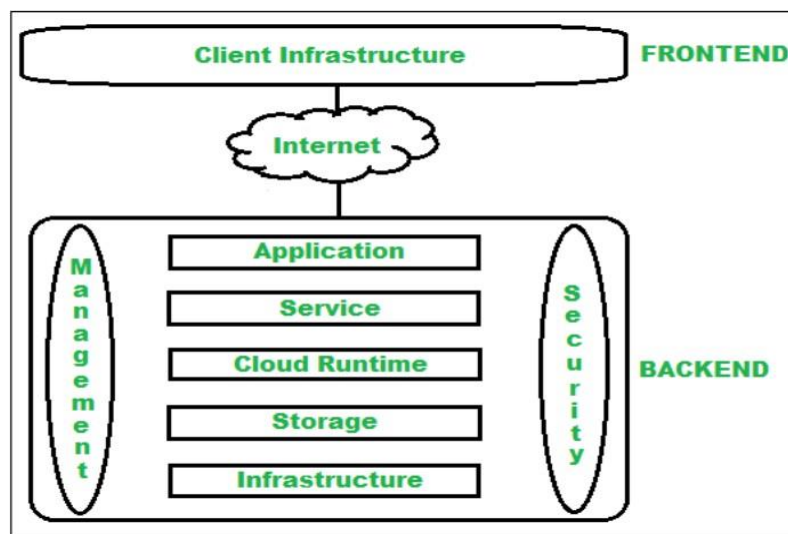


# Cloud Computing Assignment

1. What is Cloud Computing? What are the components of Cloud Computing? Explain with neat diagram.

- Cloud computing refers to services like storage, databases, software, analytics, and other platforms that are accessible via the internet. It is any service that can be delivered without being physically close to the hardware. For example, Netflix uses cloud computing for its video streaming services. Another example is G Suite, which runs entirely on the cloud. Some of the important components of Cloud Computing architecture are as follows:



- Hypervisor
- Management Software
- Deployment Software
- Network
- Cloud Server
- Cloud Storage

2. Elaborate characteristics of cloud computing. What are the advantages and disadvantages of Cloud Computing?

-There are basically 7 essential characteristics of Cloud Computing.

1. On-demand self-services: The Cloud computing services does not require any human administrators, user themselves are able to provision, monitor and manage computing resources as needed.
2. Broad network access: The Computing services are generally provided over standard networks and heterogeneous devices.
3. Rapid elasticity: The Computing services should have IT resources that are able to scale out and in quickly and on as needed basis. Whenever the user require services it is provided to him and it is scale out as soon as its requirement gets over.
4. Resource pooling: The IT resource (e.g., networks, servers, storage, applications, and services) present are shared across multiple applications and occupant in an

uncommitted manner. Multiple clients are provided service from a same physical resource.

5. Measured service: The resource utilization is tracked for each application and occupant, it will provide both the user and the resource provider with an account of what has been used. This is done for various reasons like monitoring billing and effective use of resource.
6. Multi-tenancy: Cloud computing providers can support multiple tenants (users or organizations) on a single set of shared resources.
7. Virtualization: Cloud computing providers use virtualization technology to abstract underlying hardware resources and present them as logical resources to users.

#### Advantages and Disadvantages of Cloud Computing:

- 1) Back-up and restore data: Once the data is stored in the cloud, it is easier to get back-up and restore that data using the cloud.
- 2) Improved collaboration: Cloud applications improve collaboration by allowing groups of people to quickly and easily share information in the cloud via shared storage.
- 3) Excellent accessibility: Cloud allows us to quickly and easily access store information anywhere, anytime in the whole world, using an internet connection. An internet cloud infrastructure increases organization productivity and efficiency by ensuring that our data is always accessible.
- 4) Low maintenance cost: Cloud computing reduces both hardware and software maintenance costs for organizations.
- 5) Mobility: Cloud computing allows us to easily access all cloud data via mobile.
- 6) Services in the pay-per-use model: Cloud computing offers Application Programming Interfaces (APIs) to the users for access services on the cloud and pays the charges as per the usage of service.
- 7) Unlimited storage capacity: Cloud offers us a huge amount of storing capacity for storing our important data such as documents, images, audio, video, etc. in one place.
- 8) Data security: Data security is one of the biggest advantages of cloud computing. Cloud offers many advanced features related to security and ensures that data is securely stored and handled.

#### Disadvantages of Cloud Computing:

##### 1) Internet Connectivity

As you know, in cloud computing, every data (image, audio, video, etc.) is stored on the cloud, and we access these data through the cloud by using the internet connection. If you do not have good internet connectivity, you cannot access these data. However, we have no any other way to access data from the cloud.

##### 2) Vendor lock-in

Vendor lock-in is the biggest disadvantage of cloud computing. Organizations may face problems when transferring their services from one vendor to another. As different vendors provide different platforms, that can cause difficulty moving from one cloud to another.

##### 3) Limited Control

As we know, cloud infrastructure is completely owned, managed, and monitored by the service provider, so the cloud users have less control over the function and execution of services within a cloud infrastructure.

##### 4) Security

Although cloud service providers implement the best security standards to store important information. But, before adopting cloud technology, you should be aware that you will be sending all your organization's sensitive information to a third party, i.e., a cloud computing service provider. While sending the data on the cloud, there may be a chance that your organization's information is hacked by Hackers.

### 3. Explain Cloud Service Models: SaaS, PaaS, IaaS, Storage in details.

#### -Infrastructure as a Service (IaaS)

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.

Characteristics of IaaS

There are the following characteristics of IaaS -

- Resources are available as a service
- Services are highly scalable
- Dynamic and flexible
- GUI and API-based access
- Automated administrative tasks

Example: DigitalOcean, Linode, Amazon Web Services (AWS), Microsoft Azure, Google Compute Engine (GCE), Rackspace, and Cisco Metacloud.

To know more about the IaaS, [click here](#).

#### Platform as a Service (PaaS)

PaaS cloud computing platform is created for the programmer to develop, test, run, and manage the applications.

Characteristics of PaaS

There are the following characteristics of PaaS -

- 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".

Example: AWS Elastic Beanstalk, Windows Azure, Heroku, Force.com, Google App Engine, Apache Stratos, Magento Commerce Cloud, and OpenShift.

To know more about PaaS, [click here](#).

#### Software as a Service (SaaS)

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.

Characteristics of SaaS

There are the following characteristics of SaaS -

- 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

Example: BigCommerce, Google Apps, Salesforce, Dropbox, ZenDesk, Cisco WebEx, ZenDesk, Slack, and GoToMeeting.

#### 4. Explain cloud computing reference model.

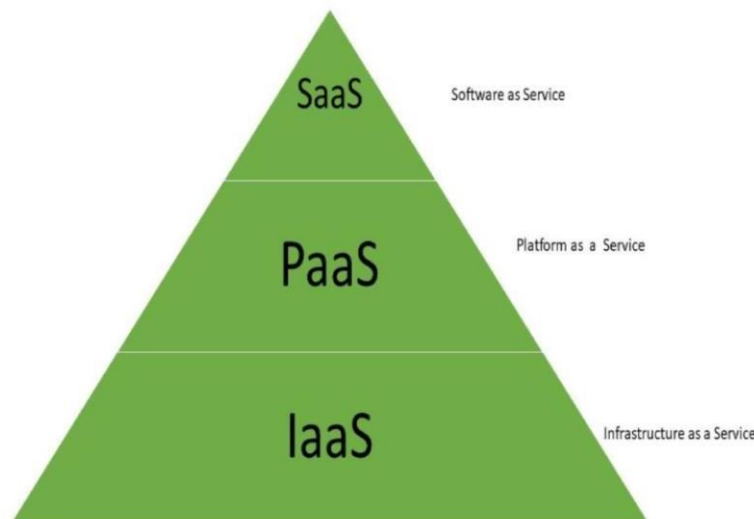
-The cloud computing reference model is an abstract model that divides a cloud computing environment into abstraction layers and cross-layer functions to characterize and standardize its functions. This reference model divides cloud computing activities and functions into three cross-layer functions and five logical layers.

Each of these layers describes different things that might be present in a cloud computing environment, such as computing systems, networking, storage equipment, virtualization software, security measures, control and management software, and so forth. It also explains the connections between these organizations. The five layers are the Physical layer, virtual layer, control layer, service orchestration layer, and service layer.

Cloud Computing reference model is divided into 3 major service models:

1. Software as a Service (SaaS)
2. Platform as a Service (PaaS)
3. Infrastructure as a Service (IaaS)

The below diagram explains the cloud computing reference model:



#### Cloud Computing Reference Model Overview

IaaS, PaaS, and SaaS are the three most prevalent cloud delivery models, and together they have been widely adopted and formalized. A cloud delivery service model is a specific, preconfigured combination of IT resources made available by a cloud service provider. But the functionality and degree of administrative control each of these three delivery types offer cloud users varies.

These abstraction layers can also be considered a tiered architecture, where services from one layer can be combined with services from another, for example, SaaS can supply infrastructure to create services from a higher layer. Let us have a look at the layers of cloud computing reference model.

### 1. SaaS

Software as a Service (SaaS) is a form of application delivery that relieves users of the burden of software maintenance while making development and testing easier for service providers.

The cloud delivery model's top layer is where applications are located. End customers get access to the services this tier offers via web portals. Because online software services provide the same functionality as locally installed computer programs, consumers (users) are rapidly switching from them. Today, ILMS and other application software can be accessed via the web as a service.

In terms of data access, collaboration, editing, storage, and document sharing, SaaS is unquestionably a crucial service. Email service in a web browser is the most well-known and widely used example of SaaS, but SaaS applications are becoming more cooperative and advanced.

Features of SaaS are as follows:

- The cloud consumer has full control over all the cloud services.
- The provider has full control over software applications-based services.
- The cloud provider has partial control over the implementation of cloud services.
- The consumer has limited control over the implementation of these cloud services.

### 2. PaaS

Platform as a Service is a strategy that offers a high level of abstraction to make a cloud readily programmable in addition to infrastructure-oriented clouds that offer basic compute and storage capabilities (PaaS). Developers can construct and deploy apps on a cloud platform without necessarily needing to know how many processors or how much memory their applications would use. A PaaS offering that provides a scalable environment for creating and hosting web applications is Google App Engine, for instance.

Features of PaaS layer are as follows:

- The cloud provider has entire rights or control over the provision of cloud services to consumers.
- The cloud consumer has selective control based on the resources they need or have opted for on the application server, database, or middleware.
- Consumers get environments in which they can develop their applications or databases. These environments are usually very visual and very easy to use.
- Provides options for scalability and security of the user's resources.
- Services to create workflows and websites.
- Services to connect users' cloud platforms to other external platforms.

### 3. IaaS

Infrastructure as a Service (IaaS) offers storage and computer resources that developers and IT organizations use to deliver custom/business solutions. IaaS delivers computer hardware (servers, networking technology, storage, and data center space) as a service. It may also include the delivery of OS and virtualization technology to manage the resources. Here, the more important point is that IaaS customers rent computing resources instead of buying and installing them in their data centers. The service is typically paid for on a usage basis. The service may include dynamic scaling so that if the customers need more resources than expected, they can get them immediately.

The control of the IaaS layer is as follows:

- The consumer has full/partial control over the infrastructure of the cloud, servers, and databases.
- The consumer has control over the Virtual Machines' implementation and maintenance.
- The consumer has a choice of already installed VM machines with preinstalled Operating systems.
- The cloud provider has full control over the data centers and the other hardware involved in them.
- It has the ability to scale resources based on the usage of users.
- It can also copy data worldwide so that data can be accessed from anywhere in the world as soon as possible.

## 5. What are the Cloud Deployment Model. Explain in details.

-Today, organizations have many exciting opportunities to reimagine, repurpose and reinvent their businesses with the cloud. The last decade has seen even more businesses rely on it for quicker time to market, better efficiency, and scalability. It helps them achieve long-term digital goals as part of their digital strategy.

Though the answer to which cloud model is an ideal fit for a business depends on your organization's computing and business needs. Choosing the right one from the various types of cloud service deployment models is essential. It would ensure your business is equipped with the performance, scalability, privacy, security, compliance & cost-effectiveness it requires. It is important to learn and explore what different deployment types can offer - around what particular problems it can solve.

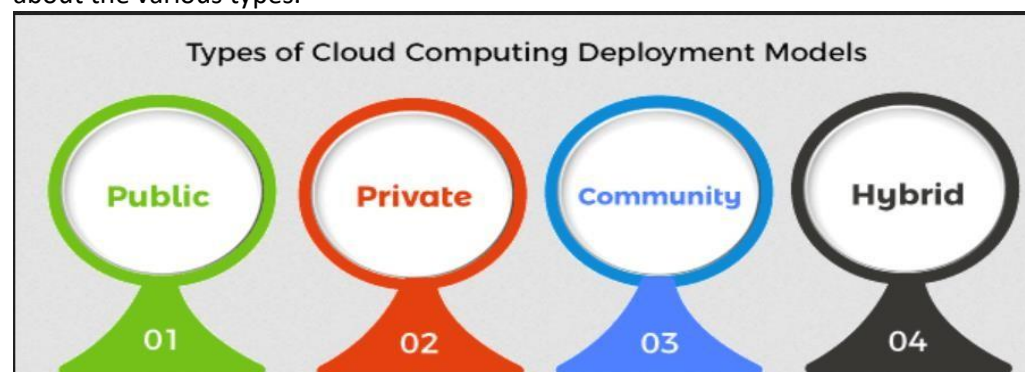
Read on as we cover the various cloud computing deployment and service models to help discover the best choice for your business.

What Is A Cloud Deployment Model?

It works as your virtual computing environment with a choice of deployment model depending on how much data you want to store and who has access to the Infrastructure.

Different Types Of Cloud Computing Deployment Models

Most cloud hubs have tens of thousands of servers and storage devices to enable fast loading. It is often possible to choose a geographic area to put the data "closer" to users. Thus, deployment models for cloud computing are categorized based on their location. To know which model would best fit the requirements of your organization, let us first learn about the various types.

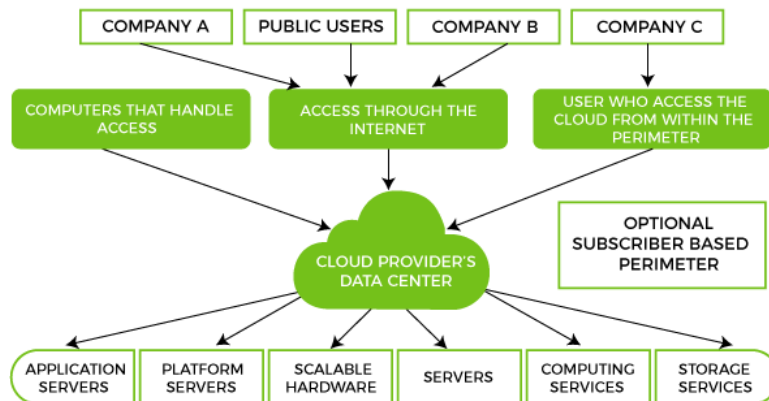


Public Cloud

The name says it all. It is accessible to the public. Public deployment models in the cloud are perfect for organizations with growing and fluctuating demands. It also makes a great choice

for companies with low-security concerns. Thus, you pay a cloud service provider for networking services, compute virtualization & storage available on the public internet. It is also a great delivery model for the teams with development and testing. Its configuration and deployment are quick and easy, making it an ideal choice for test environments.

### Public Cloud



### Benefits of Public Cloud

**Minimal Investment** - As a pay-per-use service, there is no large upfront cost and is ideal for businesses who need quick access to resources

**No Hardware Setup** - The cloud service providers fully fund the entire Infrastructure

**No Infrastructure Management** - This does not require an in-house team to utilize the public cloud.

### Limitations of Public Cloud

**Data Security and Privacy Concerns** - Since it is accessible to all, it does not fully protect against cyber-attacks and could lead to vulnerabilities.

**Reliability Issues** - Since the same server network is open to a wide range of users, it can lead to malfunction and outages

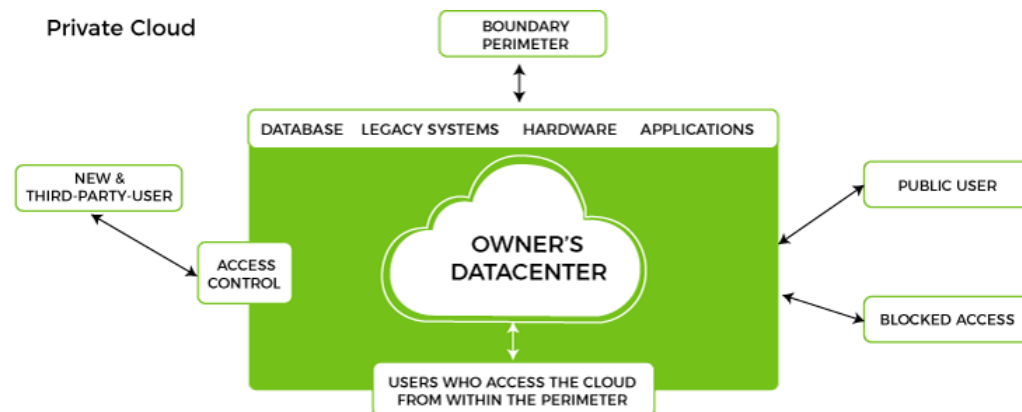
**Service/License Limitation** - While there are many resources you can exchange with tenants, there is a usage cap.

### Private Cloud

Now that you understand what the public cloud could offer you, of course, you are keen to know what a private cloud can do. Companies that look for cost efficiency and greater control over data & resources will find the private cloud a more suitable choice.

It means that it will be integrated with your data center and managed by your IT team.

Alternatively, you can also choose to host it externally. The private cloud offers bigger opportunities that help meet specific organizations' requirements when it comes to customization. It's also a wise choice for mission-critical processes that may have frequently changing requirements.



### Benefits of Private Cloud

**Data Privacy** - It is ideal for storing corporate data where only authorized personnel gets access

**Security** - Segmentation of resources within the same Infrastructure can help with better access and higher levels of security.

**Supports Legacy Systems** - This model supports legacy systems that cannot access the public cloud.

### Limitations of Private Cloud

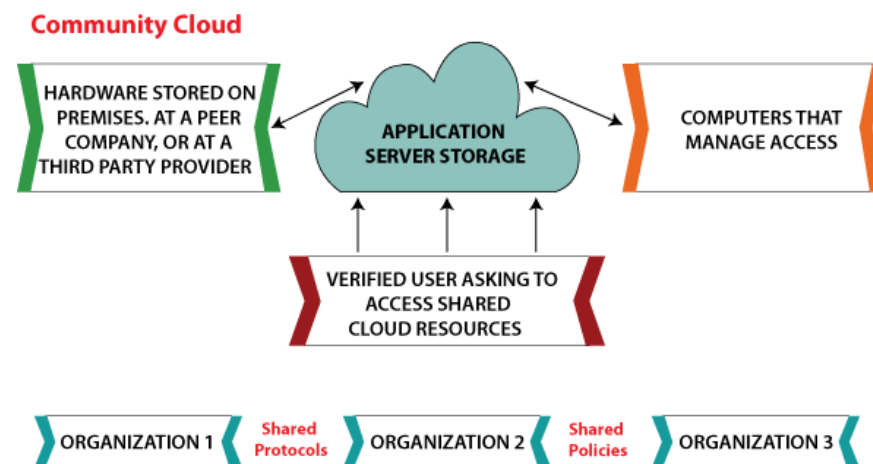
**Higher Cost** - With the benefits you get, the investment will also be larger than the public cloud. Here, you will pay for software, hardware, and resources for staff and training.

**Fixed Scalability** - The hardware you choose will accordingly help you scale in a certain direction

**High Maintenance** - Since it is managed in-house, the maintenance costs also increase.

### Community Cloud

The community cloud operates in a way that is similar to the public cloud. There's just one difference - it allows access to only a specific set of users who share common objectives and use cases. This type of deployment model of cloud computing is managed and hosted internally or by a third-party vendor. However, you can also choose a combination of all three.



### Benefits of Community Cloud

**Smaller Investment** - A community cloud is much cheaper than the private & public cloud and provides great performance

**Setup Benefits** - The protocols and configuration of a community cloud must align with industry standards, allowing customers to work much more efficiently.

### Limitations of Community Cloud

**Shared Resources** - Due to restricted bandwidth and storage capacity, community resources often pose challenges.

**Not as Popular** - Since this is a recently introduced model, it is not that popular or available across industries

### Hybrid Cloud

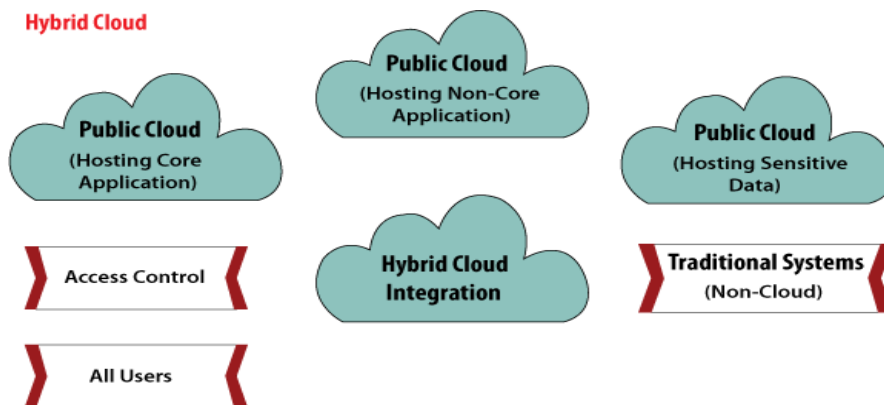
As the name suggests, a hybrid cloud is a combination of two or more cloud architectures.

While each model in the hybrid cloud functions differently, it is all part of the same architecture. Further, as part of this deployment of the cloud computing model, the internal or external providers can offer resources.

Let's understand the hybrid model better. A company with critical data will prefer storing on a private cloud, while less sensitive data can be stored on a public cloud. The hybrid cloud is



also frequently used for 'cloud bursting'. It means, supposes an organization runs an application on-premises, but due to heavy load, it can burst into the public cloud.



#### Benefits of Hybrid Cloud

**Cost-Effectiveness** - The overall cost of a hybrid solution decreases since it majorly uses the public cloud to store data.

**Security** - Since data is properly segmented, the chances of data theft from attackers are significantly reduced.

**Flexibility** - With higher levels of flexibility, businesses can create custom solutions that fit their exact requirements

#### Limitations of Hybrid Cloud

**Complexity** - It is complex setting up a hybrid cloud since it needs to integrate two or more cloud architectures

**Specific Use Case** - This model makes more sense for organizations that have multiple use cases or need to separate critical and sensitive data.

### 6. Write a note on different cloud storage providers.

-A cloud storage provider, sometimes referred to as a managed service provider, is a company that offers organizations and individuals the ability to place and retain data in an off-site storage system. Customers can lease cloud storage capacity per month or on demand.

A cloud storage provider hosts a customer's data in its own data center, providing fee-based computing, networking and storage infrastructure. Both individual and corporate customers can get unlimited storage capacity on a provider's servers at a low per-gigabyte price.

#### List of Cloud Storage Providers

##### 1. Ice Drive

Ice drive is a famous cloud storage service provider for businesses that specialize in mobile services. It offers solutions for the web, desktop, and mobile applications. The question of how to use cloud storage becomes simple with ice drive mainly because of its simple interface. The cloud storage solution can be used without worrying about the operating system, or device. The mobile application of Ice Drive allows users to upload and download files into the cloud. The platform has custom software for videos and audio files. Also, it features an exquisite backup wizard to help with backup and restore. Native application in the platform help users edit their files and documents too.

##### 2. pCloud

The pCloud cloud drive storage offers access for a lifetime. This makes cloud file storage a great choice for businesses with a limited budget. The cost of cloud storage reduces drastically with PCloud and its affordable lifetime access plans. How cloud storage works

from pCloud is interesting, users need to pay 175 USD for 500 GB of storage. The plan needs a one-time registration fee. Apart from this, pCloud is famous for its annual plans too. The basic package has collaboration features and even military graded encryption for the data stored. The military graded encryption can be obtained at a fee of 125 USD.

### 3. IDrive

IDrive is one of the safest cloud storage options in the industry. It is often used for data backup. And, it is known for its automatic file retrieval methods. Backup can play an important role when the project and data are priceless. Mainly because it is hard to predict when content would be deleted or corrupted by user operations. IDrive has express tools that can be used to back up desktops, mobile data, NAS, and SQLs. The IDrive allows businesses to manage their devices remotely. It is top cloud storage for retrieving data from backup. The backup settings can be reversed in real-time, but without the user actually sitting in front of the machine.

### 4. Zoolz

Zoolz is another top free cloud storage for heavy volume and long term storage. Zoolz is an affordable choice too. Some of its plans begin at 19.99 USD per month. This is one of the few cloud storage service providers with the ability to save 100 TB of data for three to five years. Important features of Zoolz are on the go military encryption – The ability to utilize its smart duplication algorithms – The ease in deployment to a thousand, or more users – Continuous protection of data with backup preview. It also allows users to set advanced access rules mainly Zoolz a great choice for confidential information.

### 5. Sync

The talk about cloud storage for regulated industries will remain incomplete without Sync. Sync is in compliance with three crucial standards: HIPAA, GDPR, and PIPEDA. Both healthcare and banking industries rely on sync for storing their data. Above this feature, all the data stored in Sync is protected using end to end encryption. Since it offers regulated cloud storage solutions, there is no third-party tracking with Sync. Furthermore, the cloud storage system offered by Sync allows users to send and receive files with password protection. Based on the plans you pick, unlimited files and folders can be created in Sync.

### 6. Dropbox

Dropbox is one of the market's fastest cloud storage solutions. It has been offering cloud services since 2008. Indeed, this is one of the most famous cloud data storage providers out there. Regardless of the device or platform used, Dropbox offers many versatile features. Its admin dashboard is extremely useful, especially for transmitting files and documents on the fly. Even though it ranks among the major cloud storage providers, Dropbox limits new users to only 2GB of free storage space. Once the free plan is exhausted, users can buy 3TB for 16.58 USD. This comes with watermarking, password protection, and remote device wiping. Dropbox Paper is another offering from Dropbox for uploading documents and single-page files.

### 7. iCloud

Unlike most popular cloud storage providers, iCloud has an exquisite range of features for Apple users. It integrates seamlessly with the Apple Finder App. Also, if you are a user of iWork, saving, and retrieving files from iCloud is simple. Just like OneDrive users receive only 5GB for free. If you own an Apple device, this feature is offered by default. Any picture captured using the Apple iPhone will be uploaded to the iCloud automatically too. Apart from the photos, you will be able to upload your files and message as well. Even though iCloud is a pioneer in cloud services, users can buy 50 GB of storage for 0.99 USD.

### 8. OneDrive

OneDrive is identified as one of the most secure cloud storage providers. It is created and managed by Microsoft. This means OneDrive is an ideal choice for windows users. The cloud platform integrates seamlessly with outlook and the office suite. It takes care of scanning and automatic backup of documents too. It supports offline access. This means users don't need an active network connection to view and open their files. Personal Vault is an important feature of OneDrive. As suggested by its name, it supports the storage of confidential files with identity verification. The verification is broken into multiple layers, making the OneDrive a choice for many companies.

#### 9. Google Drive

Another important player in this list would be Google Drive. The Drive became famous for its free offerings. If your daily need depends on the GSuite, Android applications, and other services offered by Google, this would be your ideal solution. Google Drive offers 15 GB of free cloud storage space to newbie users.

#### 10. LiveDrive

A pioneer in cloud storage for remote collaboration would be LiveDrive. It is a smart way of sharing data with teams located remotely. The cloud service supports unlimited amounts of pc and mobile backups. LiveDrive offers bank-grade security features like a state of art intrusion prevention technology.

#### Conclusion

Investing in cloud storage proves to be useful if you are keen on saving money, creating backups, and have the ability to access files from anywhere in the world. And, when you choose a cloud storage service provider, you need to focus on attributes like security, flexibility, and ease of integration.

#### 7. Explain the Cloud System Architecture.

-As we know, cloud computing technology is used by both small and large organizations to store the information in cloud and access it from anywhere at anytime using the internet connection.

Cloud computing architecture is a combination of service-oriented architecture and event-driven architecture.

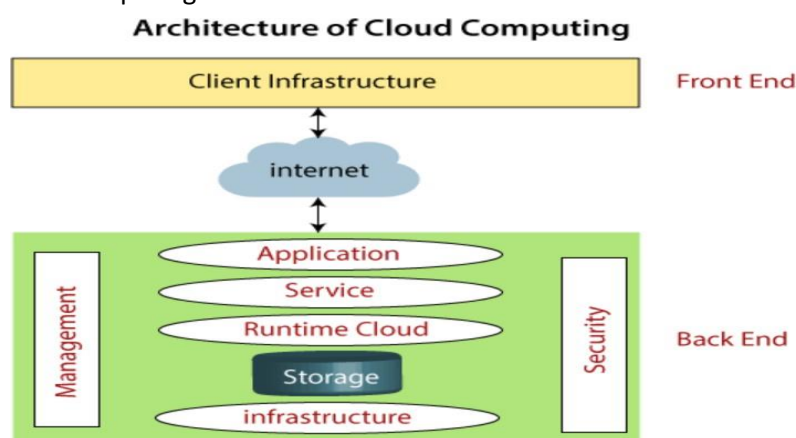
Cloud computing architecture is divided into the following two parts -

Front End

Back End

The below diagram shows the architecture of cloud computing -

Cloud Computing Architecture



## Front End

The front end is used by the client. It contains client-side interfaces and applications that are required to access the cloud computing platforms. The front end includes web servers (including Chrome, Firefox, internet explorer, etc.), thin & fat clients, tablets, and mobile devices.

## Back End

The back end is used by the service provider. It manages all the resources that are required to provide cloud computing services. It includes a huge amount of data storage, security mechanism, virtual machines, deploying models, servers, traffic control mechanisms, etc. Note: Both front end and back end are connected to others through a network, generally using the internet connection.

## Components of Cloud Computing Architecture

There are the following components of cloud computing architecture -

### 1. Client Infrastructure

Client Infrastructure is a Front end component. It provides GUI (Graphical User Interface) to interact with the cloud.

### 2. Application

The application may be any software or platform that a client wants to access.

### 3. Service

A Cloud Services manages that which type of service you access according to the client's requirement.

Cloud computing offers the following three type of services:

- i. Software as a Service (SaaS) – It is also known as cloud application services. Mostly, SaaS applications run directly through the web browser means we do not require to download and install these applications. Some important example of SaaS is given below –  
Example: Google Apps, Salesforce Dropbox, Slack, Hubspot, Cisco WebEx.
- ii. Platform as a Service (PaaS) – It is also known as cloud platform services. It is quite similar to SaaS, but the difference is that PaaS provides a platform for software creation, but using SaaS, we can access software over the internet without the need of any platform.  
Example: Windows Azure, Force.com, Magento Commerce Cloud, OpenShift.
- iii. Infrastructure as a Service (IaaS) – It is also known as cloud infrastructure services. It is responsible for managing applications data, middleware, and runtime environments.  
Example: Amazon Web Services (AWS) EC2, Google Compute Engine (GCE), Cisco Metapod.

### 4. Runtime Cloud

Runtime Cloud provides the execution and runtime environment to the virtual machines.

### 5. Storage

Storage is one of the most important components of cloud computing. It provides a huge amount of storage capacity in the cloud to store and manage data.

## 6. Infrastructure

It provides services on the host level, application level, and network level. Cloud infrastructure includes hardware and software components such as servers, storage, network devices, virtualization software, and other storage resources that are needed to support the cloud computing model.

## 7. Management

Management is used to manage components such as application, service, runtime cloud, storage, infrastructure, and other security issues in the backend and establish coordination between them.

## 8. Security

Security is an in-built back end component of cloud computing. It implements a security mechanism in the back end.

## 9. Internet

The Internet is medium through which front end and back end can interact and communicate with each other.

## 8. Explain Cloud Economics in details.

-Economics of Cloud Computing is based on the PAY AS YOU GO method. Users/Customers must have to pay only for their way of the usage of the cloud services. It is definitely beneficial for the users. So the Cloud is economically very convenient for all. Another side is to eliminate some indirect costs which is generated by assets such as license of the software and their support. In the cloud, users can use software applications on a subscription basis without any cost because the property of the software providing service remains to the cloud provider.

Economical background of the cloud is more useful for developers in the following ways:

- Pay as you go model offered by cloud providers.
- Scalable and Simple.

Cloud Computing Allows:

- Reduces the capital costs of infrastructure.
- Removes the maintenance cost.
- Removes the administrative cost.

What is Capital Cost?

It is cost occurred in the purchasing infrastructure or the assets that is important in the production of goods. It takes a long time to generate profit.

In the case of start-ups, there is no extra budget for the infrastructure and its maintenance. So cloud can minimize expenses of any small organization in terms of economy. It leads to the developers can only focus on the development logic and not on the maintenance of the infrastructure.

There are three different Pricing Strategies that are introduced by Cloud Computing: Tiered Pricing, Per-unit Pricing, and Subscription-based Pricing. These are explained as following below.

- Tiered Pricing: Cloud Services are offered in the various tiers. Each tier offers to fix service agreements at a specific cost. Amazon EC2 uses this kind of pricing.
- Per-unit Pricing: The model is based upon the unit-specific service concept. Data transfer and memory allocation include in this model for specific units. GoGrid uses this kind of pricing in terms of RAM/hour.
- Subscription-based Pricing: In this model, users are paying periodic subscription fees for the usage of the software.

So these models give more flexible solutions to the cloud economy.

9. Explain involvement of cloud computing in an organization. Explain its types.

-Cloud computing is an example of a virtualized system, ultimately, it is a natural evolution for data centers that use automated systems management, workload balancing, and virtualization technologies.

Cloud Services offers a number of benefits that your company can take advantage of :

#### Costs

The cloud promises to reduce the cost, delivery and maintenance of computational power, allowing companies to buy only the necessary computing services instead of investing in expensive and complex infrastructure.

**Low-cost Computers To The User:** You do not need a computer to run next generation applications that are hosted in the cloud. As the application runs on the server, not the user's computer, it does not need many resources on the computers. Thus, we can get lower cost computers, with ability to basically perform the operating system and web browser.

**Lower Costs Of IT Infrastructure:** The investment that would be made in purchasing ever more powerful servers, may be directed to the hiring of cloud servers and those adequate resources can be easily resized as the business need. It is possible to hire servers that overcome a spike in usage and dismiss them when no longer needed.

**Reduce The Cost Of Software:** It is no longer necessary to purchase the software, since cloud computing companies charge an amount to provide software as a service. And yet today we have companies that are offering their web based applications for free, which makes it much more interesting than paying the high values of software licensing traditionally charged.

**Decreasing Hardware Costs:** The cloud providers acquire servers, network equipment, internet connection and many other equipment in large quantities, thus able to negotiate better prices with suppliers and with a much shorter period than most companies.

**Lower Investment:** When you purchase a server in the cloud, you make a contract in the form of service, like a lease, paying a small amount per month, according to what was contracted. At the end of the contract, you recover your data and return it to the server provider hired. So in addition to not having to face a great investment at the beginning of the service, when the contract ends you are not left with an obsolete server kept in any room of your company.

### Scalability

If you are anticipating an increase in your computing needs (or even if you are surprised by a demand), cloud computing can help you manage this demand.

The cloud allows users to suit their specific needs. Cloud computing is infinitely scalable and enables IT infrastructures to be expanded efficiently without the need to make large capital investments.

**Increased Computational Power:** When a cloud is contracted, there is no limitation on the computing power of a physical machine. With the new computing model, we can perform tasks that require high performance computing by utilizing the power of thousands of servers in the cloud. In other words, you can perform more tasks in the cloud than you can do on the server.

**Unlimited Storage Capacity:** Likewise, the cloud offers virtually unlimited storage capacity. Thus, it is not necessary to worry if the disk space is running low. When this does occur, simply allocate more disk to the cloud server almost instantly and continue with your work normally.

### Maximizing Resources

Cloud computing relieves the burden on already overburdened IT resources. By changing the non-critical data to the cloud, your IT department is free to work in business-related tasks. You also do not need to add more people and specialized training to handle these tasks.

Moreover, as network outages are a nightmare for IT staff, this burden is discharged.

**Less Maintenance Problems:** In the case of maintenance costs, cloud computing dramatically reduces maintenance costs of hardware and software. With the need for fewer physical servers in the company, maintenance costs are reduced immediately and as cloud applications are in the cloud, there is no software on computers in the organization to maintain.

**Software Updates:** Another advantage is that, we no longer need to use older software or pay high fees to upgrade them to a newer version. When an application is web-based, updates happen automatically and are available for the next time you use it in the cloud. In the case of cloud servers, the cost of updating software will certainly be much lower than buying the new version.

**Best Performance:** With regard to performance, the computer must run fewer applications to provide what a user needs. Thus, with fewer programs allocating memory space, not

using hard drive space and not using CPU cycles, you may notice a significant improvement of performance of your computer while performing your daily tasks.

#### Access

The cloud promises universal access to high computing power and storage resources for anyone with a device having access to the internet network.

For example, you do not need to take your documents with you. Instead, they stay in the cloud, where you can access them from anywhere that has an internet connection. All your documents are instantly available. No matter where you are.

#### Security

Unlike traditional computing, where a hard disk crash can destroy all your data, a computer with problems in the cloud does not affect the storage of your data. This is because, data in the cloud is automatically duplicated, so that nothing is lost. This also means that if your computer crashes while working, all your data will still be in the cloud. In a world where only a few users make backup of data regularly, cloud computing can keep data safe.

#### Collaboration

For many users, collaborative work is one of the most important advantages of cloud computing. Several people may have access to documents in a project simultaneously. As the document is edited, the changes appear automatically on the screen of other users who are using the document.

#### 10. Explain role of Networking in Cloud Computing.

-Cloud networking is a kind of information technology (IT) infrastructure in which some or all of an organization's networking resources are hosted in the cloud, whether in public cloud, private cloud or a hybrid cloud combination.

Hosting networking resources in the cloud -- which can include virtual routers, network management software bandwidth, firewalls and other tools as needed -- means businesses can create complex networks using only an internet connection.

Cloud networking focuses on the ability of a cloud customer or cloud service provider to design, configure and manage the underlying network in a cloud service. This enables a shift of network management, control and data connectivity from an organization's premises to cloud infrastructure.

Networking resources or services that can be hosted in the cloud include the following:

- network management software
- connectivity
- virtual routers
- firewalls
- load balancers
- bandwidth
- content delivery networks (CDNs)



virtual private network (VPN)  
domain name system (DNS)

Cloud providers offer a broad range of network security options . In addition to firewalls other options include distributed denial of service (DDoS) protection services and AI-driven network monitoring tools for threat detection.

Types of cloud networking

The two main types of cloud networking are cloud-enabled networking and cloud-based networking.

Cloud-enabled networking is a cloud networking method where network architecture is on the customer's premises, but some or the rest of other network resources used for management are in the cloud. For example, core network infrastructure, such as packet forwarding and routing, would stay on premises, while services such as network management, monitoring and security services maintenance may be located in the cloud.

Cloud-based networking is another method in which the entire network is based in the cloud. This process is used to enable connectivity between the resources and applications deployed in the cloud.

How does cloud networking work?

In general, cloud networking architectures should provide centralized management, control and visibility. Cloud networking is created using cloud-based services and will be set up differently depending on the type of cloud service it is being hosted on. For example, with a private cloud, architects have more flexibility when it comes to the overall design. This is because the cloud provider fully manages the underlying hardware and software on which the cloud is built.

For public clouds, customers can control and manage networking only in infrastructure as a service (IaaS) deployments. With software as a service (SaaS) and platform as a service (PaaS), the customer has no control over network functions, as they're fully managed by the service provider. If organizations need to configure aspects of their network in a public cloud, IaaS is their best option.

Difference between public and private clouds

This image shows some of the base differences between public and private clouds.

An organization may instead opt to operate in a hybrid cloud architecture. That means some applications, data and services reside on premises, while others are moved to an IaaS provider. The ideal scenario for organizations with this method would be to mimic the network Internet Protocol (IP) space, policies and procedures already established in their own data centers.

Some businesses may even go an additional step further by using multiple cloud service providers in a multi-cloud architecture. Symmetry among clouds is key in this method, from both an operational and cloud management perspective. Organizations moving toward multi-cloud must be able to manage routing, access lists, load balancing and other network functions, no matter which cloud they're in. Multi-cloud management tools need to be purpose-built in order to create a software overlay between private and public clouds, which masks any underlying differences in configuration management. The multi-cloud option is far more complex than other options.

## Benefits and challenges of cloud networking

The benefits of cloud networking include the following:

**Lower cost.** This is compared to having organizations buy their own network equipment and software. Cloud networking is also based on pay-per-use models.

**Productivity.** IT staff won't have to worry about pushing hardware and software upgrades or configuration and maintenance updates to the cloud networking service. This should free an organization's IT staff to work on other network priorities.

**Reliability.** Server load balancing helps minimize downtime, and reduces the need to bring the system down for updates. Cloud services also normally promote high availability (HA).

**Fast deployments.** Users can access new applications without needing to spend time installing and configuring networking tools.

**Scalability.** Cloud networking providers can add more of an organization's data, as opposed to adding more infrastructure on premises.

**Flexibility.** Customers have the option to choose from public, private or hybrid cloud deployment.

**Security.** Cloud networking providers can provide security options, such as firewalls, encryption, authentication and malware protection.

Cloud networking is not free from challenges, however. Some of the challenges can include the following:

**Vendor lock-in.** Being locked into one cloud provider could prevent any needed movements or pivots among different cloud services. This can be mitigated using a multi-cloud method; however, this is more difficult to accomplish.

**Connectivity and uptime.** Even though cloud providers tend to promote highly accessible services, if something goes wrong, it is out of the customer's control.

**Security.** Because security is a concern with any tool, organizations should first make sure an acceptable amount of network security services are offered by the vendor they choose.

## Cloud networking vs. cloud computing

Cloud networking and cloud computing are two similar concepts that can be easily confused. Cloud computing is a general term that involves delivering hosted services over the internet. These services are divided into three categories: IaaS, PaaS and SaaS. Cloud computing involves hosting in a cloud service provider's data centers rather than in traditional in-house or colocated data centers. Cloud networking is more specific, however, as it focuses on hosting an organization's networking resources in the cloud.

Cloud networking and cloud computing have a natural overlap. As an example, some functions contained in network appliances in a legacy data center can be embedded in a cloud computing environment, as with load balancers, or delivered as a SaaS-style cloud service, as with secure web gateways or firewalls.

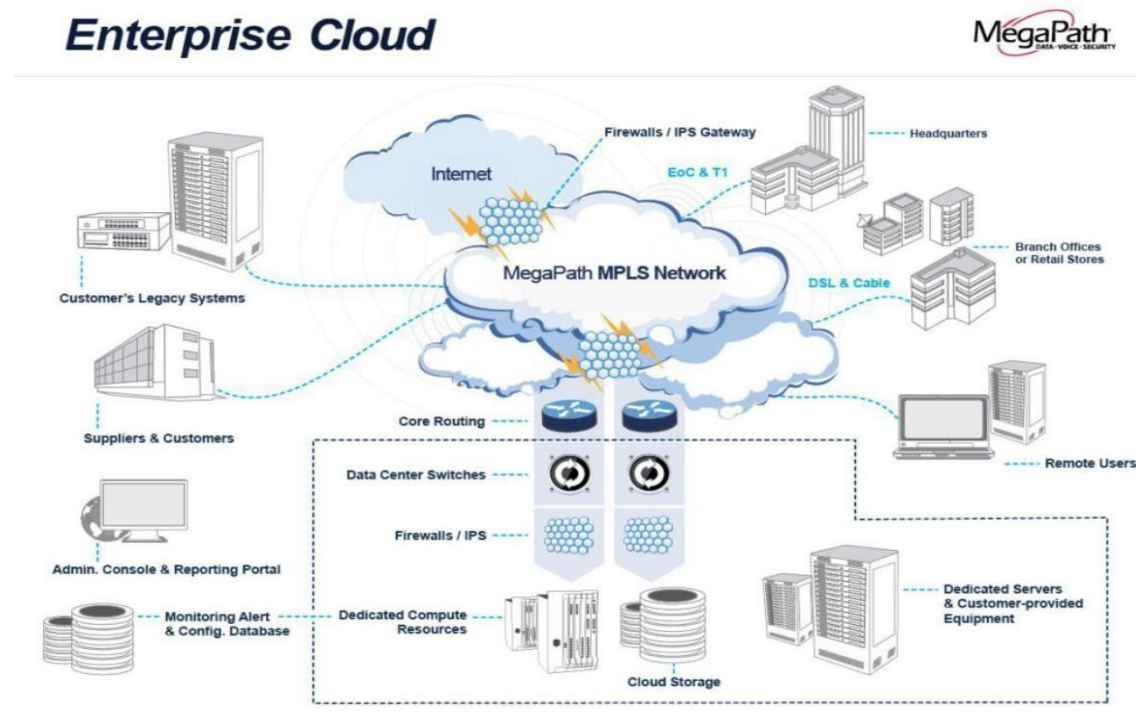
## History of cloud networking

The history of cloud networking follows the history of cloud computing closely. Over time, corporate data center resources evolved and moved from on-premises mainframes to the cloud. The added benefits of hosting data centers in the cloud includes security, uptime, scalability and the freedom of not having to worry about on-premises deployments. Because of these benefits, more organizations began moving to the cloud. For example, software-

defined networks could now be hosted in the cloud. With this movement, the option of hosting just networking systems in the cloud arose. Product offerings released by vendors such as IBM and Juniper offered software to help build agile network infrastructures. Juniper Contrail Enterprise Multicloud, for example, delivers software-defined networking cloud options, as well as cloud service automation.

#### 11. Explain Seven-step model of migration into a Cloud.

-Migrating an application to the cloud is not an easy task. It is important to strictly adhere to the seven step model to ensure that the process is robust and error free. The seven quick stages of migration into the cloud are outlined below.



#### Migration Into The Cloud Tips

##### 1. Assessment

Migration starts with an assessment of the issues relating to migration, at the application, code, design, and architecture levels. Moreover, assessments are also required for tools being used, functionality, test cases, and configuration of the application. The proof of concepts for migration and the corresponding pricing details will help to assess these issues properly.

##### 2. Isolate

The second step is the isolation of all the environmental and systemic dependencies of the enterprise application within the captive data center. These include library, application, and architectural dependencies. This step results in a better understanding of the complexity of the migration.

##### 3. Map

A mapping construct is generated to separate the components that should reside in the captive data center from the ones that will go into the cloud.

##### 4. Re-architect

It is likely that a substantial part of the application has to be re-architected and implemented in the cloud. This can affect the functionalities of the application and some of these might be lost. It is possible to approximate lost functionality using cloud runtime support API.

#### 5. Augment

The features of cloud computing service are used to augment the application.

#### 6. Test

Once the augmentation is done, the application needs to be validated and tested. This is to be done using a test suite for the applications on the cloud. New test cases due to augmentation and proof-of-concepts are also tested at this stage.

#### 7. Optimise

The test results from the last step can be mixed and so require iteration and optimization. It may take several optimizing iterations for the migration to be successful. It is best to iterate through this seven step model as this will ensure the migration to be robust and comprehensive.