

Unit 1

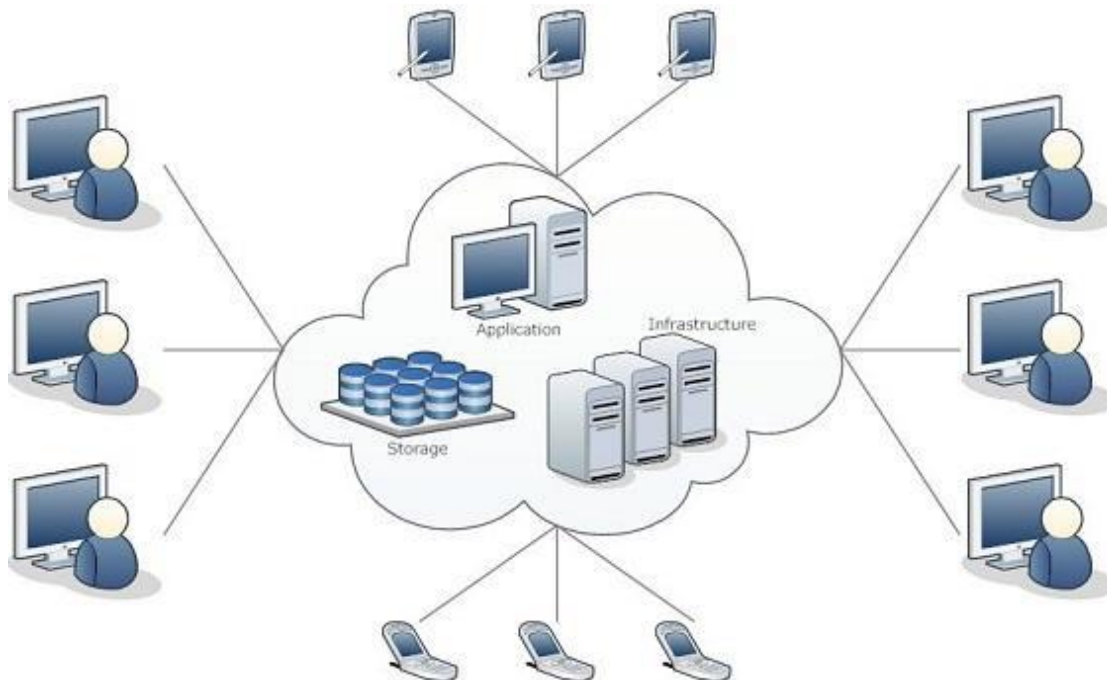
Introduction to Cloud Computing [6hrs]

Cloud

The term Cloud refers to a Network or Internet. In other words, we can say that Cloud is something, which is present at remote location. Cloud can provide services over network, i.e., on public networks or on private networks, i.e., WAN, LAN or VPN. Applications such as e-mail, web conferencing, customer relationship management (CRM), all run in cloud.

Cloud Computing

Cloud Computing refers to manipulating, configuring, and accessing the applications online. It offers online data storage, infrastructure and application.



We need not to install a piece of software on our local PC and this is how the cloud computing overcomes **platform dependency issues**. Hence, the Cloud Computing is making our business application **mobile** and **collaborative**.

Cloud computing is an abstraction based on the notion of pooling physical resources and presenting them as a virtual resource. It is a new model for provisioning resources, for staging applications, and for platform-independent user access to services. Clouds can come in many different types, and the services and applications that run on clouds may or may not be delivered by a cloud service provider. These different types and levels of cloud services mean that it is important to define what type of cloud computing system you are working with.

To help clarify how cloud computing has changed the nature of commercial system deployment, consider these three examples:

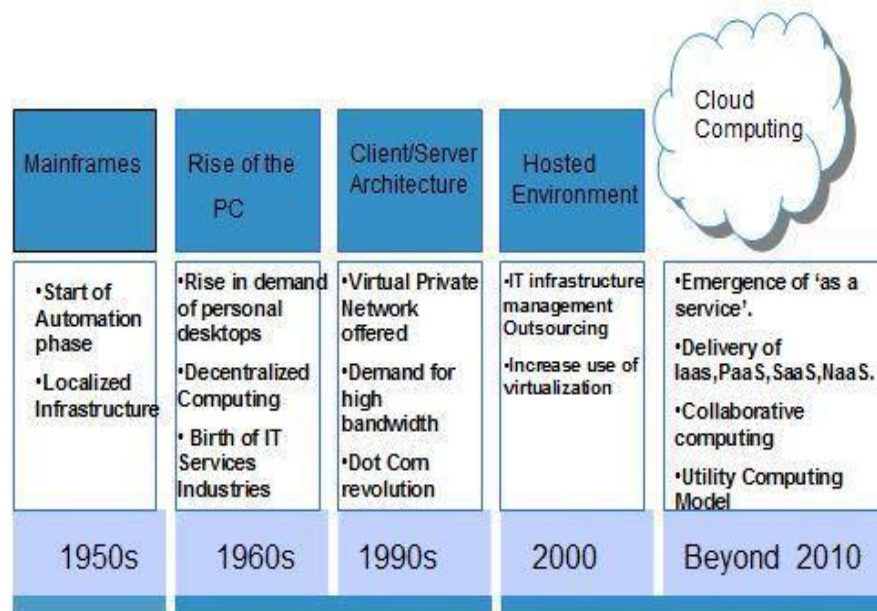
- ⇒ Google: In the last decade, Google has built a worldwide network of datacenters to service its search engine. In doing so Google has captured a substantial portion of the world's advertising revenue. That revenue has enabled Google to offer free software to users based on that infrastructure and has changed the market for user-facing software. This is the classic Software as a Service.
- ⇒ Azure Platform: By contrast, Microsoft is creating the Azure Platform. It enables .NET Framework applications to run over the Internet as an alternate platform for Microsoft developer software running on desktops.
- ⇒ Amazon Web Services: One of the most successful cloud-based businesses is Amazon Web Services, which is an Infrastructure as a Service offering that lets you rent virtual computers on Amazon's own infrastructure.

There are certain services and models working behind the scene making the cloud computing feasible and accessible to end users. Following are the working models for cloud computing:

- ⇒ Deployment Models
- ⇒ Service Models

HISTORY OF CLOUD COMPUTING

- ⇒ The concept of **Cloud Computing** came into existence in 1950 with implementation of mainframe computers, accessible via **thin/static clients**. Since then, cloud computing has been evolved from static clients to dynamic ones from software to services. The following diagram explains the evolution of cloud computing:



CHARACTERISTICS OF CLOUD COMPUTING

There are four key characteristics of cloud computing. They are shown in the following diagram:

On demand self-service

Cloud Computing allows the users to use web services and resources on demand. One can logon to a website at any time and use them.

Broad network access

Since Cloud Computing is completely web based, it can be accessed from anywhere and at any time.

Resource pooling

Cloud Computing allows multiple tenants to share a pool of resources. One can share single physical instance of hardware, database and basic infrastructure.

Rapid elasticity

It is very easy to scale up or down the resources at any time. Resources used by the customers or currently assigned to customers are automatically monitored and resources. It makes it possible

Measured service

In this service cloud provider controls and monitors all the aspects of cloud service. Resource optimization, billing, and capacity planning etc. depend on it.

CLOUD TYPES AND ITS SERVICES

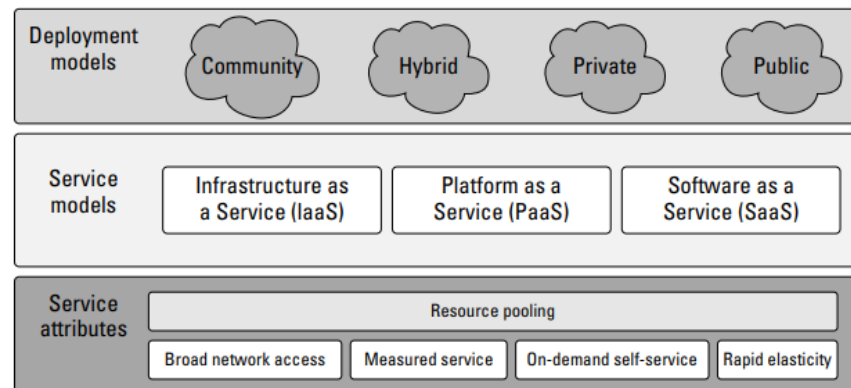
Most people separate cloud computing into two distinct sets of models:

1. Deployment models: This refers to the location and management of the cloud's infrastructure.
2. Service models: This consists of the particular types of services that you can access on a cloud computing platform.

The NIST model

The U.S. National Institute of Standards and Technology (NIST) has a set of working definitions that separate cloud computing into service models and deployment models. Those models and their relationship to essential characteristics of cloud computing are shown in Figure.

The NIST cloud computing definitions



The NIST model originally did not require a cloud to use virtualization to pool resources, nor did it absolutely require that a cloud support multi-tenancy in the earliest definitions of cloud computing. Multi-tenancy is the sharing of resources among two or more clients. The latest version of the NIST definition does require that cloud computing networks use virtualization and support multi-tenancy.

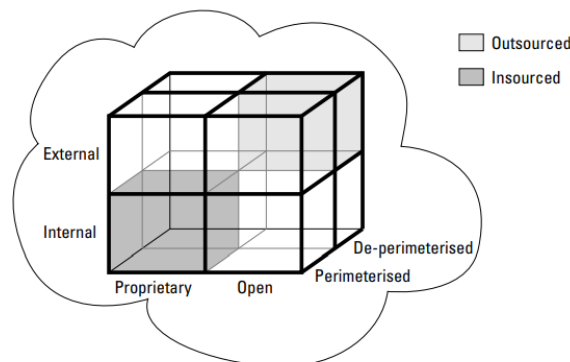
The Cloud Cube Model

The Open Group maintains an association called the Jericho whose main focus is how to protect cloud networks. The group has an interesting model that attempts to categorize a cloud network based on four dimensional factors.

The four dimensions of the Cloud Cube Model are shown in Figure and listed here:

- ⇒ Physical location of the data: Internal (I) / External (E) determines your organization's boundaries.
- ⇒ Ownership: Proprietary (P) / Open (O) is a measure of not only the technology ownership, but of interoperability, ease of data transfer, and degree of vendor application lock-in.
- ⇒ Security boundary: Perimeterised (Per) / De-perimeterised (D-p) is a measure of whether the operation is inside or outside the security boundary or network firewall.
- ⇒ Sourcing: Insourced or Outsourced means whether the service is provided by the customer or the service provider.

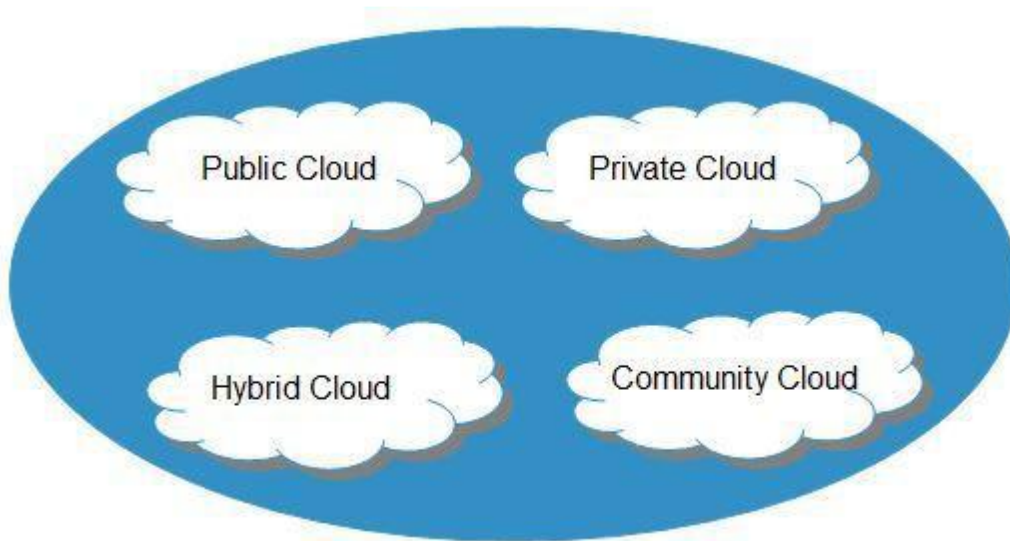
The Jericho Forum's Cloud Cube Model



The Jericho Forum has designed the Cloud Cube Model to help select cloud formations for security cooperation. Their fascinating new cloud model helps IT managers and business tycoons assess the benefits of cloud computing.

DEPLOYMENT MODELS

Deployment models define the type of access to the cloud, i.e., how the cloud is located? Cloud can have any of the four types of access: Public, Private, Hybrid and Community.



Public cloud

The **Public Cloud** allows systems and services to be easily accessible to the general public. Public cloud may be less secure because of its openness, e.g., e-mail.

Private cloud

The **Private Cloud** allows systems and services to be accessible within an organization. It offers increased security because of its private nature.

Community cloud

The **Community Cloud** allows systems and services to be accessible by group of organizations.

Hybrid cloud

The **Hybrid Cloud** is mixture of public and private cloud. However, the critical activities are performed using private cloud while the non-critical activities are performed using public cloud.

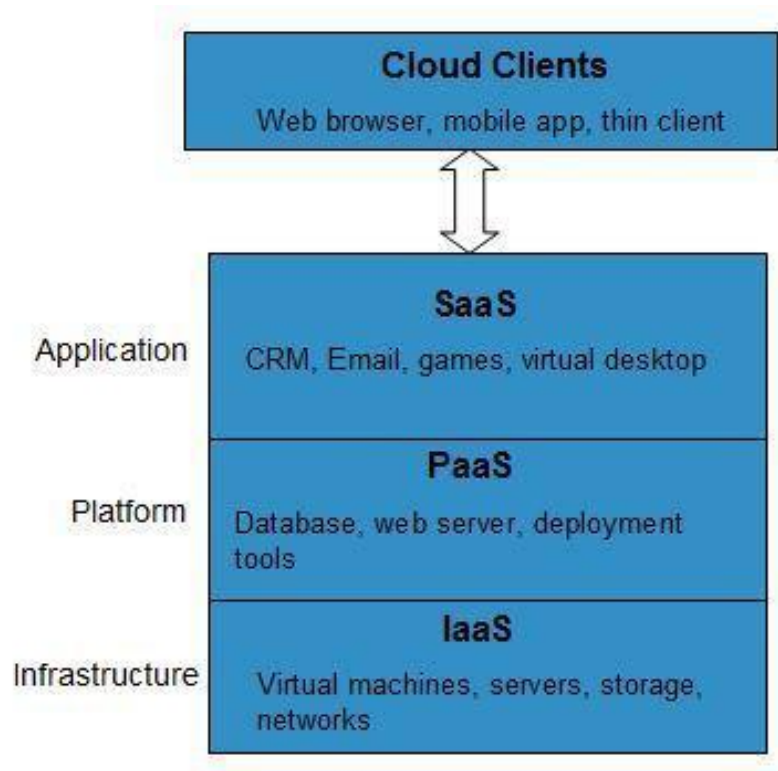
SERVICE MODELS

Service Models are the reference models on which the Cloud Computing is based. These can be categorized into three basic service models as listed below:

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

There are many other service models all of which can take the form like **XaaS**, i.e., **Anything as a Service**. This can be **Network as a Service**, **Business as a Service**, **Identity as a Service**, **Database as a Service**

The **Infrastructure as a Service (IaaS)** is the most basic level of service. Each of the service models make use of the underlying service model, i.e., each inherits the security and management mechanism from the underlying model, as shown in the following diagram:



Infrastructure as a service (iaas)

IaaS provides access to fundamental resources such as physical machines, virtual machines, virtual storage, etc.

Platform as a service (paas)

PaaS provides the runtime environment for applications, development & deployment tools, etc.

Software as a service (saas)

SaaS model allows to use software applications as a service to end users.

SaaS examples: BigCommerce, Google Apps, Salesforce, Dropbox, MailChimp, ZenDesk, DocuSign, Slack, Hubspot.

PaaS examples: AWS Elastic Beanstalk, Heroku, Windows Azure (mostly used as PaaS), Force.com, OpenShift, Apache Stratos, Magento Commerce Cloud.

IaaS examples: AWS EC2, Rackspace, Google Compute Engine (GCE), Digital Ocean, Magento 1 Enterprise Edition*.

ADVANTAGES OF CLOUD COMPUTING

Cloud computing is an emerging technology that almost every company switched to from on-premise technologies. Whether it is public, private or hybrid, Cloud computing has become an essential factor for the companies to rise up to the competition. Let us find out why Cloud is so much preferred over the on-premise technologies.

- **Cost efficiency** – The biggest reason behind shifting to cloud computing is that it takes considerably lesser cost than an on-premise technology. Now the companies need not store the data in disks anymore as the Cloud offers enormous storage space, saving money and resources of the companies.
- **High Speed** – Cloud computing lets you deploy the service quickly in fewer clicks. This quick deployment lets you get the resources required for your system within fewer minutes.
- **Excellent accessibility** – Storing the information in cloud allows you to access it anywhere and anytime regardless of the machine making it highly accessible and flexible technology of present times.
- **Back-up and restore data** – Once the data is stored in Cloud, it is easier to get the back-up and recovery of that, which is quite a time taking process on-premise.
- **Manageability** – Cloud computing eliminates the need for IT infrastructure updates and maintenance since the service provider ensures timely, guaranteed and seamless delivery of your services and also takes care of all the maintenance and management of your IT services according to the service level agreement (SLA).
- **Sporadic Batch processing** – Cloud computing lets you add or subtract resources and services according to your needs. So, if the workload is not 24/7, you need not worry about the resources and services getting wasted and you won't end up stuck with unused services.
- **Strategic edge** – Cloud computing provides your company a competitive edge over the competitors when it comes to accessing the latest and mission critical applications whenever you need them without having to invest your time and money on installations. It lets you focus on keeping up with the business competition by offering access to most trending and in demand applications and doing all the manual work of installing and maintaining the applications for you.

DISADVANTAGES OF CLOUD COMPUTING

Every technology has positive and negative aspects that are highly important to discuss before implementing it. Aforementioned points highlight the benefits of using cloud technology and following discussion will outline the potential cons of Cloud Computing.

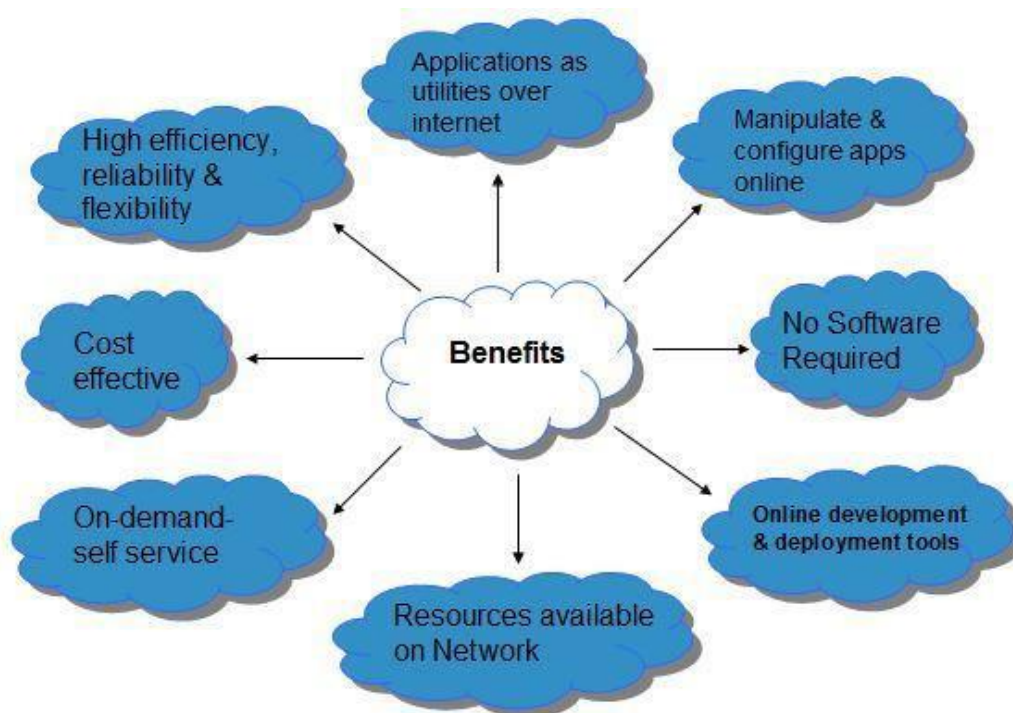
- **Vulnerability to attacks** – Storing data in cloud may pose serious challenge of information theft since in cloud every data of your company is online. Security breach is something that even the best organizations have suffered from and it's a potential risk in cloud as well. Though advanced security measures are deployed on cloud, still storing a confidential data in cloud can be a risky affair.
- **Network connectivity dependency** – Cloud computing is entirely dependent on the internet. This direct tie up with internet means that you need a reliable and consistent internet service as well as a good connection speed and bandwidth for your business to reap the benefits of cloud computing.
- **Downtime** – Downtime is considered as one of the biggest potential downside of using Cloud computing. Your cloud providers may sometimes face technical outages which can happen due to various reasons such as loss of power, low internet connectivity, data centres going out of service for maintenance etc. This can lead to a temporary downtime in your cloud services.
- **Vendor lock in** – When in need to migrate from one cloud platform to another, your company might face some serious challenges because of the differences between vendor platforms. Hosting and running the applications of your current cloud platform on some other platform may cause support issues, configuration complexities and additional expenses. Your data might also be left vulnerable to security attacks due to compromises that might have been made during migrations.
- **Limited control** – Cloud customers may face limited control over their deployments. The cloud services run on remote servers which are completely owned and managed by the service providers, which makes it hard for the companies to have the level of control that they would want over their back-end infrastructure.

BENEFITS OF CLOUD COMPUTING

Cloud Computing has numerous advantages. Some of them are listed below:

- ⇒ One can access applications as utilities, over the Internet.
- ⇒ Manipulate and configure the application online at any time.

- ⇒ It does not require to install a specific piece of software to access or manipulate cloud application.
- ⇒ Cloud Computing offers online development and deployment tools, programming runtime environment through **Platform as a Service model**.
- ⇒ Cloud resources are available over the network in a manner that provides platform independent access to any type of clients.
- ⇒ Cloud Computing offers **on-demand self-service**. The resources can be used without interaction with cloud service provider.
- ⇒ Cloud Computing is highly cost effective because it operates at higher efficiencies with greater utilization. It just requires an Internet connection.
- ⇒ Cloud Computing offers load balancing that makes it more reliable.



CLOUD COMPUTING CHALLENGES

Cloud computing, an emergent technology, has placed many challenges in different aspects of data and information handling. Some of these are shown in the following diagram:



Security and Privacy

Security and Privacy of information is the biggest challenge to cloud computing. Security and privacy issues can be overcome by employing encryption, security hardware and security applications.

Portability

This is another challenge to cloud computing those applications should easily be migrated from one cloud provider to another. There must not be vendor lock-in. However, it is not yet made possible because each of the cloud provider uses different standard languages for their platforms.

Interoperability

It means the application on one platform should be able to incorporate services from the other platforms. It is made possible via web services, but developing such web services is very complex.

Computing Performance

Data intensive applications on cloud requires high network bandwidth, which results in high cost. Low bandwidth does not meet the desired computing performance of cloud application.

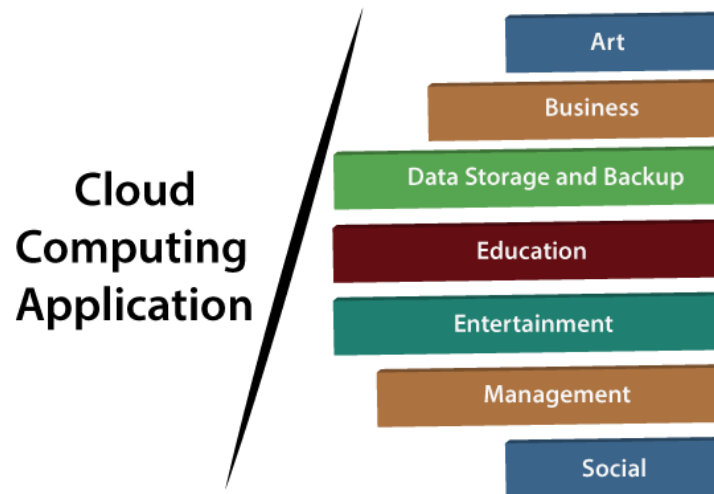
Reliability and Availability

It is necessary for cloud systems to be reliable and robust because most of the businesses are now becoming dependent on services provided by third-party.

CLOUD COMPUTING APPLICATIONS

Cloud service providers provide various applications in the field of art, business, data storage and backup services, education, entertainment, management, social networking, etc.

The most widely used cloud computing applications are given below -



1. Art Applications

Cloud computing offers various art applications for quickly and easily design **attractive cards, booklets, and images**. Some most commonly used cloud art applications are given below:

i Moo

Moo is one of the best cloud art applications. It is used for designing and printing business cards, postcards, and mini cards.

ii. Vistaprint

Vistaprint allows us to easily design various printed marketing products such as business cards, Postcards, Booklets, and wedding invitations cards.

iii. Adobe Creative Cloud

Adobe creative cloud is made for designers, artists, filmmakers, and other creative professionals. It is a suite of apps which includes PhotoShop image editing programming, Illustrator, InDesign, TypeKit, Dreamweaver, XD, and Audition.

2. Business Applications

Business applications are based on cloud service providers. Today, every organization requires the cloud business application to grow their business. It also ensures that business applications are 24*7 available to users.

There are the following business applications of cloud computing -

i. MailChimp

MailChimp is an **email publishing platform** which provides various options to **design, send, and save** templates for emails.

iii. Salesforce

Salesforce platform provides tools for sales, service, marketing, e-commerce, and more. It also provides a cloud development platform.

iv. Chatter

Chatter helps us to **share important information** about the organization in real time.

v. Bitrix24

Bitrix24 is a **collaboration** platform which provides communication, management, and social collaboration tools.

vi. Paypal

Paypal offers the simplest and easiest **online payment** mode using a secure internet account. Paypal accepts the payment through debit cards, credit cards, and also from Paypal account holders.

vii. Slack

Slack stands for **Searchable Log of all Conversation and Knowledge**. It provides a **user-friendly** interface that helps us to create public and private channels for communication.

viii. Quickbooks

Quickbooks works on the terminology "**Run Enterprise anytime, anywhere, on any device.**" It provides online accounting solutions for the business. It allows more than 20 users to work simultaneously on the same system.

3. Data Storage and Backup Applications

Cloud computing allows us to store information (data, files, images, audios, and videos) on the cloud and access this information using an internet connection. As the cloud provider is responsible for providing security, so they offer various backup recovery application for retrieving the lost data.

A list of data storage and backup applications in the cloud are given below -

i. Box.com

Box provides an online environment for **secure content management, workflow, and collaboration**. It allows us to store different files such as Excel, Word, PDF, and images on the cloud. The main advantage of using box is that it provides drag & drop service for files and easily integrates with Office 365, G Suite, Salesforce, and more than 1400 tools.

ii. Mozy

Mozy provides powerful **online backup solutions** for our personal and business data. It schedules automatically back up for each day at a specific time.

iii. Joukuu

Joukuu provides the simplest way to **share and track cloud-based backup files**. Many users use joukuu to search files, folders, and collaborate on documents.

iv. Google G Suite

Google G Suite is one of the best **cloud storage and backup** application. It includes Google Calendar, Docs, Forms, Google+, Hangouts, as well as cloud storage and tools for managing cloud apps. The most popular app in the Google G Suite is Gmail. Gmail offers free email services to users.

4. Education Applications

Cloud computing in the education sector becomes very popular. It offers various **online distance learning platforms** and **student information portals** to the students. The advantage of using cloud in the field of education is that it offers strong virtual classroom environments, Ease of accessibility, secure data storage, scalability, greater reach for the students, and minimal hardware requirements for the applications.

There are the following education applications offered by the cloud -

i. Google Apps for Education

Google Apps for Education is the most widely used platform for free web-based email, calendar, documents, and collaborative study.

ii. Chromebooks for Education

Chromebook for Education is one of the most important Google's projects. It is designed for the purpose that it enhances education innovation.

iii. Tablets with Google Play for Education

It allows educators to quickly implement the latest technology solutions into the classroom and make it available to their students.

iv. AWS in Education

AWS cloud provides an education-friendly environment to universities, community colleges, and schools.

5. Entertainment Applications

Entertainment industries use a **multi-cloud strategy** to interact with the target audience. Cloud computing offers various entertainment applications such as online games and video conferencing.

i. Online games

Today, cloud gaming becomes one of the most important entertainment media. It offers various online games that run remotely from the cloud. The best cloud gaming services are Shaow, GeForce Now, Vortex, Project xCloud, and PlayStation Now.

ii. Video Conferencing Apps

Video conferencing apps provides a simple and instant connected experience. It allows us to communicate with our business partners, friends, and relatives using a cloud-based video conferencing. The benefits of using video conferencing are that it reduces cost, increases efficiency, and removes interoperability.

6. Management Applications

Cloud computing offers various cloud management tools which help admins to manage all types of cloud activities, such as resource deployment, data integration, and disaster recovery. These management tools also provide administrative control over the platforms, applications, and infrastructure.

Some important management applications are -

i. Toggl

Toggl helps users to track allocated time period for a particular project.

ii. Evernote

Evernote allows you to sync and save your recorded notes, typed notes, and other notes in one convenient place. It is available for both free as well as a paid version.

It uses platforms like Windows, macOS, Android, iOS, Browser, and Unix.

iii. Outright

Outright is used by management users for the purpose of accounts. It helps to track income, expenses, profits, and losses in real-time environment.

iv. GoToMeeting

GoToMeeting provides **Video Conferencing** and **online meeting apps**, which allows you to start a meeting with your business partners from anytime, anywhere using mobile phones or tablets. Using GoToMeeting app, you can perform the tasks related to the management such as join meetings in seconds, view presentations on the shared screen, get alerts for upcoming meetings, etc.

7. Social Applications

Social cloud applications allow a large number of users to connect with each other using social networking applications such as **Facebook, Twitter, LinkedIn**, etc.

There are the following cloud based social applications -

i. Facebook

Facebook is a **social networking website** which allows active users to share files, photos, videos, status, more to their friends, relatives, and business partners using the cloud storage system. On Facebook, we will always get notifications when our friends like and comment on the posts.

ii. Twitter

Twitter is a **social networking** site. It is a **microblogging** system. It allows users to follow high profile celebrities, friends, relatives, and receive news. It sends and receives short posts called tweets.

iii. Yammer

Yammer is the **best team collaboration** tool that allows a team of employees to chat, share images, documents, and videos.

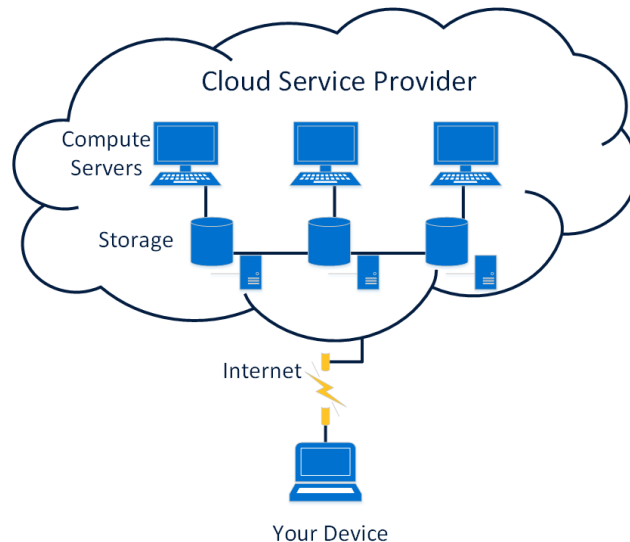
iv. LinkedIn

LinkedIn is a **social network** for students, freshers, and professionals.

CLOUD STORAGE

Cloud storage is the process of storing digital data in an online space that spans multiple servers and locations, and it is usually maintained by a hosting company.

Here's a diagram representing the process:



Essentially, an individual or organization can store and access data in this online space maintained by a host service using the internet. You are likely using cloud storage already – whether it is Microsoft Office 365, Dropbox, Google Drive – or one of the other dozens of cloud storage providers. Even media sharing devices like Instagram and YouTube or webmail clients like Gmail and Hotmail fall into this category. Each of these services stores data – your data – on the cloud.

BENEFITS OF CLOUD STORAGE

Data Retrieval: You can retrieve data from virtually anywhere. Companies can now offer work-from-home and bring-your-own-device (BYOD) solutions. As the business changes, the agile nature of cloud storage makes it easy to adjust.

Collaboration: Other people can access the same data and tools, enabling teams to work together more easily. Engaging the right provider with the right tools, even version control can become a breeze.

Pay-As-You-Use: In the past, businesses had to purchase computing infrastructure – hardware, licenses, equipment – based on their expectations on business growth for the next several years. Companies tended to over-buy, fearing being underprepared, and were left with expensive equipment and storage space they didn't use. Cloud storage and virtualization allows businesses

to pay for the data they actually use. This means businesses can scale and adjust up and down as their business needs and strategy change.

Increased Capabilities: Small and medium-sized businesses of the past were only able to use the tools they could afford. Today, using a cloud storage provider means SMBs can utilize the different services the cloud provider offers for all their clients.

CHALLENGES OF CLOUD STORAGE

Attack Surface Area: This is a mathematical understanding of risk. The data stored on a local network is in one place and one place only. By distributing data to more locations, the risk of that data being subject to unauthorized access increases. More people = more risk of compromise. The cloud also uses the internet to transfer data. So, instead of data being transferred via a local area network (LAN), it uses a wide area network (WAN), which increases the risk.

Supplier Sustainability: What happens if your cloud storage provider goes bankrupt, suffers a disaster, or changes their business strategy? Teaming up with another party means aligning business goals. That isn't always easy.

Security: Many businesses store sensitive data, such as healthcare or financial records. These industries are subject to strict regulations. Putting this data in the hands of someone else can be a difficult decision to make. Understanding the safeguards cloud storage providers take and how your team will need to leverage those tools for added security is an important step in migrating your data to the cloud.

TYPES OF CLOUD STORAGE

- Public Cloud
- Private Cloud
- Hybrid Cloud

i. Public Cloud

Public cloud storage is basically compatible with unstructured data. It provides a multi-tenant storage environment. Here, the data store in multiple data centres and can access across multiple regions for continents. The cloud storage providers completely manage the public cloud storage.

ii. Private Cloud

Private cloud is mostly compatible with the customers you need to customize their control over their data. Here, the enterprise and the cloud storage providers combine the data centre to serve the customer better.

iii. Hybrid Cloud

Hybrid cloud is a combination of private and personal cloud which can modify as per the demand. It provides more flexibility to the customer and has more data deployment options.

Hybrid cloud is suitable for both small and large sector organizations. It is accessible from anywhere and can provide numerous amount of benefits to the customer.

CLOUD STORAGE INFRASTRUCTURE

Cloud storage has an infrastructure which bases on the principle of **virtualization in Cloud Computing**. Virtualization eliminates the hardware by utilizing the single hardware and making many virtual separations of it.

Its infrastructure is elastic, scalable, and multi-tenant. With the help of proper tools, the whole infrastructure can manage and information can store and retrieve easily.

With the help of ID and password, the whole content can retrieve from anywhere and at any time. In addition, there are proper security measures which authenticate the whole process of uploading and downloading.

RISKS RELATED TO CLOUD COMPUTING

Although Cloud Computing is a great innovation in the world of computing, there also exist downsides of cloud computing. Some of them are discussed below:

Security & privacy

It is the biggest concern about cloud computing. Since data management and infrastructure management in cloud is provided by third-party, it is always a risk to handover the sensitive information to such providers. Although the cloud computing vendors ensure more secure password protected accounts, any sign of security breach would result in loss of clients and businesses.

Lock-in

It is very difficult for the customers to switch from one **Cloud Service Provider (CSP)** to another. It results in dependency on a particular CSP for service.

Isolation failure

This risk involves the failure of isolation mechanism that separates storage, memory, routing between the different tenants.

Management interface compromise

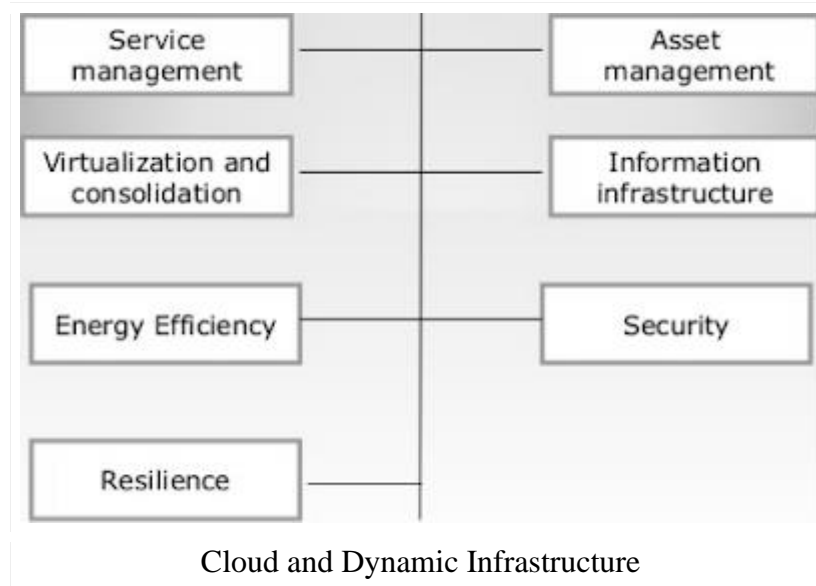
In case of public cloud provider, the customer management interfaces are accessible through the Internet.

Insecure or incomplete data deletion

It is possible that the data requested for deletion may not get deleted. It happens either because extra copies of data are stored but are not available or disk destroyed also stores data from other tenants.

CLOUD SERVICE REQUIREMENTS

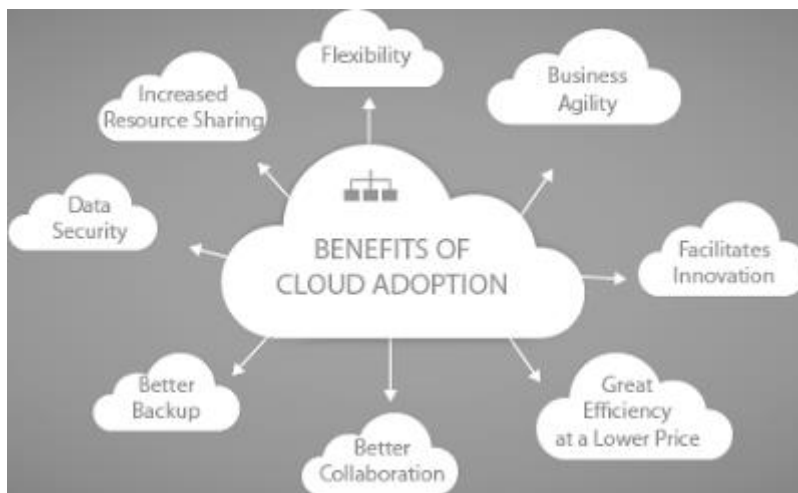
1. Efficiency / cost reduction
 2. Data security
 3. Scalability
 4. Mobility
 5. Disaster recovery
 6. Control
 7. Market reach
 8. Automatic Software Updates
- a. **Efficiency / cost reduction:** By using cloud infrastructure, you don't have to spend huge amounts of money on purchasing and maintaining equipment.
 - b. **Data security:** Cloud offers many advanced security features that guarantee that data is securely stored and handled. Cloud storage providers implement baseline protections for their platforms and the data they process, such authentication, access control, and encryption.
 - c. **Scalability:** Different companies have different IT needs -- a large enterprise of 1000+ employees won't have the same IT requirements as a start-up. Using cloud is a great solution because it enables enterprise to efficiently -- and quickly -- scale up/down according to business demands.
 - d. **Mobility:** Cloud computing allows mobile access to corporate data via smartphones and devices, which is a great way to ensure that no one is ever left out of the loop. Staff with busy schedules, or who live a long way away from the corporate office, can use this feature to keep instantly up-to-date with clients and coworkers.
 - e. **Disaster recovery:** Data loss is a major concern for all organizations, along with data security. Storing your data in the cloud guarantees that data is always available, even if your equipment like laptops or PCs, is damaged. Cloud-based services provide quick data recovery for all kinds of emergency scenarios.
 - f. **Control:** Cloud enables you complete visibility and control over your data. You can easily decide which users have what level of access to what data.
 - g. **Market reach:** Developing in the cloud enables users to get their applications to market quickly.
 - h. **Automatic Software Updates:** Cloud-based applications automatically refresh and update themselves.

CLOUD AND DYNAMIC INFRASTRUCTURE:

- a. **Service management:** This type of special facility or a functionality is provided to the cloud IT services by the cloud service providers. This facility includes visibility, automation and control to delivering the first-class IT services.
- b. **Asset-Management:** In this the assets or the property which is involved in providing the cloud services are getting managed.
- c. **Virtualization and consolidation:** Consolidation is an effort to reduce the cost of a technology by improving its operating efficiency and effectiveness. It means migrating from large number of resources to fewer one, which is done by virtualization technology.
- d. **Information Infrastructure:** It helps the business organizations to achieve the following: Information compliance, availability of resources retention and security objectives.
- e. **Energy-Efficiency:** Here the IT infrastructure or organization sustainable. It means it is not likely to damage or effect any other thing.
- f. **Security:** This cloud infrastructure is responsible for the risk management. Risk management Refers to the risks involved in the services which are being provided by the cloud-service providers.
- g. **Resilience:** This infrastructure provides the feature of resilience means the services are resilient. It means the infrastructure is safe from all sides. The IT operations will not be easily get affected.

CLOUD ADOPTION:

- “the cloud” is comprised of software and services residing and operating on the Internet instead of a local computer or on-premise network of servers. Cloud adoption is a strategy used by enterprises to improve the scalability of Internet-based database capabilities while reducing cost and risk.
- To achieve this, businesses engage in the practice of cloud computing or using remote servers hosted on the Internet to store, manage, and process critical data. While cloud computing has been available to the general public for several years, hybrid cloud computing is a relatively newer concept combining one or more cloud providers, such as Amazon Web Services, SAP HANA Cloud Platform, VMWare, or Salesforce, with a private IT infrastructure designed for a specific organization.



Who Needs Cloud Adoption?

1. **Healthcare:** Fueled by digital and social consumer behaviors and the need for secure and accessible electronic health records (EHRs), hospitals, clinics, and other medical organizations are using cloud computing for document storage, marketing, and human resources.
2. **Marketing and Advertising:** In an industry dependent on social media, as well as the quick creation and publishing of customer-relevant content, agencies are using hybrid cloud adoption strategies to deliver critical client messages to their local and worldwide audiences.
3. **Retail:** A successful e-commerce strategy requires a sound Internet strategy. With the help of cloud adoption, Internet-based retail is able to effectively market to customers and save their product data for less money.
4. **Finance:** Efficient expense management, human resources, and customer communications are three of the most important business needs of today's finance

organizations. For these reasons, financial services institutions are now placing their email platforms and marketing tools in the cloud.

5. **Education:** Internet-based education opportunities are now more popular than ever. The cloud allows universities, private institutions, and K-12 public schools to provide learning, homework, and grading systems online.