

## 1 Introduction to Cloud Computing

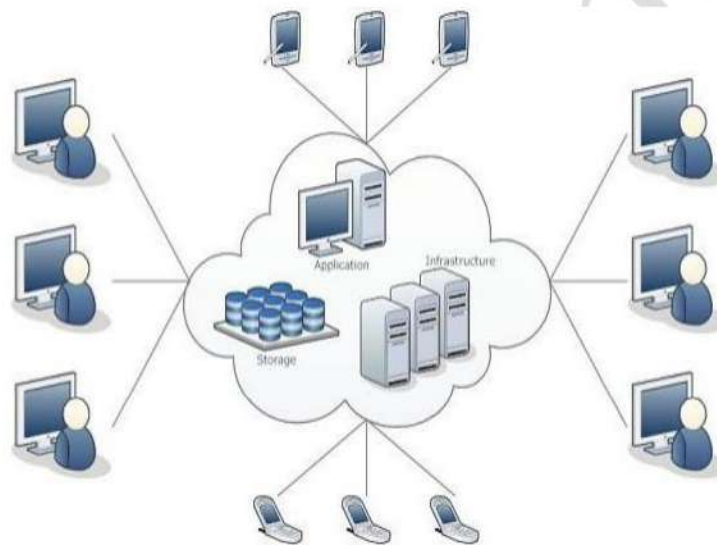
### 1.1 Cloud Computing Overview

#### ❖ What is 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.

#### ❖ What is 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 refers to the delivery of computing services over the internet, allowing users to access a wide range of resources, including servers, storage, databases, networking, software, and more, without the need to own or manage the underlying infrastructure. These services are typically provided by cloud service providers (CSPs) who maintain and manage vast data centers worldwide.

#### ❖ Definition by NIST Cloud Computing

➤ The National Institute of Standards and Technology (NIST) has a more comprehensive definition of cloud computing. It describes cloud computing as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."

- Ability / space where you store your data ,process it and can access anywhere from the world
- As a Metaphor for the internet.

#### ➤ Cloud computing is :

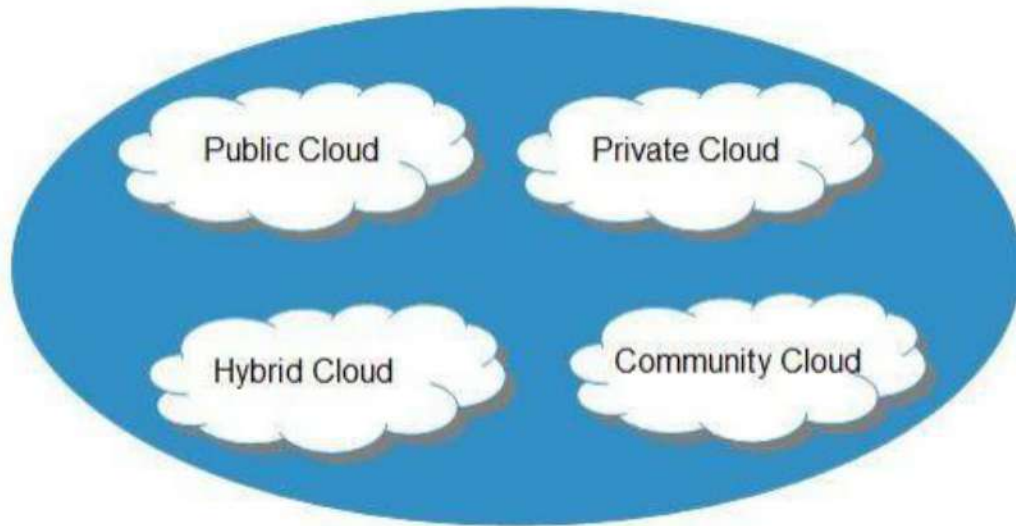
- Storing data /Applications on remote servers
- Processing Data / Applications from servers
- Accessing Data / Applications via internet

❖ **Basic Concepts**

- 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

**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:**

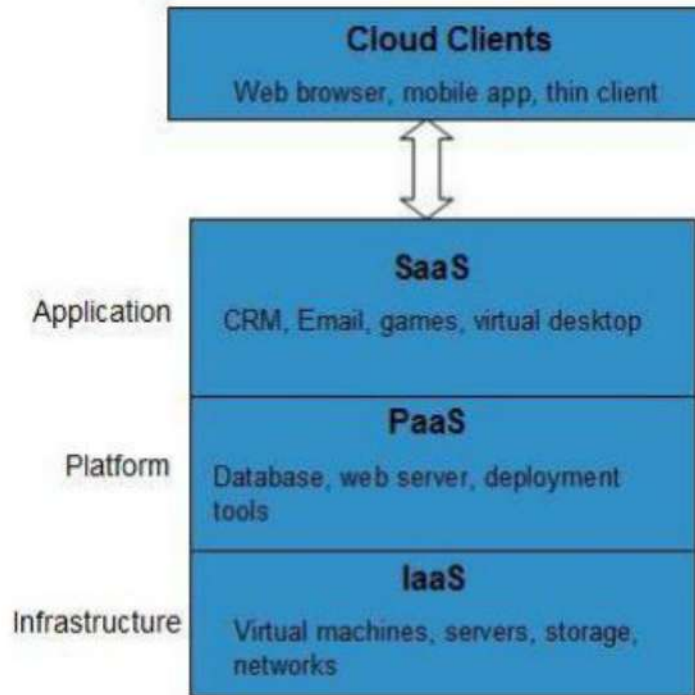
- The Hybrid Cloud is mixture of public and private cloud. However, the critical activities are performed using private cloud while the non-critical activities are performed using public cloud.

**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 or Strategy as a Service. The Infrastructure as a Service (IaaS) is the most basic level of service. Each of the service models makes 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.

### 1.2 Evolution of Cloud Computing

The evolution of cloud computing is a fascinating journey that has transformed the way we store, process, and access data and services. It has evolved over several decades, with various key milestones and developments along the way. Here is an overview of the evolution of cloud computing:

#### 1960s-1970s: Early Concepts

- The concept of cloud computing has its roots in the 1960s and 1970s, with the development of ARPANET (Advanced Research Projects Agency Network), which laid the foundation for the modern internet.
- Early experiments with time-sharing systems allowed multiple users to share access to a single computer.

### **1990s: Emergence of ASPs**

- Application Service Providers (ASPs) offered hosted applications and services to businesses over the internet. This marked an early form of cloud computing.

### **Late 1990s: Dot-com Boom**

- The dot-com boom of the late 1990s saw the rise of internet-based companies and data centers, setting the stage for the expansion of cloud infrastructure.

### **2000s: Virtualization and Web Services**

- Virtualization technologies became more prevalent, allowing multiple virtual servers to run on a single physical server.
- Amazon Web Services (AWS) was launched in 2006, introducing Infrastructure as a Service (IaaS) and paving the way for cloud computing's rapid growth.

### **Late 2000s: Expansion of Cloud Services**

- Microsoft Azure, Google Cloud Platform, and other major cloud providers entered the market, expanding the range of cloud services available.
- Platform as a Service (PaaS) and Software as a Service (SaaS) offerings became popular.

### **2010s: Cloud Dominance**

- The 2010s marked the era of cloud dominance, with cloud computing becoming the standard for businesses and individuals.
- The term "cloud-first" emerged, emphasizing the preference for cloud solutions over on-premises alternatives.
- Hybrid and multi-cloud strategies gained popularity, allowing organizations to leverage multiple cloud providers and their services.

### **2015-2019: Serverless and Containerization**

- Serverless computing and containerization technologies, such as Docker and Kubernetes, gained prominence. Serverless computing allows developers to focus on writing code without managing the underlying infrastructure.

### **2020s: Edge Computing and AI**

- The 2020s brought the integration of edge computing with the cloud, enabling data processing closer to the source, improving latency for real-time applications.
- Cloud providers began offering specialized services for artificial intelligence and machine learning.

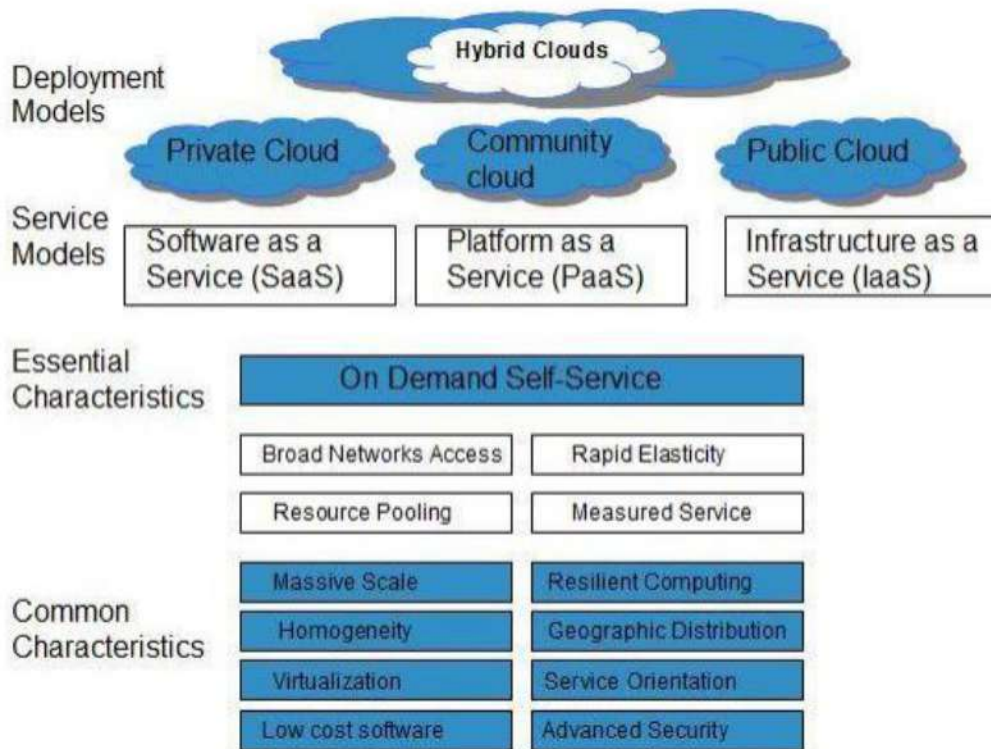
### **Ongoing Trends: Sustainability and Quantum Computing**

- Sustainability and energy efficiency have become important considerations in data center operations, with cloud providers increasingly adopting green practices.
- Quantum computing research is ongoing, and cloud providers are exploring quantum services for the future.

The evolution of cloud computing has been characterized by continuous innovation, increased accessibility, and a growing range of services. It has become an integral part of the modern technology landscape, supporting businesses, individuals, and a wide array of applications, from basic data storage to advanced AI and machine learning capabilities. As technology continues to evolve, cloud computing is expected to play a pivotal role in shaping the future of digital services and data management.

### 1.3 Characteristics of Cloud Computing

- According to the NIST, all true cloud environments have five key characteristics:



#### On-demand self-service:

This means that cloud customers can sign up for, pay for and start using cloud resources very quickly on their own without help from a sales agent.

**Broad network access:** Customers access cloud services via the Internet.

**Resource pooling:** Many different customers (individuals, organizations or different departments within an organization) all use the same servers, storage or other computing resources.

**Rapid elasticity or expansion:** Cloud customers can easily scale their use of resources up or down as their needs change.

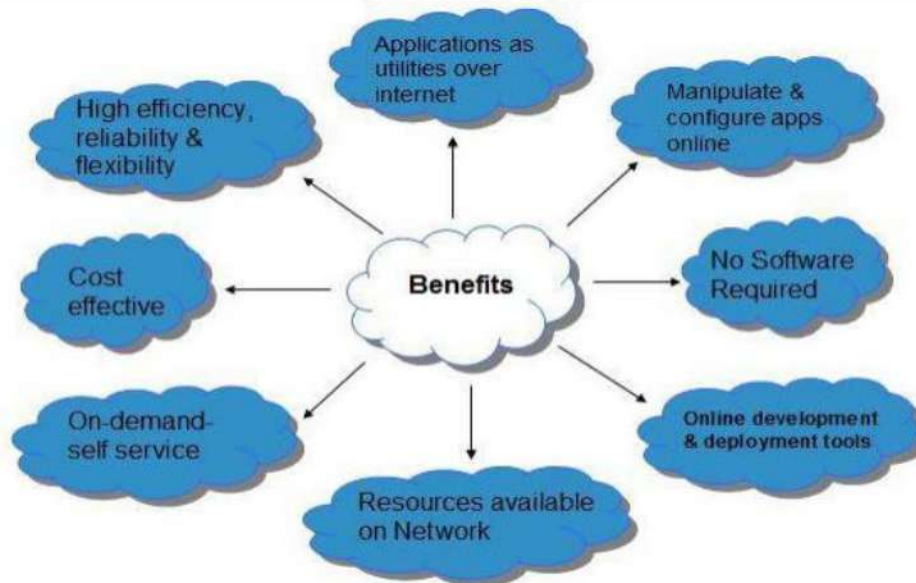
**Measured service:** Customers pay for the amount of resources they use in a given period of time rather than paying for hardware or software upfront. (Note that in a private cloud, this measured service usually involves some form of charge backs where IT keeps track of how many resources different departments within an organization are using.)

### 1.4 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 installing a specific piece of software to access or manipulating 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



### 1.5 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.

## 1.6 Limitations / Disadvantages of Cloud Computing

- **Down time:**
  - Since cloud computing systems are internet-based, service outages are always an unfortunate possibility and can occur for any reason.
  - **Best Practices for minimizing planned downtime in a cloud environment:**
    - Design services with high availability and disaster recovery in mind. Leverage the multiavailability zones provided by cloud vendors in your infrastructure.
    - If your services have a low tolerance for failure, consider multi-region deployments with automated failover to ensure the best business continuity possible.
    - Define and implement a disaster recovery plan in line with your business objectives that provide the lowest possible recovery time (RTO) and recovery point objectives (RPO).
    - Consider implementing dedicated connectivity such as AWS Direct Connect, Azure Express Route, or Google Cloud's Dedicated Interconnect or Partner Interconnect. These services provide a dedicated network connection between you and the cloud service point of presence. This can reduce exposure to the risk of business interruption from the public internet.
- **Security and Privacy:**
  - Code Space and the hacking of their AWS EC2 console, which led to data deletion and the eventual shutdown of the company. Their dependence on remote cloudbased infrastructure meant taking on the risks of outsourcing everything.
  - **Best practices for minimizing security and privacy risks:**
    - Understand the shared responsibility model of your cloud provider.
    - Implement security at every level of your deployment.
    - Know who is supposed to have access to each resource and service and limit access to least privilege.
    - Make sure your team's skills are up to the task: Solid security skills for your cloud teams are one of the best ways to mitigate security and privacy concerns in the cloud.
    - Take a risk-based approach to securing assets used in the cloud Extend security to the device.
    - Implement multi-factor authentication for all accounts accessing sensitive data or systems.
- **Vulnerability to Attack:**
  - Even the best teams suffer severe attacks and security breaches from time to time.
  - Best practices to help you reduce cloud attacks:
    - Make security a core aspect of all IT operations.
    - Keep ALL your teams up to date with cloud security best practices.
    - Ensure security policies and procedures are regularly checked and reviewed.
    - Proactively classify information and apply access control.
    - Use cloud services such as AWS Inspector, AWS CloudWatch, AWS CloudTrail, and AWS Config to automate compliance controls.
- **Prevent data ex-filtration.**
  - Integrate prevention and response strategies into security operations.
  - Discover rogue projects with audits.
  - Remove password access from accounts that do not need to log in to services.
  - Review and rotate access keys and access credentials.
  - Follow security blogs and announcements to be aware of known attacks.
  - Apply security best practices for any open source software that you are using.
- **Limited control and flexibility:**
  - Since the cloud infrastructure is entirely owned, managed and monitored by the service provider, it transfers minimal control over to the customer. To varying degrees (depending on the particular service), cloud users may find they have less control over the function and execution of services within a cloud-hosted infrastructure. A cloud provider's end-user license agreement (EULA) and management policies might impose limits on what customers can do with their deployments.

Customers retain control of their applications, data, and services, but may not have the same level of control over their backend infrastructure.

➤ Best practices for maintaining control and flexibility:

- Consider using a cloud provider partner to help with implementing, running, and supporting cloud services.
- Understanding your responsibilities and the responsibilities of the cloud vendor in the shared responsibility model will reduce the chance of omission or error.
- Make time to understand your cloud service provider's basic level of support. Will this service level meet your support requirements? Most cloud providers offer additional support tiers over and above the basic support for an additional cost.
- Make sure you understand the service level agreement (SLA) concerning the infrastructure and services that you're going to use and how that will impact your agreements with your customers.

• **Vendor Lock-In:**

➤ Organizations may find it difficult to migrate their services from one vendor to another. Differences between vendor platforms may create difficulties in migrating from one cloud platform to another, which could equate to additional costs and configuration complexities.

➤ Best practices to decrease dependency:

- Design with cloud architecture best practices in mind. All cloud services provide the opportunity to improve availability and performance, decouple layers, and reduce performance bottlenecks. If you have built your services using cloud architecture best practices, you are less likely to have issues porting from one cloud platform to another. Properly understanding what your vendors are selling can help avoid lock-in challenges. Employing a multi-cloud strategy is another way to avoid vendor lock-in.
- While this may add both development and operational complexity to your deployments, it doesn't have to be a deal breaker. Training can help prepare teams to architect and select best-fit services and technologies.
- Build in flexibility as a matter of strategy when designing applications to ensure portability now and in the future.

• **Costs Savings:**

➤ Adopting cloud solutions on a small scale and for short-term projects can be perceived as being expensive.

➤ Best practices to reduce costs:

- Try not to over-provision, instead of looking into using auto-scaling services
- Scale DOWN as well as UP
- Pre-pay if you have a known minimum usage
- Stop your instances when they are not being used
- Create alerts to track cloud spending

### 1.7 Challenges of Cloud Computing

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:

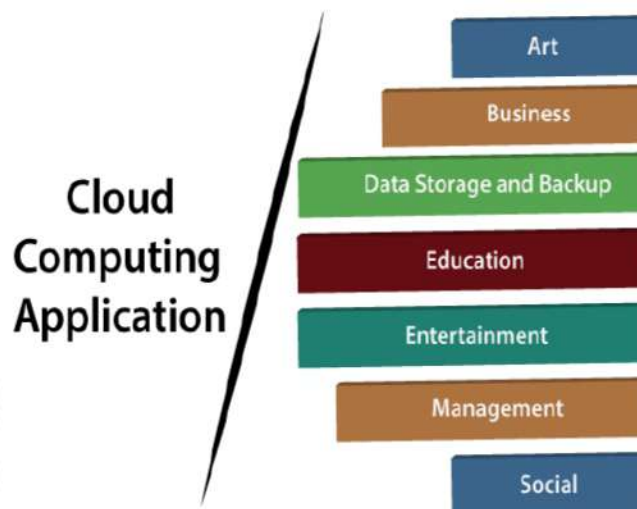




- **Security and Privacy**
  - Security and Privacy of information is the biggest challenge to cloud computing. Security and privacy issues can be overcome by employing encryption, security hardware and security applications.
- **Portability**
  - This is another challenge to cloud computing those applications 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 require 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.

### 1.8 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:-



#### 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:
  - **Moo**

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

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

- **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.

### **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:
  - MailChimp: MailChimp is an email publishing platform which provides various options to design, send, and save templates for emails.
  - Salesforce  
Salesforce platform provides tools for sales, service, marketing, e-commerce, and more. It also provides a cloud development platform.
  - Chatter  
Chatter helps us to share important information about the organization in real time.
  - Bitrix24  
Bitrix24 is a collaboration platform which provides communication, management, and social collaboration tools.
  - 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.
  - 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.
  - 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.

### **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 -
  - 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.
  - 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.

- 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.

- 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.

### **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 -

- Google Apps for Education

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

- 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.

- 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.

- AWS in Education

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

### **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.

- 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.

- 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.

### **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 -

- Toggl

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

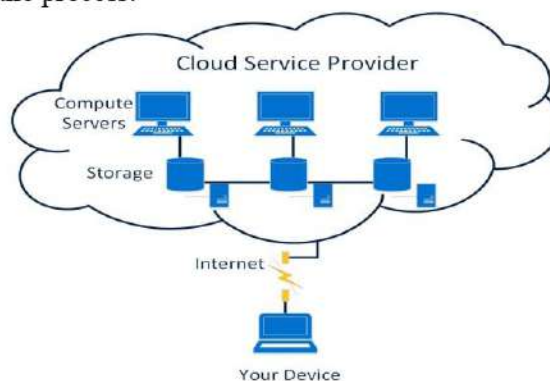
- Evernote  
Evernote allows you to sync and save your recorded notes, typed notes, and other notes in one convenient place. It is available for both free as well as a paid version.  
It uses platforms like Windows, macOS, Android, iOS, Browser, and Unix.
- Outright  
Outright is used by management users for the purpose of accounts. It helps to track income, expenses, profits, and losses in real-time environment.
- 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.

### 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 -
- 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.
- 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.
- Yammer  
Yammer is the best team collaboration tool that allows a team of employees to chat, share images, documents, and videos.
- LinkedIn  
LinkedIn is a social network for students, freshers, and professionals.

### 1.9 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.

### 1.9.1 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.

### 1.9.2 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.
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### TYPES OF CLOUD STORAGE

- Public Cloud
- Private Cloud
- Hybrid Cloud

#### 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.

#### 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.

### 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.

### **1.10 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.

### **1.11 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.

### **1.12 Cloud Service Requirements**

- Efficiency / cost reduction
- Data security
- Scalability
- Mobility
- Disaster recovery
- Control
- Market reach
- Automatic Software Updates

**Efficiency / cost reduction:** By using cloud infrastructure, you don't have to spend huge amounts of money on purchasing and maintaining equipment.

**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.

**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.

**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.

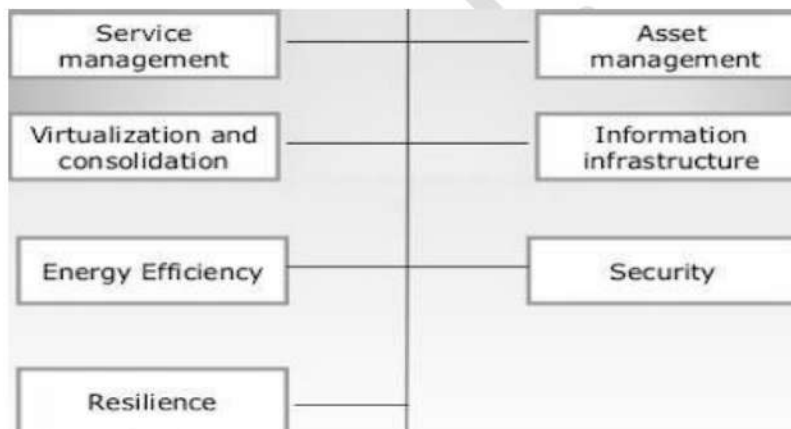
**Disaster recovery:** Data loss is a major concern for all organizations, along with data security. Storing your data in the cloud guarantees that data is always available, even if your equipment like laptops or PCs, is damaged. Cloud-based services provide quick data recovery for all kinds of emergency scenarios.

**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.

**Market reach:** Developing in the cloud enables users to get their applications to market quickly.

**Automatic Software Updates:** Cloud-based applications automatically refresh and update themselves.

### 1.13 CLOUD AND DYNAMIC INFRASTRUCTURE:



**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.

**Asset-Management:** In this the assets or the property which is involved in providing the cloud services are getting managed.

**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.

**Information Infrastructure:** It helps the business organizations to achieve the following: Information compliance, availability of resources retention and security objectives.

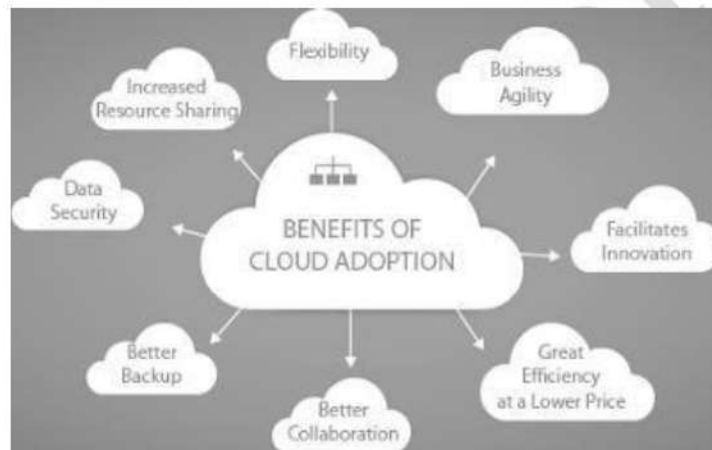
**Energy-Efficiency:** Here the IT infrastructure or organization sustainable. It means it is not likely to damage or effect any other thing.

**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.

**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.

#### 1.14 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?

**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.

**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.

**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.

**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.

**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.