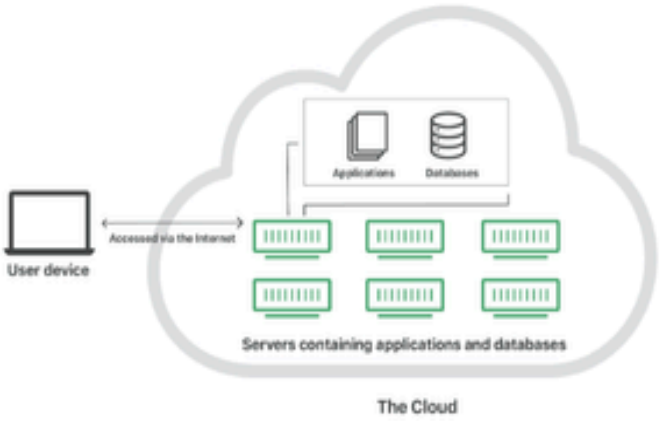
# UNIT-1

## What is cloud ?




"The cloud" refers to servers that are accessed over the Internet, and the software and databases that run on those servers. Cloud servers are located in data centers (data center is a physical location that stores computing machines and their related hardware equipment. It contains the computing infrastructure that IT systems require, such as servers, data storage drives, and network equipment) all over the world. By using cloud computing, users and companies do not have to manage physical servers themselves or run software applications on their own machines.

The cloud enables users to access the same files and applications from almost any device, because the computing and storage takes place on servers in a data center, instead of locally on the user device. This is why a user can log in to their Instagram account on a new phone after their old phone breaks and still find their old account in place, with all their photos, videos, and conversation history. It works the same way with cloud email providers like Gmail or Microsoft Office 365, and with cloud storage providers like Dropbox or Google Drive.

For businesses, switching to cloud computing removes some IT costs and overhead: for instance, they no longer need to update and maintain their own servers, as the cloud vendor they are using will do that. This especially makes an impact for small businesses that may not have been able to afford their own internal infrastructure but can outsource their infrastructure needs affordably via the cloud. The cloud can also make it easier for companies to operate internationally, because employees and customers can access the same files and applications from any location.

## What is cloud computing?

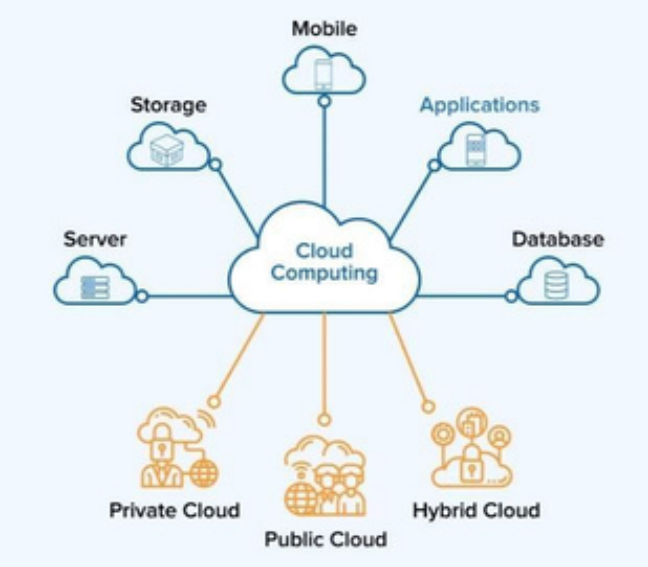
Cloud computing is a general term for the delivery of hosted computing services and IT resources over the internet with pay-as-you-go pricing. Users can obtain technology services such as processing power, storage and databases from a cloud provider, eliminating the need for purchasing, operating and maintaining on-premises physical data centers and servers.

A cloud can be private, public or a hybrid. A public cloud sells services to anyone on the internet. A private cloud is a proprietary network or a data center that supplies hosted services to a limited number of people, with certain access and permissions settings. A hybrid cloud offers a mixed computing environment where data and resources can be shared between both public and private clouds. Regardless of the type, the goal of cloud computing is to provide easy, scalable access to computing resources and IT services.

Cloud infrastructure involves the hardware and software components required for the proper deployment of a cloud computing model. Cloud computing can also be thought of as utility computing or on-demand computing.

*The name cloud computing was inspired by the cloud symbol that's often used to represent the internet in flowcharts and diagrams.*

Instead of storing files on a storage device or hard drive, a user can save them on cloud, making it possible to access the files from anywhere, as long as they have access to the web. The **services** hosted on cloud can be broadly divided into infrastructure-as-a-service (IaaS), platform-as-a-service (PaaS), and software-as-a-service (SaaS). Based on the *deployment model*, cloud can also be classified as public, private, and hybrid cloud.




Further, cloud can be divided into two different layers, namely, front-end and back-end. The layer with which users interact is called the front-end layer. This layer enables a user to access the data that has been stored in cloud through cloud computing software.

The layer made up of software and hardware, i.e., the computers, servers, central servers, and databases, is the back-end layer. This layer is the primary component of cloud and is entirely responsible for storing information securely. To ensure seamless connectivity between devices linked via cloud computing, the central servers use a software called middleware Opens a new window that acts as a bridge between the database and applications.

## Advantages and Disadvantages of Cloud Computing

Advantages of Cloud Computing

**Cost Reduction**

The major reason companies shift towards cloud computing is that it takes lower costs. The business does not need to build its own IT infrastructure or purchase hardware or equipment. Costs include physical

hardware for data storage purposes like hard drives, solid-state drives or disks, etc.

**Better Collaboration**

Cloud computing allows people to access cloud data from any device, from anywhere, from any time as long as they have an internet connection.

Suppose the team is working remotely. The team is spread worldwide, so it is a good option to go ahead with cloud computing as employees can access data from anywhere in the world, at any time, and from any device.

**Backup and Restore Data**

As the data is stored in the cloud, it is a lot easier to get the backup and recovery of that data with just a few clicks; otherwise, manually, it is a very time-consuming process on-premise.

**Security**

Due to different security reasons, cloud providers have designed very high-security cloud features so that you can allow what data is accessible to which person groups.

Cloud providers also hire top security experts and develop the most advanced security solutions, providing robust protection. Research by RapidScale says that 94% of businesses saw major security improvements after switching to the cloud.

**Pay as you go**

Cloud computing allows you flexibility because you have to pay only for what you use as a service.

**Boundless storage capacity**

No storage capacity is predefined, so you can increase or decrease storage capacity according to your needs at any time.

**Accessibility**

Cloud computing allows you to quickly and easily store, access, and manipulate information on the cloud.

**Mobility**

Cloud computing allows easy access to all cloud data via mobile through the internet.

**Quicker Deployments**

Cloud computing allows us to deploy our services to the cloud more quickly and with fewer clicks. As compared to setting up all the configurations on the normal deployments.

**Automatic Software Integrations**

Cloud computing allows you to set automation of software updates and upgrades. So as soon as a newer version of any software is released, it will automatically integrate into the services you are using.

## Disadvantages of Cloud Computing

**Internet Connectivity**

In cloud computing, data (files, images, video, audio, etc.) is stored in the cloud. So to access the data, an internet connection is required. In the absence of the internet, we can't access it.

**Downtime**

We can't access the data if there is downtime (internet loss at the cloud provider's end). Other than this, downtime also includes cloud providers that may face power loss, service maintenance, etc.

**Vendor lock-in**

When transferring all the data from one cloud provider to another, there can be many issues, such as the different cloud providers using different platforms, hosting, and running of the applications on the different platforms that can result in configuration and complexities issues.

The company data might be left vulnerable to security or thereat attacks due to compromises made during the data migrations.

**Limited Bandwidth**

As the Cloud provider provides limited bandwidth to all its users, you have to pay significantly higher costs if your organization surpasses that limit.

**Security**

Even though the cloud providers are storing information very securely, we still don't have to forget that data is vulnerable to cyber-attacks when stored in the cloud. Many organizations and companies have suffered from security breaches and their potential risks in the cloud.

**Performance Variation**

As the server is hosted on a cloud provider, which also provides services to other businesses, any cyber attack on shared resources may slow down your services.

**Lack of support staff**

Some cloud companies do not provide proper support to their clients; then, you have to only depend on FAQs or online help.

**Limited Control and Flexibility**

The cloud infrastructure is completely owned, managed, and monitored by the cloud providers. So businesses using cloud computing have limited control over their data, applications, and services. It makes it hard for companies to have the level of control they want over the different services they use.

The customer may not have access to key administrative services. So it's recommended that companies have a proper end-user license agreement(EULA) so that what a company can do and what not with cloud infrastructure is clearly defined.

**Technical issues**

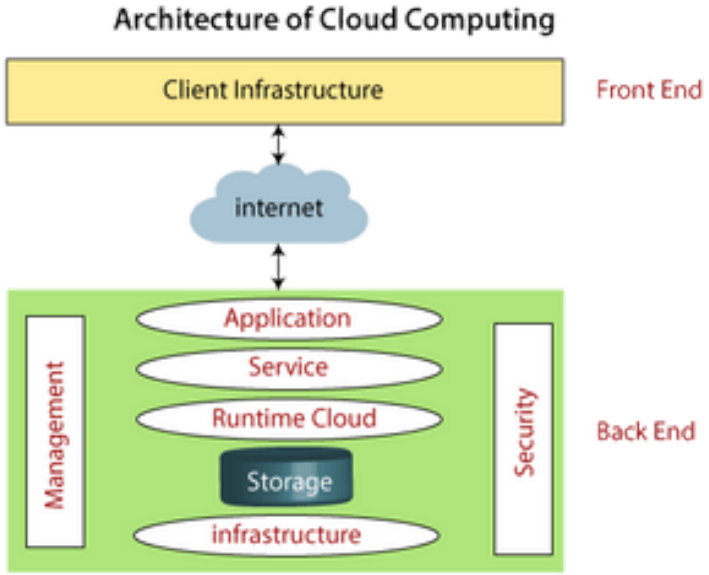
Due to frequent version releases of some applications, you have to constantly upgrade your systems to meet a market need; in between these updates, there is a chance that you may be stuck on some technical problems.

**Cloud Computing Architecture & Deployment Mode**

It serves as a blueprint that illustrates how different cloud elements, such as servers, databases, networks,

and services, interact and integrate with one another.

**Cloud architecture components include:**

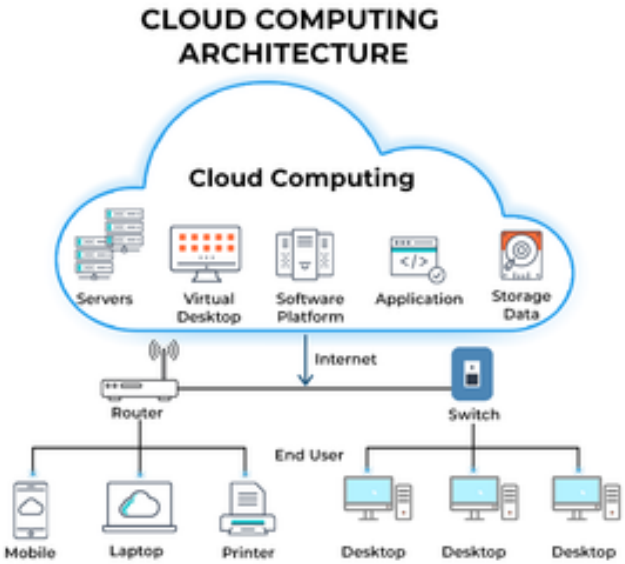



- A frontend platform
- A backend platform
- A cloud-based delivery model
- A network (internet, intranet, or intercloud)

In cloud computing, frontend platforms contain the client infrastructure—user interfaces, client-side applications, and the client device or network that enables users to interact with and access cloud computing services. For example, you can open the web browser on your mobile phone and edit a Google Doc. All three of these things describe frontend cloud architecture components.

On the other hand, the back end refers to the cloud architecture components that make up the cloud itself, including computing resources, storage, security mechanisms, management, and more.

Below is a list of the main backend components:




**Application:** The backend software or application the client is accessing from the front end to coordinate or fulfill client requests and requirements.

**Service:** The service is the heart of cloud architecture, taking care of all the tasks being run on a cloud computing system. It manages which resources you can access, including storage, application development environments, and web applications.

**Runtime cloud:** Runtime cloud provides the environment where services are run, acting as an operating system that handles the execution of service tasks and management. Runtimes use virtualization technology to create hypervisors that represent all your services, including apps, servers, storage, and networking.

**Storage:** The storage component in the back end is where data to operate applications is stored. While cloud storage options vary by provider, most cloud service providers offer flexible scalable storage services that are designed to store and manage vast amounts of data in the cloud. Storage may include hard drives, solid-state drives, or persistent disks in server bays.

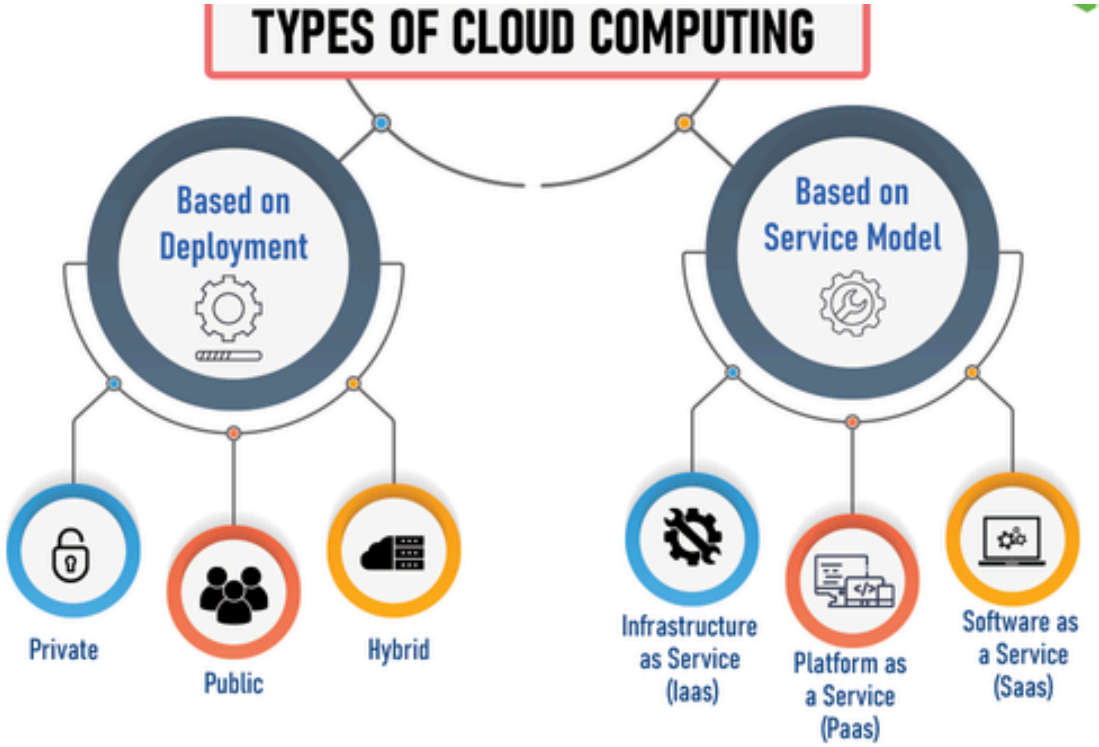
**Infrastructure:** Infrastructure is probably the most commonly known component of cloud architecture. In fact, you might have thought that cloud infrastructure *is* cloud architecture. However, cloud infrastructure comprises all the major hardware components that power cloud services, including the CPU, graphics processing unit (GPU), network devices, and other hardware components needed for systems to run smoothly. Infrastructure also refers to all the software needed to run and manage everything.

Cloud architecture, on the other hand, is the plan that dictates how cloud resources and infrastructure are organized.

**Management:** Cloud service models require that resources be managed in real time according to user requirements. It is essential to use management software, also known as middleware, to coordinate communication between the backend and frontend cloud architecture components and allocate resources for specific tasks. Beyond middleware, management software will also include capabilities for usage monitoring, data integration, application deployment, and disaster recovery.

**Security:** As more organizations continue to adopt cloud computing, implementing cloud security features and tools is critical to securing data, applications, and platforms. It's essential to plan and design data security and network security to provide visibility, prevent data loss and downtime, and ensure redundancy. This may include regular backups, debugging, and virtual firewalls.

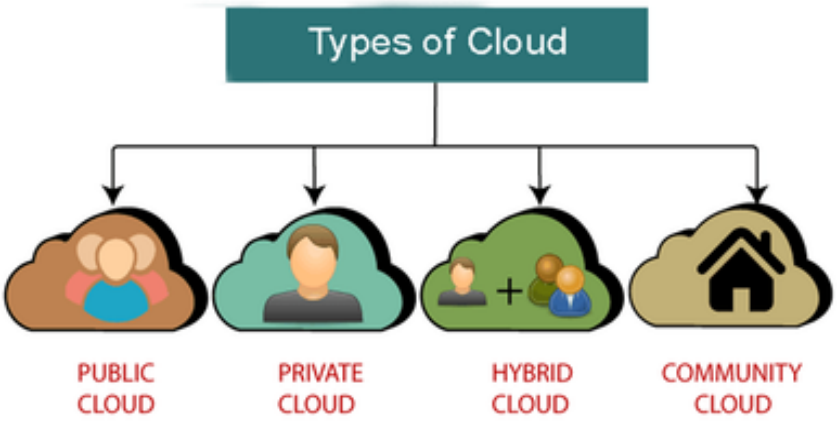
**Types of Cloud Deployment Model :-**



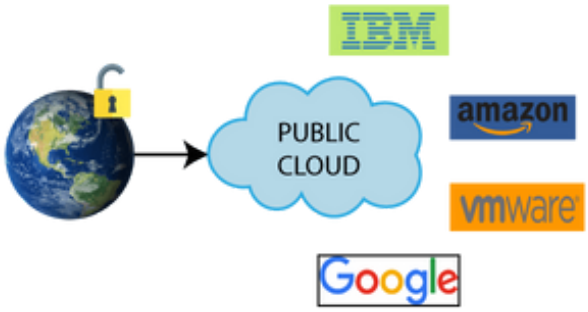

**Public Cloud**

Public cloud is open to all to store and access information via the Internet using the pay-per-usage method.

In public cloud, computing resources are managed and operated by the Cloud Service Provider (CSP). The CSP looks after the supporting infrastructure and ensures that the resources are accessible to and scalable for the users.




Due to its open architecture, anyone with an internet connection may use the public cloud, regardless of location or company size. Users can use the CSP's numerous services, store their data, and run apps. By using a pay-per-usage strategy, customers can be assured that they will only be charged for the resources they actually use, which is a smart financial choice.




**Example:** Amazon elastic compute cloud (EC2), IBM SmartCloud Enterprise, Microsoft, Google App Engine, Windows Azure Services Platform.

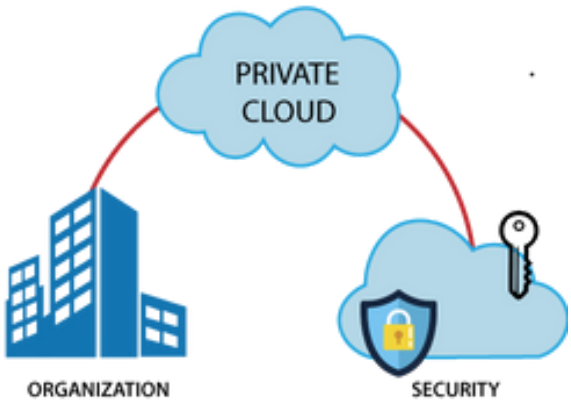
**Advantages**

- Public cloud is owned at a lower cost than the private and hybrid cloud.
- Public cloud is maintained by the cloud service provider, so do not need to worry about the maintenance.
- Public cloud is easier to integrate. Hence it offers a better flexibility approach to consumers.
- Public cloud is location independent because its services are delivered through the internet.
- It is accessible by the general public, so there is no limit to the number of users.
- Reduced time and effort in hardware procurement and setup.
- The cloud provider offers a range of services and resources that you can avail of.

**Disadvantages of Public Cloud**

- Public Cloud is less secure because resources are shared publicly.
- Performance depends upon the high-speed internet network link to the cloud provider.
- The data is not under the control of the client.
- Concerns about data privacy and confidentiality.
- Lack of customization options and flexibility compared to private or hybrid cloud environments.
- Reliance to the cloud provider's support and responsiveness for issue resolution.

**Private Cloud**




Private cloud is also known as an **internal cloud** or **corporate cloud**. It is used by organizations to build and manage their own data centers internally or by the third party. It can be deployed using Opensource tools such as Openstack and Eucalyptus.

**Examples:** VMware vSphere, OpenStack, Microsoft Azure Stack, Oracle Cloud at Customer, and IBM

Cloud Private.

Based on the location and management, National Institute of Standards and Technology (NIST) divide private cloud into the following two parts-

- **On-premise private cloud:** An on-premise private cloud is situated within the physical infrastructure of the organization. It involves setting up and running a specific data center that offers cloud services just for internal usage by the company. The infrastructure is still completely under the hands of the organization, which gives them the freedom to modify and set it up in any way they see fit. Organizations can successfully manage security and compliance issues with this degree of control. However, on-premise private cloud setup and management necessitate significant hardware, software, and IT knowledge expenditures.
- **Outsourced private cloud:** An outsourced private cloud involves partnering with a third-party service provider to host and manage the cloud infrastructure on behalf of the organization. The provider may operate the private cloud in their data center or a colocation facility. In this arrangement, the organization benefits from the expertise and resources of the service provider, alleviating the burden of infrastructure management. The outsourced private cloud model offers scalability, as the provider can adjust resources based on the organization's needs. Due to its flexibility, it is a desirable choice for businesses that desire the advantages of a private cloud deployment without the initial capital outlay and ongoing maintenance expenses involved with an on-premise implementation.

**Advantages of Private Cloud**

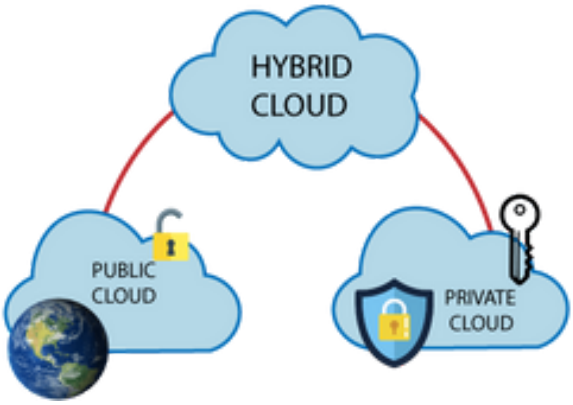
There are the following advantages of the Private Cloud -

- Private cloud provides a high level of security and privacy to the users.
- Private cloud offers better performance with improved speed and space capacity.
- It allows the IT team to quickly allocate and deliver on-demand IT resources.
- The organization has full control over the cloud because it is managed by the organization itself. So, there is no need for the organization to depends on anybody.
- It is suitable for organizations that require a separate cloud for their personal use and data security is the first priority.
- Customizable to meet specific business needs and compliance regulations.
- Higher reliability and uptime compared to public cloud environments.
- Seamless integration with existing on-premises systems and applications.
- Better compliance and governance capabilities for industry-specific regulations.
- Enhanced flexibility in resource allocation and application deployment.

**Disadvantages of Private Cloud**

- Skilled people are required to manage and operate cloud services.
- Private cloud is accessible within the organization, so the area of operations is limited.
- Private cloud is not suitable for organizations that have a high user base, and organizations that do not have the prebuilt infrastructure, sufficient manpower to maintain and manage the cloud.
- Higher upfront costs and ongoing maintenance expenses.
- Scaling resources can be challenging compared to public or hybrid cloud options.
- Relies on internal IT staff for management and troubleshooting.
- Slower deployment timelines and implementation compared to public cloud solutions.
- Limited access to the latest advancements and innovations offered by public cloud providers.
- Reduced flexibility and agility compared to public cloud options.
- Challenges in keeping up with hardware and software upgrades and compatibility.
- Higher risks of technology becoming outdated and the need for regular infrastructure updates.

**Hybrid Cloud**




Hybrid Cloud is a combination of the public cloud and the private cloud. we can say:

***Hybrid Cloud = Public Cloud + Private Cloud***

Hybrid cloud is partially secure because the services which are running on the public cloud can be accessed by anyone, while the services which are running on a private cloud can be accessed only by the organization's users. In a hybrid cloud setup, organizations can leverage the benefits of both public and private clouds to create a flexible and scalable computing environment. The public cloud portion allows using cloud services provided by third-party providers, accessible over the Internet.

**Example:** Google Application Suite (Gmail, Google Apps, and Google Drive), Office 365 (MS Office on the Web and One Drive), Amazon Web Services.

**Advantages of Hybrid Cloud**

There are the following advantages of Hybrid Cloud -

- Hybrid cloud is suitable for organizations that require more security than the public cloud.
- Hybrid cloud helps you to deliver new products and services more quickly.
- Hybrid cloud provides an excellent way to reduce the risk.
- Hybrid cloud offers flexible resources because of the public cloud and secure resources because of the private cloud.
- Hybrid facilitates seamless integration between on-premises infrastructure and cloud environments.
- Hybrid provides greater control over sensitive data and compliance requirements.
- Hybrid enables efficient workload distribution based on specific needs and performance requirements.
- Hybrid offers cost optimization by allowing organizations to choose the most suitable cloud platform for different workloads.
- Hybrid enhances business continuity and disaster recovery capabilities with private and public cloud resources.
- Hybrid supports hybrid cloud architecture, allowing applications and data to be deployed across multiple cloud environments based on their unique requirements.

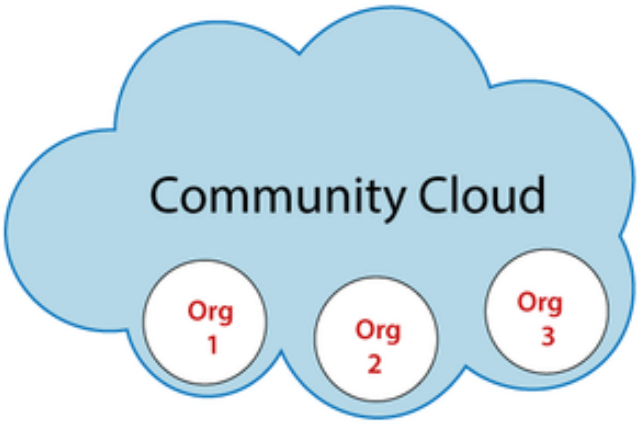
**Disadvantages of Hybrid Cloud**

- In Hybrid Cloud, security feature is not as good as the private cloud.
- Managing a hybrid cloud is complex because it is difficult to manage more than one type of deployment model.
- In the hybrid cloud, the reliability of the services depends on cloud service providers.
- Potential challenges in data integration and ensuring seamless connectivity between different cloud platforms.
- Higher costs due to the need for managing and integrating multiple cloud environments.
- Increased complexity in data governance and compliance management across different cloud providers.
- Dependency on stable and high-bandwidth internet connections for efficient hybrid cloud operations.
- Potential compatibility issues between various cloud platforms and applications.

- Risk of vendor lock-in and limited portability of applications and data across different cloud providers.
- Requires skilled IT staff with expertise in managing hybrid cloud environments.

**Community Cloud**

Community cloud allows systems and services to be accessible by a group of several organizations to share the information between the organization and a specific community. It is owned, managed, and operated by one or more organizations in the community, a third party, or a combination of them.




In a community cloud setup, the participating organizations, which can be from the same industry, government sector, or any other community, collaborate to establish a shared cloud infrastructure. This infrastructure allows them to access shared services, applications, and data relevant to their community.

**Example:** Health Care community cloud

**Advantages of Community Cloud**

There are the following advantages of Community Cloud -

- Community cloud is cost-effective because the whole cloud is being shared by several organizations or communities.
- Community cloud is suitable for organizations that want to have a collaborative cloud with more security features than the public cloud.
- It provides better security than the public cloud.
- It provdes collaborative and distributive environment.
- Community cloud allows us to share cloud resources, infrastructure, and other capabilities among various organizations.
- Offers customization options to meet the unique needs and requirements of the community.
- Simplifies compliance with industry-specific regulations and standards through shared security measures.
- Provides scalability and flexibility, allowing organizations to scale resources based on changing demands.
- Promotes efficient resource utilization, reducing wastage, and optimizing performance within the community.
- Enables organizations to leverage shared expertise and experiences, leading to improved decision-making and problem-solving.

**Disadvantages of Community Cloud**

- Community cloud is not a good choice for every organization.
- Security features are not as good as the private cloud.
- It is not suitable if there is no collaboration.
- The fixed amount of data storage and bandwidth is shared among all community members.
- Challenges in ensuring consistent performance and availability when multiple organizations share the same resources.
- Limited scalability options as the shared resources determine the community cloud's capacity.
- Potential conflicts of interest among community members regarding resource allocation and usage.
- Transparent governance and agreement frameworks are required to address potential disputes and ensure fair resource distribution.
- Inadequate technical support and service level agreements (SLAs) compared to private or public cloud options.

With the cloud, you can use many cloud services and application programming interfaces (APIs) and use flexible cloud tools and environments to build new and innovative applications and processes.

**Cloud Service Models :**

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.**

The various companies providing *Software as a service* are Cloud9 Analytics, Salesforce.com, Cloud Switch, Microsoft Office 365, Big Commerce, Eloqua, dropBox, and Cloud Tran.

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 and possibly configuration settings for the application-hosting environment. 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.

The various companies providing *Platform as a service* are Amazon Web services Elastic Beanstalk, Salesforce, Windows Azure, Google App Engine, cloud Bees and IBM smart cloud.

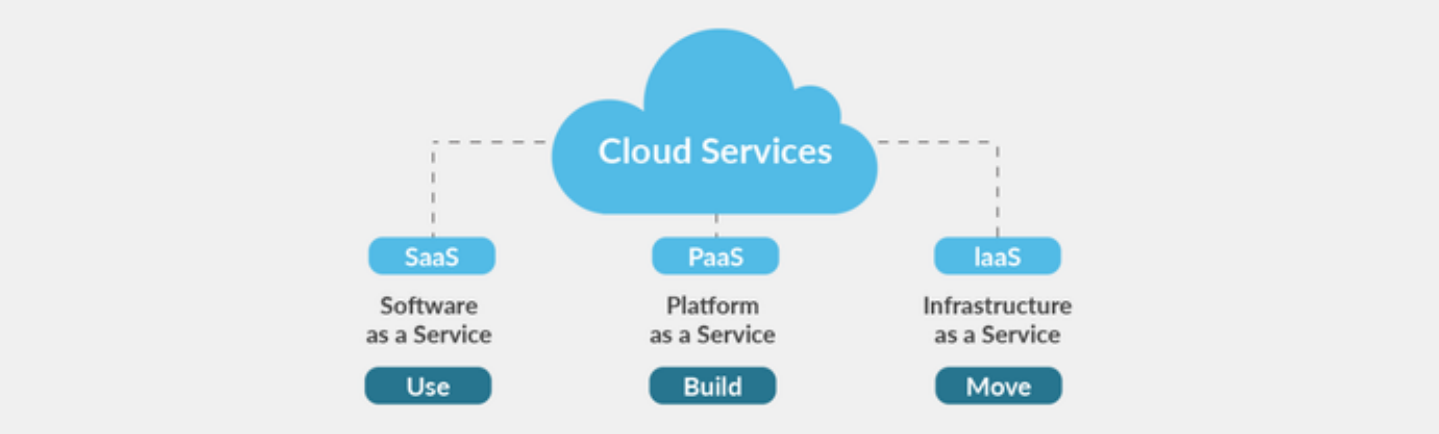
Infrastructure as a Service

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. It simply provides the underlying operating systems, security, networking, and servers for developing such applications, and services, and deploying development tools, databases, etc.

The various companies providing *Infrastructure as a service* are Amazon web services, Bluestack, IBM, Openstack, Rackspace, and Vmware.

**What are the Cloud Service Models?**

SaaS, PaaS, and IaaS are the three main cloud computing service model categories. You can access all three via an Internet browser or online apps available on different devices. The cloud service model enables the team to collaborate online instead of offline creation and then share online.




**Software as a Service (SaaS)** is a web-based deployment model that makes the software accessible through a web browser. SaaS software users don't need to care where the software is hosted, which operating system it uses, or even which programming language it is written in. The SaaS software is accessible from any device with an internet connection.


This cloud service model ensures that consumers always use the most current version of the software. The SaaS provider handles maintenance and support.

In the SaaS model, users don't control the infrastructure, such as storage, processing power, etc.

Software as a Service (SaaS) is a software distribution model in which applications are hosted by a vendor or service provider and made available to customers over a network, typically the Internet.

**Advantages SaaS**

Here are the important advantages/pros of SaaS:

The biggest benefit of using SaaS is that it is easy to set up, so you can start using it instantly.

Compared with on-premises software, it is more cost-effective.

You don't need to manage or upgrade the software, as it is typically included in a SaaS subscription or purchase.

It won't use your local resources, such as the hard disk typically required to install desktop software.

It is a cloud computing service category that provides a wide range of hosted capabilities and services.

Developers can easily build and deploy web-based software applications.

You can easily access it through a browser.

**Disadvantages SaaS**

Here are the important cons/drawbacks of SaaS:

Integrations are up to the provider, so it's impossible to "patch" an integration on your end.

SaaS tools may become incompatible with other tools and hardware already used in your business.

You depend on the SaaS company's security measures, so your data may be compromised if any leaks occur.

Things to Consider Before SaaS Implementation

Here are essential things you need to consider before SaaS implementation:

It would help if you opted for **configuration over customization** within a SaaS-based delivery model.

You must carefully understand the usage rates and set clear objectives to achieve the SaaS adoption.

You can complement your SaaS solution with integrations and security options to make it more user-oriented.

**Platform as a Service (PaaS)**

Platform-as-a-Service (PaaS) provides a cloud computing framework for software application creation and deployment. It is a platform for the deployment and management of software apps. This flexible cloud computing model scales up automatically on demand. It also manages the servers, storage, and networking, while the developers manage only the application part. It offers a runtime environment for application development and deployment tools.


This Model provides all the facilities required to support the complex life cycle of building and delivering web applications and services entirely for the Internet. This cloud computing model enables developers to rapidly develop, run, and manage their apps without building and maintaining the infrastructure or platform.

Platform as a Service (PaaS) is a way to rent hardware, operating systems, storage and network capacity over the Internet. The service delivery model allows the customer to rent virtualized servers and associated services for running existing applications or developing and testing new ones.

**Advantages PaaS**

Here are the important benefits/pros of PaaS:

Simple, cost-effective development and deployment of apps

Developers can customize SaaS apps without the headache of maintaining the software

Provide automation of Business Policy

Easy migration to the Hybrid Model

It allows developers to build applications without the overhead of the underlying operating system or

cloud infrastructure

Offers freedom to developers to focus on the application's design while the platform takes care of the language and the database

It helps developers to collaborate with other developers on a single app

Disadvantages of PaaS

**Here are the important cons/drawbacks of PaaS:**

You have control over the app's code and not its infrastructure.

The PaaS organization stores your data, so it sometimes poses a security risk to your app's users.

Vendors provide varying service levels, so selecting the right services is essential.

The risk of lock-in with a vendor may affect the ecosystem you need for your development environment.

Things to Consider Before PaaS Implementation

Here are essential things you need to consider before PaaS implementation:

Analyze your business needs, decide the automation levels, and also decides whether you want a self-service or fully automated PaaS model.

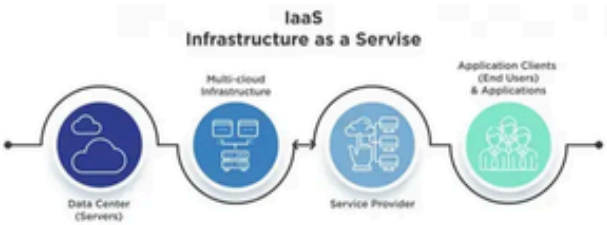
You need to determine whether to deploy on a private or public cloud.

Plan through the customization and efficiency levels.

**Infrastructure as a Service (IaaS)**

Infrastructure-as-a-Service (IaaS) is a cloud computing service offering on-demand computing, storage, and networking resources. It usually works on a pay-as-you-go basis.

Organizations can purchase resources on-demand and as needed instead of buying the hardware outright.




The IaaS cloud vendor hosts the infrastructure components, including the on-premises data center, servers, storage, networking hardware, and the hypervisor (virtualization layer).

This Model contains the basic building blocks for your web application. It provides complete control over the hardware that runs your application (storage, servers, VMs, networks & operating systems). IaaS model gives you the best flexibility and management control over your IT resources.

Infrastructure as a Service is a provision model in which an organization outsources the equipment used to support operations, including storage, hardware, servers and networking components. The service provider owns the equipment and is responsible for housing, running and maintaining it. The client typically pays on a per-use basis.

**Advantages of IaaS**

Here are the important benefits/pros of PaaS:

Easy to automate the deployment of storage, networking, and servers.

Hardware purchases can be based on consumption.

Clients keep complete control of their underlying infrastructure.

The provider can deploy the resources to a customer's environment anytime.

It can be scaled up or downsized according to your needs.

**Disadvantages of IaaS**

Here are the important Cons/drawbacks of IaaS:

You should ensure that your apps and operating systems are working correctly and providing the utmost security.

You're in charge of the data, so if any of it is lost, it's up to you to recover it.

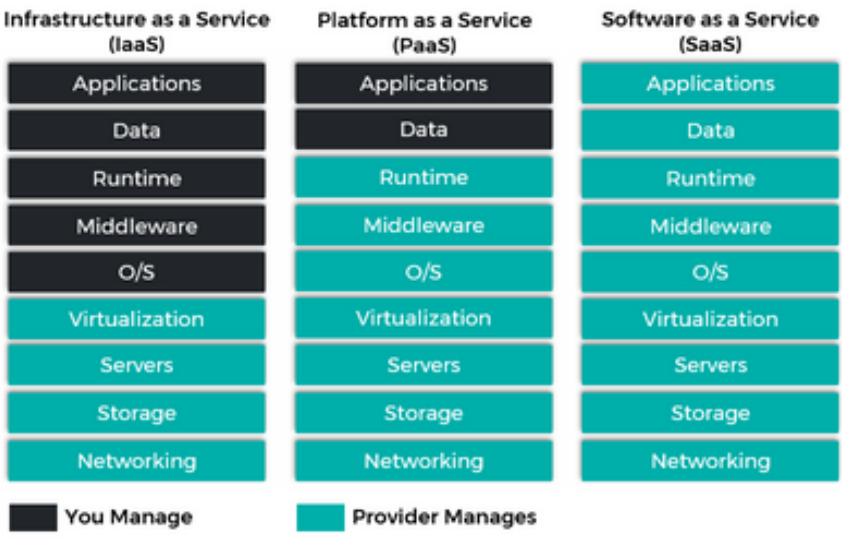
IaaS firms only provide the servers and API, so you must configure everything else.

Things to Consider Before IaaS Implementation

Here are some specific considerations you should remember before IaaS Implementation:

You should clearly define your access needs and your network's bandwidth to facilitate smooth implementation and functioning.

Plan out detailed data storage and security strategy to streamline the business process.




Ensure that your organization has a proper disaster recovery plan to keep your data safe and accessible.

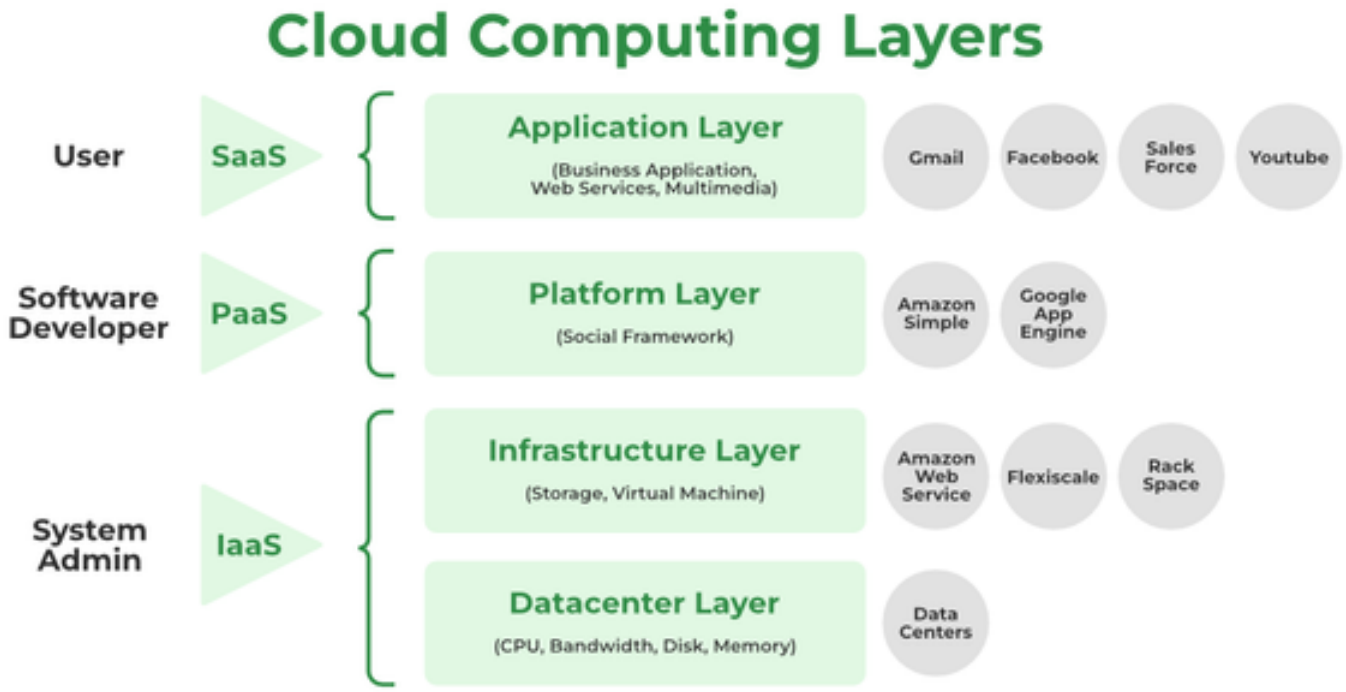
**Other important As a Services**

**MaaS–**MaaS stands for monitoring as a service. It allows the consumer to monitor the status of their critical applications regardless of location.

**CaaS** – Communication as a service use Enterprise level VPNs, VoIP, PBX, and Unified Communications between the costly investment of hosting, purchasing, and managing the IT infrastructure. It also enables you to reduce CAPEX and OPEX.

**DaaS** – Desktop as a service ensures a reliable, consistent experience for the remote use of programs, applications, and files anywhere, anytime.

**DRaaS** – Disaster Recovery as a service is a cloud computing model that provides safeguards from natural (or artificial) catastrophes.




Datacenter Layer

In a cloud environment, this layer is responsible for **Managing Physical Resources** such as servers, switches, routers, power supplies, and cooling systems.

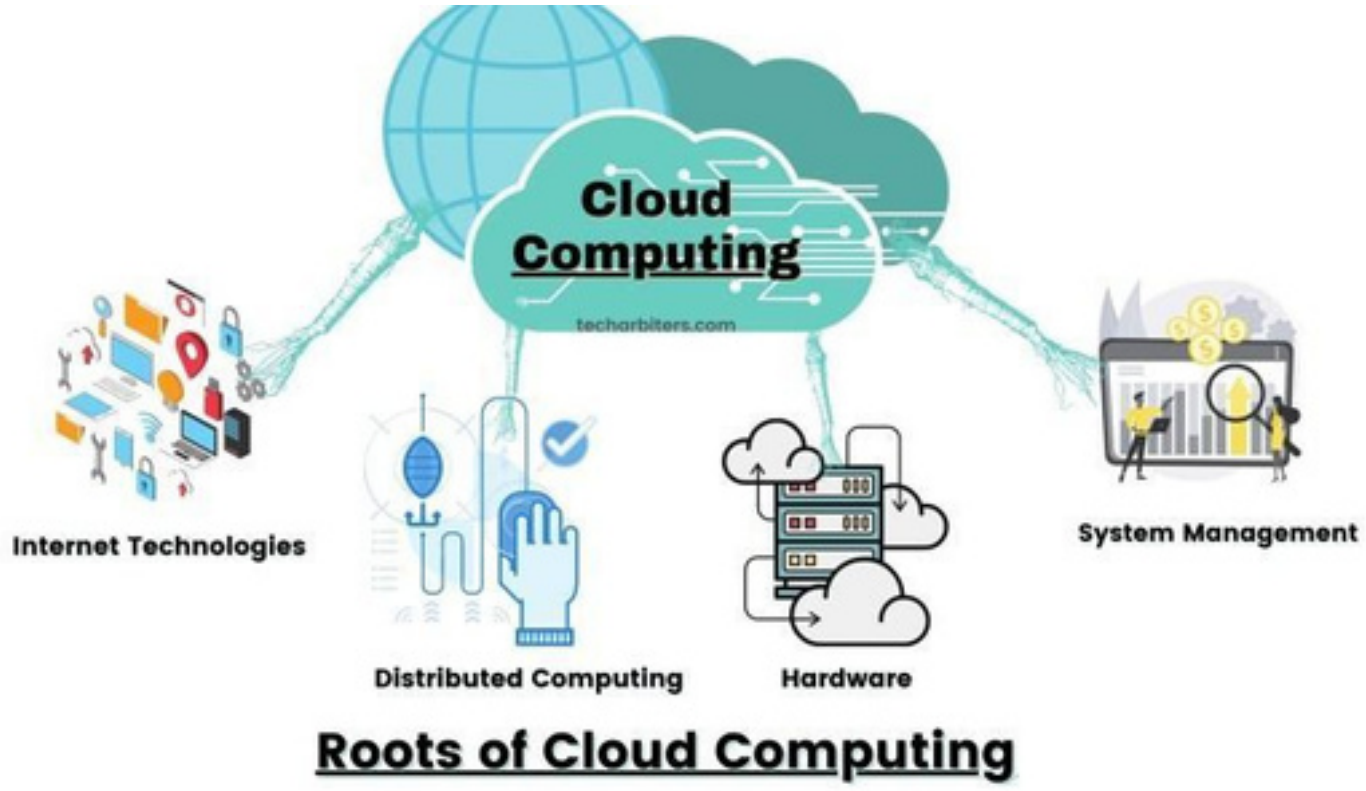
Providing end users with services requires all resources to be available and managed in data centers.

Physical servers connect through high-speed devices such as routers and switches to the data center.

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.

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.

**Roots of Cloud Computing**




There are four main roots of cloud computing: internet technologies, distributed computing, hardware, and system management. These roots help computers to extend their capacities and make them more powerful.

Cloud computing provides 3 types of services: Software as a service, IaaS – Infrastructure as a Service, and PaaS – Platform as a Service.

There are also four types of cloud available on the base of a cloud platform: Public, Hybrid, and Public.

To understand cloud computing roots of cloud computing, there are mainly four roots of cloud computing,

**Internet Technologies**

**Distributed computing**

**Hardware**

**System management**

**First Root: Internet Technologies**

The first root is Internet Technologies from the roots of cloud computing which contains service-oriented architecture (SOA), web 2.0, and web services.

Internet technologies are widely accessible to the public. People can access the content and run applications that depend on the network connection.

Cloud computing relies on the network, centralized storage, and bandwidth. However, the internet isn't just a network – it's also very complex and requires centralized management.

Hence, a person can host any website anywhere in the world. In addition, because of the network servers, anyone can create many different websites.

Service-oriented Architecture, or SOA, is a self-contained module specially designed for business functionalities. It is provided for business handling, event logging, and authentication services, which save lots of paperwork and time. Web Services like XML and HTTP provide web delivery services using common mechanisms. It is a universal concept of web service all over the world.

WEB 2.0 Services are more convenient for the users, as they do not have to learn more about coding and concepts to work with it.Information Technology companies basically provide this kind of service in which people can use the services on the common platform.

Predefined blocks or templates make their work easy, and they can work together in the centralized cloud computing system. Some examples of WEB 2.0 services are host services like Google Maps, microblogging sites like Twitter, and social networking sites like Facebook.

**Second Root: Distributed Computing**

The second root is Distributed Computing from the roots of cloud computing which contains grids, utility computing, and cluster.

To understand the second root, for example, a computer is a general store and documents in the form of files. Each document stored in the computer has a specific location, either on the local hard disk or it is stored over the internet. Now, when someone visits your website over the internet, they browse through the files on the browser without downloading them.

This means users can access the files at the specific location after processing and send that files back to the server. Thus, it is known as distributed computing of the cloud. It is distributed in a manner so people can access it anywhere in the world. With the help of this root, all the related resources like memory space, processor speed, and hard drive space are utilized in the best possible manner. A company using this technology will never face a problem and will always stay in competition with other companies.

**Third Root: Hardware**

The third root is Hardware from the roots of cloud computing which contains multi-core chips and virtualization.

When we talk about Hardware for cloud computing, it is usually virtual, and people do not need to buy it.Generally, computers require hardware such as CPU, RAM, ROM, and Motherboard to process, store, analyse, and manage the data.

There are no hardware devices or components in Cloud Computing because the applications are managed via the internet. If you are using a large amount of data, it becomes very difficult for your computer to manage the constant increase in data. On the other hand, the cloud stores data on its own computers rather than having the computer that holds the data physically.

In cloud computing, virtualization allows users to use resources from multiple virtual machines. It makes it easier and cheaper for customers to use cloud services.

Moreover, In the Service Level Agreement (SLA) based cloud computing model, each customer gets their own virtual machine called Virtual Private Cloud (VPC)

In short, a single cloud computing platform provides all the requirements of hardware, software, and operating system.

**Fourth Root: System Management**

The fourth root of cloud computing (System Management) contains data centre automation and autonomic computing. System management handles the operations to improve the productivity and efficiency of the system. To achieve this, management ensures all employees have easy access to all the necessary information. Employees can change configurations, obtain/resend information, and perform other related functions from any location. This makes it possible for the system admin to instantly respond to any user demand. Moreover, the admin can restrict or deny access to different users. IN an autonomic system, admin work becomes easier as the system is autonomic or self-managing. Additionally, data analysis and monitoring are handled by the sensors. Based on that data, the system responses perform various tasks such as optimization, adaptation, configuration, and protection. Hence, human involvement is less at this root, and the computing system handles most of the operations.

**Grid Computing & Utility Computing:**

| Grid Computing | Utility Computing |
|---|---|
| It is a process architecture that combines different computing resources from multiple locations to achieve desired and common goal. | It is process architecture that provide on-demand computing resources and infrastructure on basis of pay per use method. |
| It distributes workload across multiple systems and allow computers to contribute their individual resources to common goal. | It allows organization to allocate and segregate computing resources and infrastructure to various users on basis of their requirements. |
| It makes better use of existing resources, address rapid fluctuations in customer demands, improve computational capabilities, provide flexibility, etc. | It simply reduces IT costs, easier to manage, provide greater flexibility, compatibility, provide more convenience, etc. |
| It mainly focuses on sharing computing resources. | It mainly focuses on acquiring computing resources. |
| It is of three types i.e., computational grid, data grid, and collaborative grid. | It is of two type i.e., Internal and external utility. |
| It is used in ATMs, back-end infrastructures, marketing research, etc. | It is used in large organizations such as Amazon, Google, etc., where they establish their own utility services for computing storage and applications. |
| Its main purpose is to integrate usage of computer resources from cooperating partners in form of VO (Virtual Organizations). | Its main purpose is to make computing resources and infrastructure management available to customer as per their need, and charge them for specific usage rather than flat rate. |
| Its characteristics include resource coordination, transparent access, dependable access, etc. | Its characteristics include scalability, demand pricing, standardized utility computing services, automation, etc. |

**ASSIGNMENT QUESTIONS:**

1. Define cloud computing with its application.

2. Explain types of cloud deployment models.
3. Draw & Explain the architecture of cloud computing.
4. Explain cloud service model.