.
- A Virtual machine provides an environment that is logically separated from the underlying hardware.





Cloud Deployment Model

DIFFERENCE	PRIVATE	PUBLIC	HYBRID
Tenancy	Single tenancy: there's only the data of a single organization stored in the cloud.	Multi-tenancy: the data of multiple organizations is stored in a shared environment.	The data stored in the public cloud is usually multi-tenant, which means the data from multiple organizations is stored in a shared environment. The data stored in private cloud is kept private by the organization.
Exposed to the Public	No: only the organization itself can use the private cloud services.	Yes: anyone can use the public cloud services.	The services running on a private cloud can be accessed only by the organization's users, while the services running on public cloud can be accessed by anyone.
Data Center Location	Inside the organization's network.	Anywhere on the Internet where the cloud service provider's services are located.	Inside the organization's network for private cloud services as well as anywhere on the Internet for public cloud services.



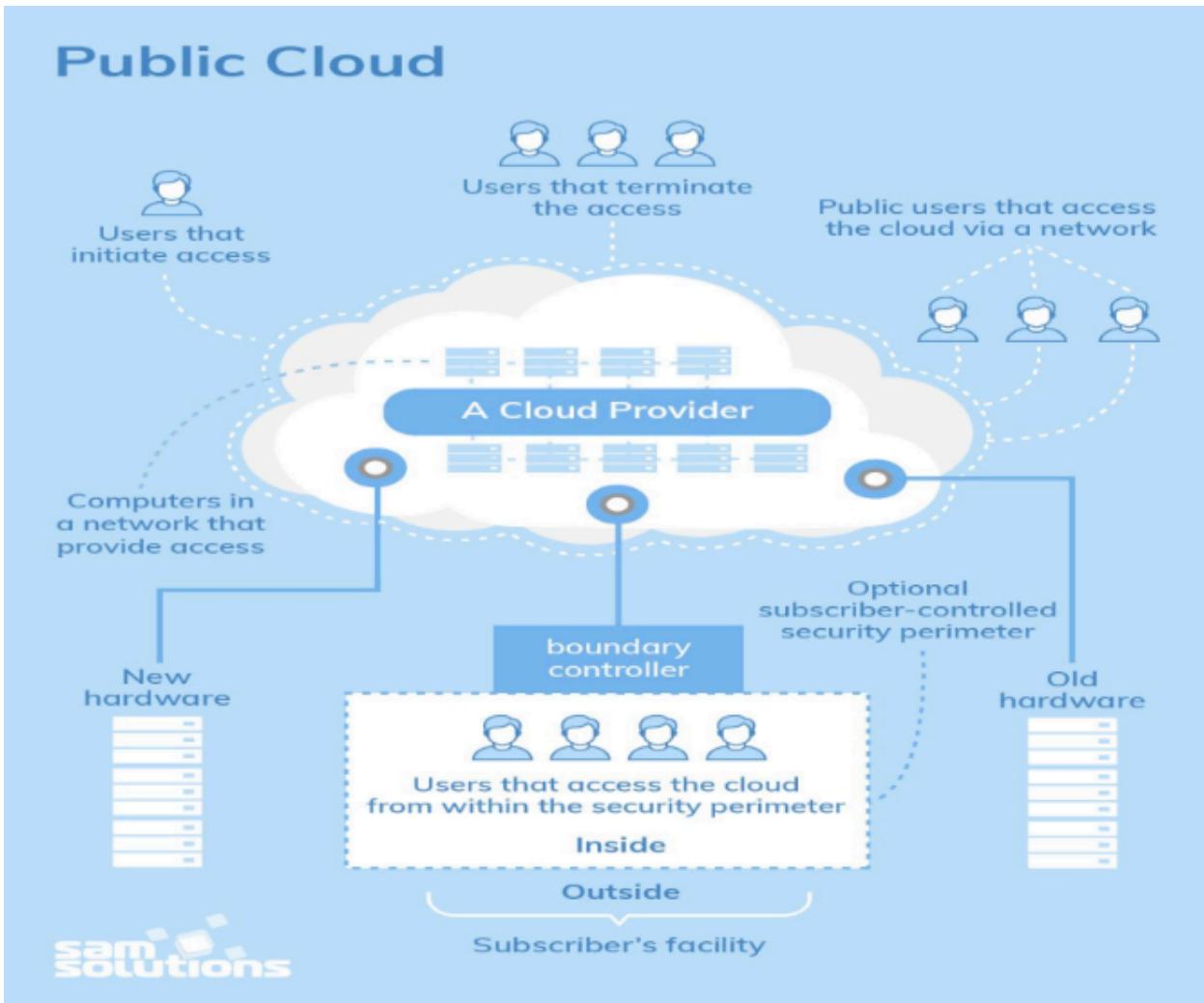
Cloud Deployment Model

Difference	Private	Public	Hybrid
Cloud Service Management	The organization must have their own administrators managing their private cloud services.	The cloud service provider manages the services, where the organization merely uses them.	The organization itself must manage the private cloud, while the public cloud is managed by the CSP.
Hardware Components	Must be provided by the organization itself, which has to buy physical servers to build the private cloud on.	The CSP provides all the hardware and ensures it's working at all times.	The organization must provide hardware for the private cloud, while the hardware of CSP is used for public cloud services.
Expenses	Can be quite expensive, since the hardware, applications and network have to be provided and managed by the organization itself.	The CSP has to provide the hardware, set-up the application and provide the network accessibility according to the SLA.	The private cloud services must be provided by the organization, including the hardware, applications and network, while the CSP manages the public cloud services.

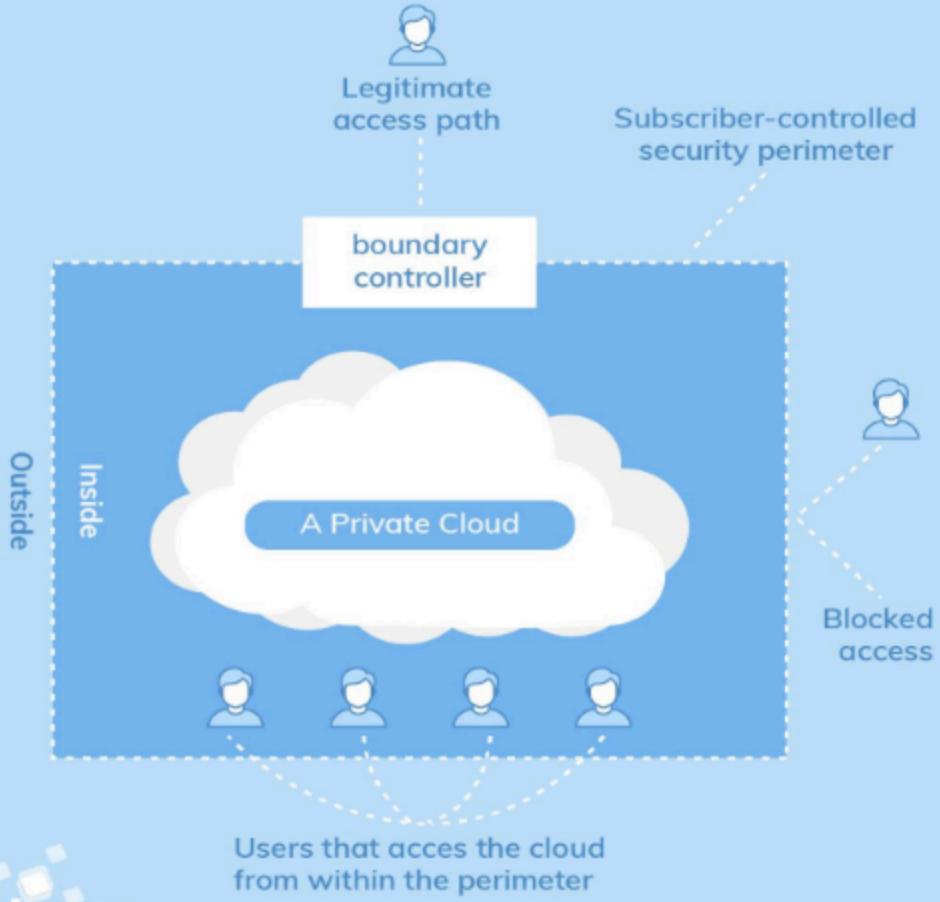
Cloud Deployment Model

	Pros	Cons	Real time Services Providers
Private	<ul style="list-style-type: none"> Control over how a cloud is setup and run Control over privacy and security practices Control over the geographical location of data 	<ul style="list-style-type: none"> Much higher setup and maintenance costs Less redundancy and resilience (especially if you host the cloud internally) Less scalability 	Hewlett Packard Enterprises, VMware, Dell, Oracle, IBM, Microsoft, and Amazon Web Services.
Public	<ul style="list-style-type: none"> Low price (sometimes even free) Scalable Location independence It's easy! 	<ul style="list-style-type: none"> Security concerns The law and location of your data Lack of control 	Amazon Web Services Microsoft Azure IBM Cloud Google Cloud Platform
Hybrid	<ul style="list-style-type: none"> Keep sensitive data safe Still, get some of the scalability and cost-effectiveness of public cloud Ultimate flexibility 	<ul style="list-style-type: none"> Complexity Difficulty communicating between cloud models More expensive than public or community models 	Microsoft, VMware, Amazon Web Services, Rackspace, Hewlett-Packard, IBM, Cisco, and Dell.

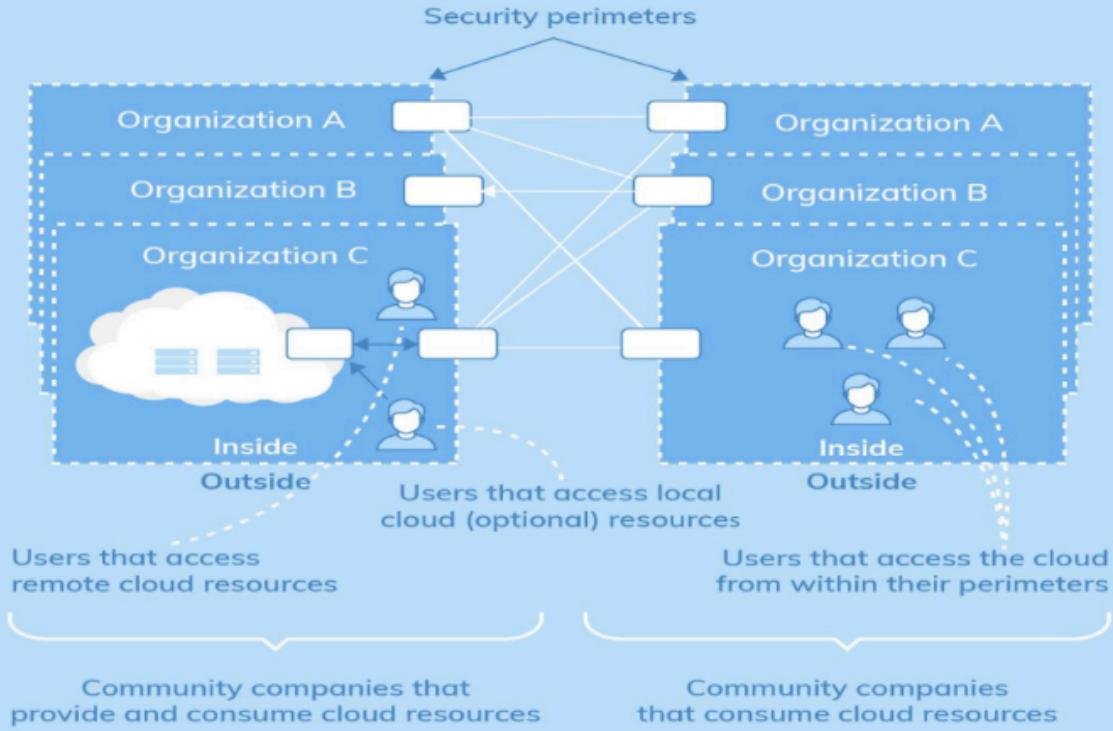
Public Cloud



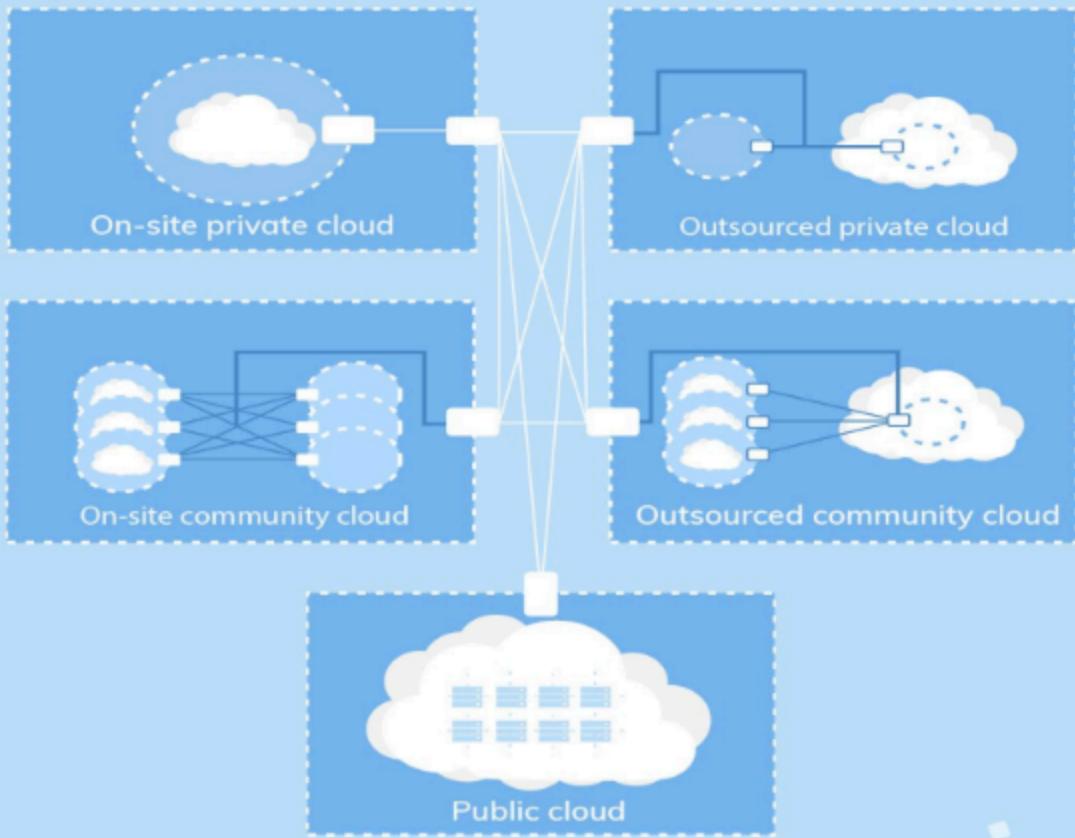
Private Cloud



Community Cloud



Hybrid Cloud



Some Real time deployment models

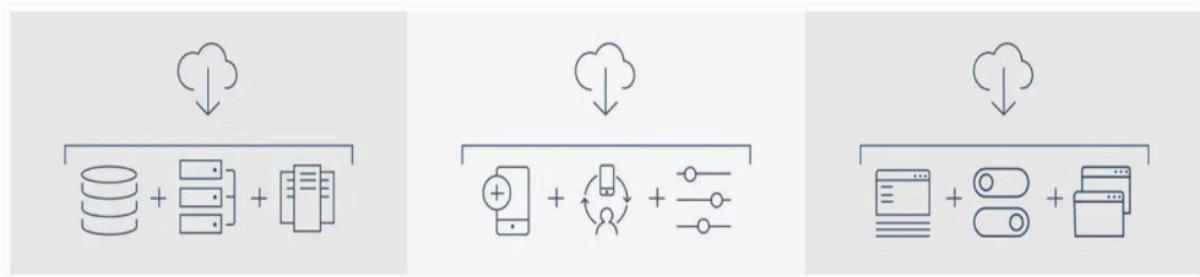
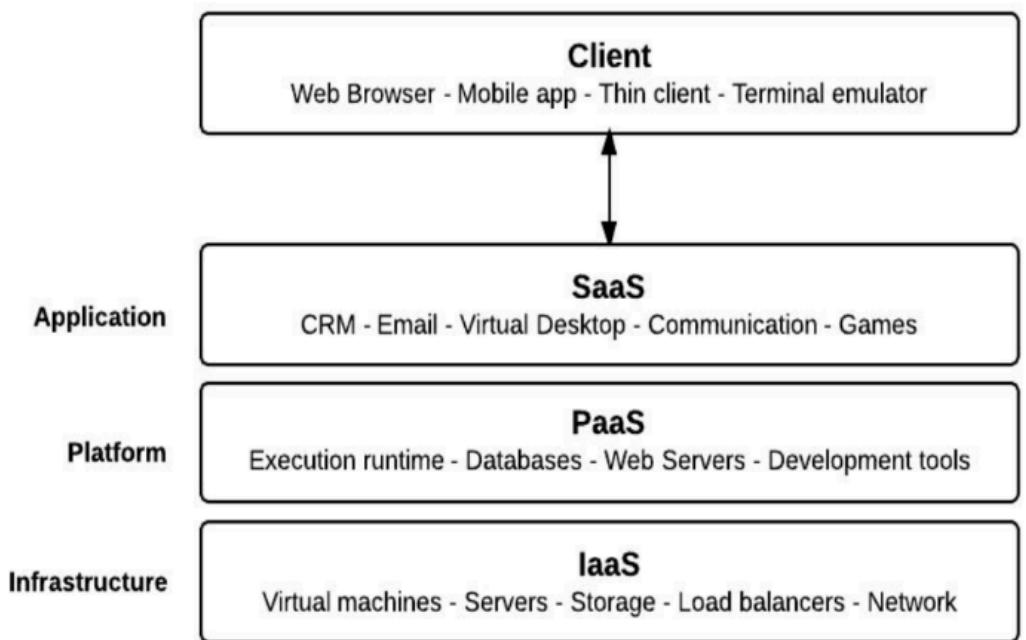


PUBLIC CLOUD	PRIVATE CLOUD	HYBRID CLOUD	COMMUNITY CLOUD
<ul style="list-style-type: none">• Netflix• Netflix used relational databases in its data centers.• Netflix migrated its functioning, content, and delivery network to Amazon's public cloud — AWS	<ul style="list-style-type: none">• State Bank of India (SBI) had to up its game to establish relevance with the digitally aware• "MeghDoot," of about 7500 VMs hosting several financial services applications based on various technologies.• Meghdoot offers features such as platform and Infrastructure-as-a-service (PaaS and IaaS), metering and monitoring, Web-based management of cloud resources and enhanced security across layers.	<ul style="list-style-type: none">• BBC has recently signed a 5-year hybrid cloud contract with Object Matrix after the success of the Planet series.• It has been a customer of Object Matrix since 2010 with a MatrixStore on-premise 200TB. After the recent shift of its headquarters, BBC has seen a spike in production.• MatrixStore Cloud is a storage platform that enables creative and production teams to self-serve access to content from work or remotely from anywhere	<ul style="list-style-type: none">• CoreHR is using Community Cloud for to assist the support efforts for their customers• CoreHR required a seamless digital experience for their customers that matched the look and feel of their company's branding.• Salesforce Sales Cloud Solution

How to choose between deployment models

- **Scalability** – Is your user activity **growing quickly or unpredictable** with spikes in demand?
- **Privacy and security** – Do you have any **sensitive data** that doesn't belong on a public server?
- **Ease of use** – How much time and money do you have to invest in learning and training?
- **Pricing model** – What's your monthly subscription budget? How much capital can you spend upfront?
- **Flexibility** – How **flexible/rigid** are your computing, processing, and storage needs?
- **Legal compliance** – Are there any relevant laws in your country or industry?

Cloud	Design
Structure of a public cloud	<p>Cloud consumers accessing the cloud over a network</p> <p>Internet</p> <p>Consumer Enterprise Network</p>
On-premise private cloud	<p>Consumer Enterprise Network</p> <p>Private Cloud</p>
Out-sourced private cloud	<p>Cloud Service Provider</p> <p>Private Cloud</p> <p>Consumer Enterprise Network</p> <p>Cloud consumers accessing the cloud within the enterprise network</p>



Infrastructure as a service (IaaS)

A vendor provides clients pay-as-you-go access to storage, networking, servers and other computing resources in the cloud.

Platform as a service (PaaS)

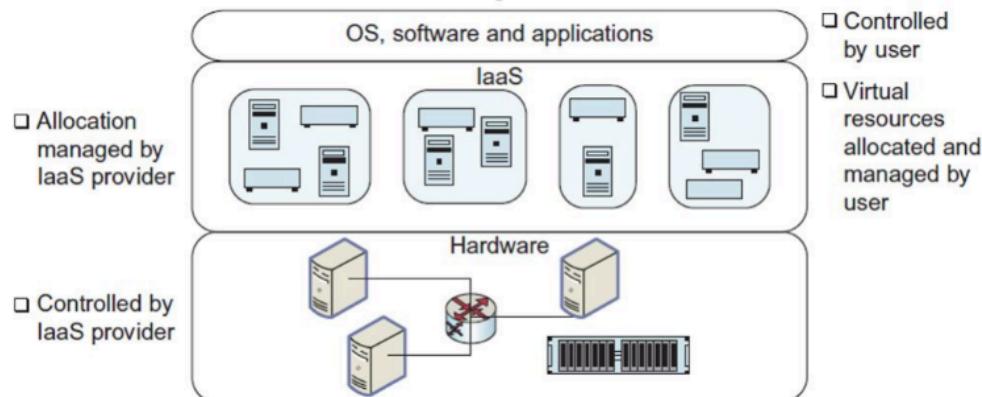
A service provider offers access to a cloud-based environment in which users can build and deliver applications. The provider supplies underlying infrastructure.

Software as a service (SaaS)

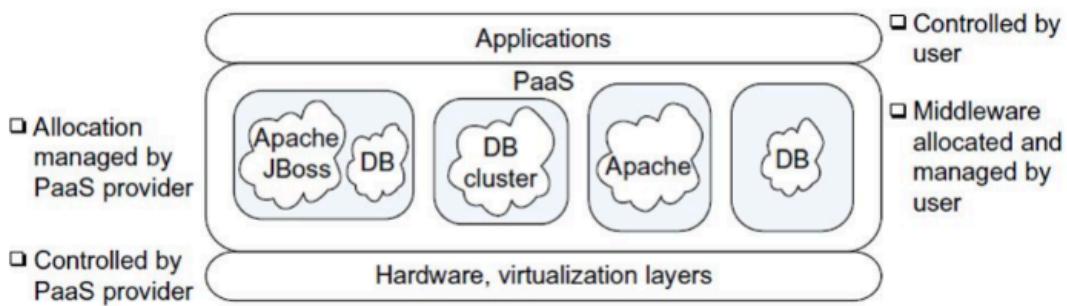
A service provider delivers software and applications through the internet. Users subscribe to the software and access it via the web or vendor APIs.

Infrastructure-as-a-Service (IaaS)			
Definition	Characteristics	Services	Service Providers
<ul style="list-style-type: none"> IaaS is also known as Hardware as a Service (HaaS). It is a computing infrastructure managed over the internet. The main advantage of using IaaS is that it helps users to avoid the cost and complexity of purchasing and managing the physical servers. 	<ul style="list-style-type: none"> RESOURCES are available as a service Services are highly scalable Dynamic and flexible GUI and API-based access Automated administrative tasks 	<p>Computing as a Service includes virtual central processing units and virtual main memory for the Vms that is provisioned to the end-users.</p> <p>Storage: IaaS provider provides back-end storage for storing files.</p> <p>Network: Network as a Service (NaaS) provides networking components such as routers, switches, and bridges for the Vms.</p> <p>Load balancers: It provides load balancing capability at the infrastructure layer.</p>	Amazon Web Services (AWS), Microsoft Azure, Google Compute Engine (GCE)

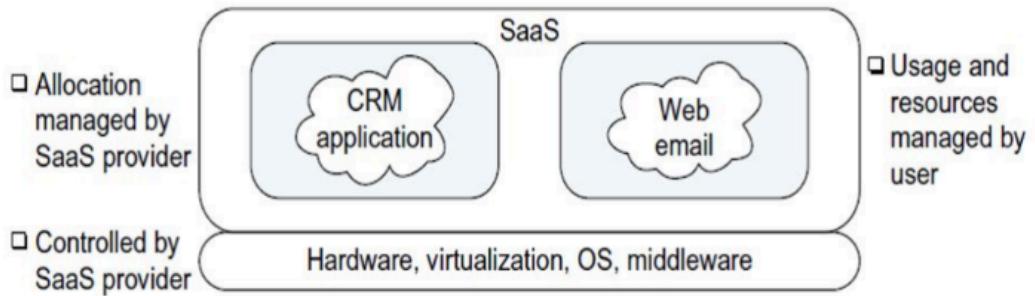
Infrastructure-as-a-Service (IaaS)



Platform as a Service (PaaS)			
Definition	Characteristics	Services	Service Providers
<ul style="list-style-type: none"> PaaS cloud computing platform is created for the programmer to develop, test, run, and manage the applications 	<ul style="list-style-type: none"> Accessible to various users via the same development application. Integrates with web services and databases. Builds on virtualization technology, so resources can easily be scaled up or down as per the organization's need. Support multiple languages and frameworks. Provides an ability to "Auto-scale". 	<p>PaaS includes infrastructure (servers, storage, and networking) and platform (middleware, development tools, database management systems, business intelligence, and more) to support the web application life cycle</p>	AWS Elastic Beanstalk, Windows Azure, Heroku, Force.com, Google App Engine, Apache Stratos, Magento Commerce Cloud, and OpenShift.

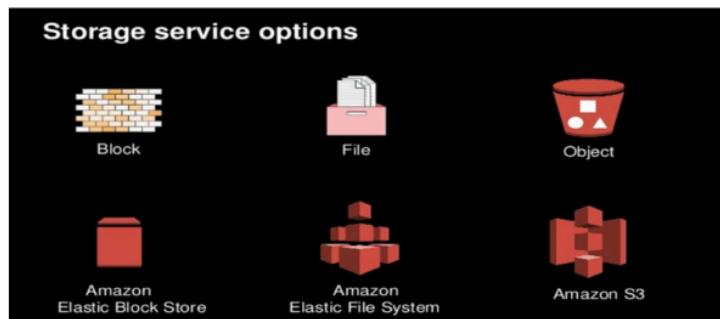


Software as a Service (SaaS)			
Definition	Characteristics	Services	Service Providers
<ul style="list-style-type: none"> SaaS is also known as "on-demand software". It is a software in which the applications are hosted by a cloud service provider. Users can access these applications with the help of internet connection and web browser. 	<ul style="list-style-type: none"> Managed from a central location Hosted on a remote server Accessible over the internet Users are not responsible for hardware and software updates. Updates are applied automatically. The services are purchased on the pay-as-per-use basis 	<ul style="list-style-type: none"> Business Services Document Management Electronic documents. Social Networks Mail Services 	Google Apps, Salesforce, Dropbox, ZenDesk, Cisco WebEx, ZenDesk, Slack, and GoToMeeting



Storage as a Service

- IaaS platforms for storage as a service and then compute as a service.
- Storage as a Service (sometimes abbreviated as SaaS) takes a detailed look at key Amazon Storage Services:
 - **Amazon Simple Storage Service (S3)**, which provides a highly reliable and highly available object store over HTTP.
 - **Amazon SimpleDB**, a key-value store
 - **Amazon Relational Database Service (RDS)**, which provides a MySQL instance in the cloud



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Amazon S3



```

import boto3
s3 = boto3.resource('s3')

# Delete the bucket previously created with the
# REST API
s3.Bucket('cloud3sciencebucket').delete()

# Create that bucket again, specifying location
bucket = s3.create_bucket(Bucket =
    'cloud4sciencebucket',
    CreateBucketConfiguration
    ={
        'LocationConstraint':
            'us-standard'})

# Upload a file 'test.jpg' into the newly
# created bucket
bucket.put_object(Key='test.jpg',
Body=open('test.jpg', 'rb'))

```



Amazon S3



```
import boto3
s3 = boto3.resource('s3',
aws_access_key_id='YOUR ACCESS KEY',
aws_secret_access_key='your secret key')
```

- to have a home directory .aws that
- contains two protected files: **config, containing your default**
- **Amazon region, and credentials, containing your access and secret keys.**
- If we have this directory in place, then the access key and secret key parameters are not needed.

Blob types

- Page blobs are commonly used to store and are designed for **random read/write access**.
- Block blobs are for everything you can think of as a file. Each block in one of these types of blobs can be a different size, up to a **maximum of 4 MB**, and a block blob can include up to **50,000 blocks**
- An append blob is an optimized blob for **append operations**. The main difference between a block blog and an append blog is that when you modify an append blob, new blocks are added to the end block

