

KCA 101 : FUNDAMENTAL OF COMPUTERS & EMERGING TECHNOLOGIES
for
Master of Computer Application (MCA)

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Unit-IV

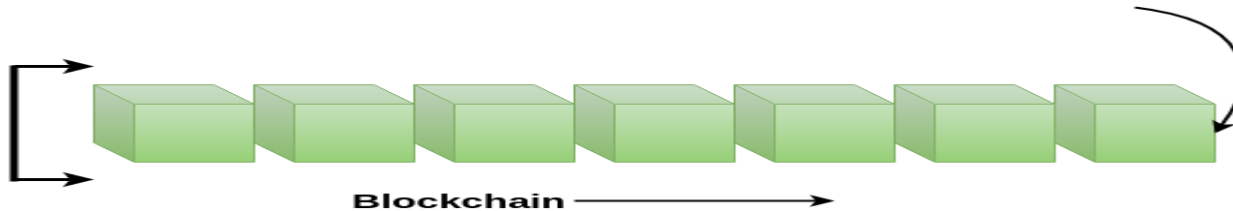
- **Block chain:** Introduction, overview, features, limitations and application areas fundamentals of Block Chain.
- **Crypto currencies:** Introduction, Applications and use cases
- **Cloud Computing:** Its nature and benefits, AWS, Google, and Microsoft & IBM Services

Blockchain

A blockchain is a constantly growing ledger which keeps a permanent record of all the transactions that have taken place in a secure, chronological, and immutable way. Let's break down the definition,

- **Ledger:** It is a file that is constantly growing.
- **Permanent:** It means once the transaction goes inside a blockchain, you can put up it permanently in the ledger.
- **Secure:** Blockchain placed information in a secure way. It uses very advanced cryptography to make sure that the information is locked inside the blockchain.
- **Chronological:** Chronological means every transaction happens after the previous one.
- **Immutable:** It means as you build all the transaction onto the blockchain, this ledger can never be changed.

A blockchain is a chain of blocks which contain information. Each block records all of the recent transactions, and once completed goes into the blockchain as a permanent database. Each time a block gets completed, a new block is generated.



Note: A blockchain can be used for the secure transfer of money, property, contracts, etc. without requiring a third -party intermediary like bank or government. Blockchain is a software protocol, but it could not be run without the Internet (like SMTP used in email).

Who Uses Block Chain

- Blockchain technology can be integrated into multiple areas.
- The primary use of blockchains is as a distributed ledger for cryptocurrencies.
- It shows great promise across a wide range of business applications like Banking, Finance, Government, Healthcare, Insurance, Media and Entertainment, Retail, etc.

Need of Blockchain

- **Security:** Blockchain uses very advanced cryptography to make sure that the information is locked inside the blockchain. It uses Distributed Ledger Technology where each party holds a copy of the original chain, so the system remains operative, even the large number of other nodes fall.

- **Collaboration:** It allows each party to transact directly with each other without requiring a third-party intermediary.
- **Decentralized:** It is decentralized because there is no central authority supervising anything. There are standards rules on how every node exchanges the blockchain information. This method ensures that all transactions are validated, and all valid transactions are added one by one.
- **Time reduction:** In the financial industry, blockchain can allow the quicker settlement of trades. It does not take a lengthy process for verification, settlement, and clearance. It is because of a single version of agreed-upon data available between all stakeholders.
- **Unchangeable transactions:** Blockchain register transactions in a chronological order which certifies the unalterability of all operations, means when a new block is added to the chain of ledgers, it cannot be removed or modified.
- **Reliability:** Blockchain certifies and verifies the identities of each interested parties. This removes double records, reducing rates and accelerates transactions.



Applications of Blockchain

1. Asset Management

Blockchain plays a big part in the financial world and it is no different in asset management. In general terms, asset management involves the handling and exchange of different assets that an individual may own such as fixed income, real estate, equity, mutual funds, commodities, and other alternative investments. Normal trading processes in asset management can be very expensive, especially if the trading involves multiple countries and cross border payments. In such situations, Blockchain can be a big help as it removes the needs for any intermediaries such as the broker, custodians, brokers, settlement managers, etc. Instead, the blockchain ledgers provide a simple and transparent process that removes the chances of error.

2. Cross-Border Payments

Have you ever tried to make cross-border payments in different currencies from one country to another? This can be a long complicated process and it can take many days for the money to arrive at its destination. Blockchain has helped in simplifying these cross border payments by providing end-to-end remittance services without any intermediaries. There are many remittance companies that offer Blockchain services which can be used to make international remittances within 24 hours.

3. Healthcare

Blockchain can have a big impact on healthcare using smart contracts. These smart contracts mean that a contract is made between 2 parties without needing any intermediary. All the parties involved in the contract know the contract details and the contract is implemented automatically when the contract conditions are met. This can be very useful in healthcare where personal health records can be encoded via Blockchain so they are only accessible to primary healthcare providers with a key. They also help in upholding the HIPAA Privacy Rule which ensures that patient information is confidential and not accessible to everyone.

4. Cryptocurrency

Perhaps one of the most popular applications of Blockchain is in Cryptocurrency. Who hasn't heard about bitcoin and its insane popularity? One of the many advantages of cryptocurrency using blockchain is that it has no geographical limitations. So cryptocurrencies can be used for transactions all over the world. The only important thing to keep in mind is exchange rates and that people may lose some money in this process. However, this option is much better than regional payment apps such as Paytm in India that are only relevant in a particular country or geographical region and cannot be used to pay money to people in other countries.

5. Birth and Death Certificates

There are many people in the world who don't have a legitimate birth certificate especially in the poorer countries of the world. According to UNICEF, one-third of all the children under the age of five don't have a birth certificate. And the problem is similar to death certificates as well. However, Blockchain can help in solving this problem by creating a secure repository of birth and death certificates that are verified and can only be accessed by the authorized people.

6. Online Identity Verification

It is not possible to complete any financial transactions online without online verification and identification. And this is true for all the possible service providers any user might have in the financial and banking industry. However, blockchain can centralize the online identity verification process so that users only need to verify their identity once using blockchain and then they can share this identity with whichever service provider they want. Users also have the option to choose their identity verification methods such as user authentication, facial recognition, etc.

7- Internet of Things

Internet of things is a network of interconnected devices that can interact with others and collect data that can be used for gaining useful insights. Any system of "things" becomes IoT once it is connected. The most common example of IoT is perhaps the Smart Home where all the home appliances such as lights, thermostat, air conditioner, smoke alarm, etc. can be connected together on a single platform. But where does Blockchain come into this? Well, Blockchain is needed for providing security for this massively distributed system. In IoT, the security of the system is only as good as the least secured device which is the weak link. Here Blockchain can ensure that the data obtained by the IoT devices are secure and only visible to trusted parties.

8. Copyright and Royalties

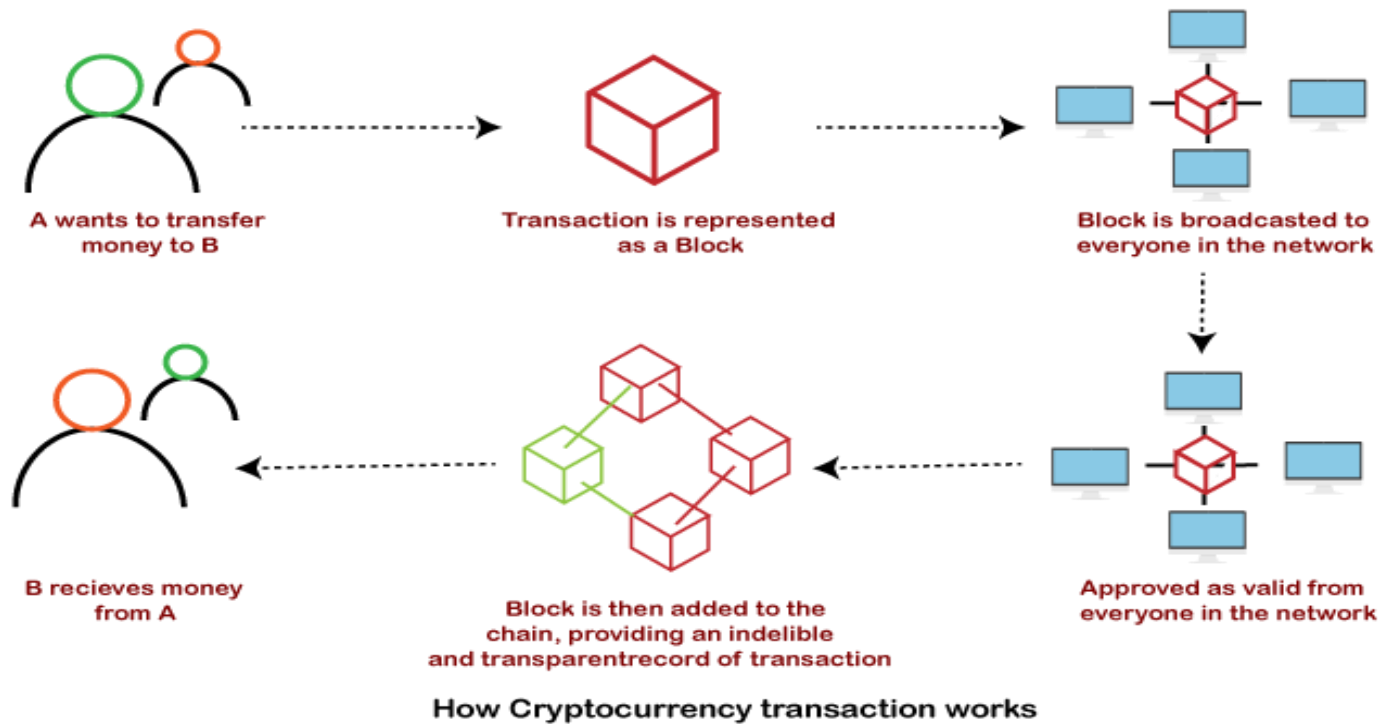
Copyright and royalties are a big issue in creative sectors like music, films, etc. These are artistic mediums and it doesn't sound like they have any link with Blockchain. But this technology is quite important in ensuring security and transparency in the creative industries. There are many instances where music, films, art, etc. is plagiarized and due credit is not given to the original artists. This can be rectified using Blockchain which has a detailed ledger of artist rights. Blockchain is also transparent and can provide a secure record of artist royalties and deals with big production companies. The payment of royalties can also be managed using digital currencies like Bitcoin.

Cryptocurrency

A cryptocurrency is a virtual or digital currency that can be used to buy goods and services; which implies there's no physical coin or bill used and all the transactions take place online. It used an online ledger with strong cryptography to ensure that online transactions are completely secure.

- The working phenomenon of cryptocurrency transaction is given below:
 - One user or sender who wants to send funds to another user starts the transaction.
 - In this, each transaction is represented as a block. And this block is forwarded over the blockchain network.
 - This block is validated by the users of the chain, and once it is verified as a valid transaction, a block is added to the chain.

Each transaction is encrypted and contains a unique set of keys, and whoever has those set of keys, he can only own the amount of cryptocurrency



Types of Cryptocurrency

After the creation of bitcoin, there are various types of cryptocurrencies available in the market. Below is the list of popular types of cryptocurrencies:

1. Bitcoin

Bitcoin is the most recognizable type of cryptocurrency system. As per the studies, there are approximately more than 18.5 million bitcoin tokens available for circulation, with a capped limit of 21 million.

2. Bitcoin Cash

Bitcoin cash was introduced in the year 2017, and it is one of the most popular types of cryptocurrencies available in the market.

3. Litecoin

Litecoin is gaining popularity day by day, and it works the same as bitcoin. It was developed by Charlie Lee(former employee of Google) in the year 2011.

4. Ethereum

Ethereum is heard in the same context as Bitcoin, but itself, it is not a cryptocurrency. Instead, it is an online programmable platform that uses blockchain technology. It helps the developer to develop and run DAapps within the system. Ethereum can be understood as an app store.

5. Ripple

Ripple is also a type of cryptocurrency, but it does not use Blockchain technology. It is not for the particular user; rather, it mainly works for large companies or corporations to move a huge amount of money across the world.

6. Stellar

Stellar is an open network, which is mainly used to store and transfer money. It is designed in a way that all the financial systems across the world can work together over the same network. It allows to create, send and trade all possible digital forms of money, whether it is **dollar, pesos, bitcoin**, or anything.

7. NEO

NEO was formally called Antshares and created in **China**. Its main goal is towards smart contracts, which enable the users to create and execute agreements without involving the intermediary.

8. Cardano

Cardano or ADA is a type of cryptocurrency, which is used for sending or receiving digital funds. It was created by Charles Hoskinson. It is the only coin that is available with the "Scientific philosophy and research-driven approach." It means it is reviewed by scientists and programmers.

9. IOTA

IOTA stands for **Internet of Things Application**. It was launched in the year **2016**. The main difference between IOTA and other blockchain technologies is that IOTA does not work with blocks and chains; rather, it works with smart devices on the internet of things.

What is the Use of Cryptocurrency

- It is worth wondering if the popularity that cryptocurrency has garnered over the years is hollow or not.
- However, even though it is still nowhere near to replacing institutionalised cash, cryptocurrency, especially Bitcoin, has found wide acceptance across the world.

As a mode of payment

- Initially, Bitcoin had little value as a mode of payment to merchants. However, with time, several merchants worldwide like restaurants, flights, jewellers, and apps have come to accept it as a viable payment medium.
- One of the most notable acceptors of cryptocurrency as a viable medium of payment is Apple Inc. It allows 10 types of cryptocurrencies for carrying out transactions in the App Store.
- However, India, as an economy is still exploring cryptocurrency as a viable payment mode extensively. Nevertheless, with big companies like Apple and Facebook
- hoisting its cause, it is expected that cryptocurrency will gain traction in India soon.

What is the Use of Cryptocurrency

Investment

- Cryptocurrencies, especially Bitcoin, are one of the most lucrative investment options currently present. Its value appreciation is supremely dynamic and can prove to be an excellent avenue for capital expansion.
- However, individuals must also note the volatility of this investment avenue.
- Bitcoin, the most popular cryptocurrency with the largest market share, has experienced some of the most erratic price changes as an asset.
- For instance, in December 2017, Bitcoin's value plunged from \$19000 per BTC to \$7000 per BTC.
- Since cryptocurrency is not rooted in any material change but a change in popularity and fad, such price fluctuation is natural. •

What is the Use of Cryptocurrency

What is Bitcoin?

Satoshi Nakamoto introduced the bitcoin in the year 2008. Bitcoin is a cryptocurrency(virtual currency), or a **digital currency** that uses rules of cryptography for regulation and generation of units of currency. A Bitcoin fell under the scope of cryptocurrency and became the first and most valuable among them. It is commonly called **decentralized digital currency**.

A bitcoin is a type of digital assets which can be bought, sold, and transfer between the two parties securely over the internet. Bitcoin can be used to store values much like fine gold, silver, and some other type of investments. We can also use bitcoin to buy products and services as well as make payments and exchange values electronically.

A bitcoin is different from other traditional currencies such as **Dollar, Pound, and Euro**, which can also be used to buy things and exchange values electronically. There are no physical coins for bitcoins or paper bills. When you send bitcoin to someone or used bitcoin to buy anything, you don't need to use a bank, a credit card, or any other third-party. Instead, you can simply send bitcoin directly to another party over the internet with securely and almost instantly.

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What is the Use of Cryptocurrency

- **How Bitcoin Works?**
- When you send an email to another person, you just type an email address and can communicate directly to that person. It is the same thing when you send an instant message.
- This type of communication between two parties is commonly known as Peer-to-Peer communication.
- Whenever you want to transfer money to someone over the internet, you need to use a service of third-party such as banks, a credit card, a PayPal, or some other type of money transfer services.
- The reason for using third-party is to ensure that you are transferring that money.
- In other words, you need to be able to verify that both parties have done what they need to do in real exchange.

What is the Use of Cryptocurrency

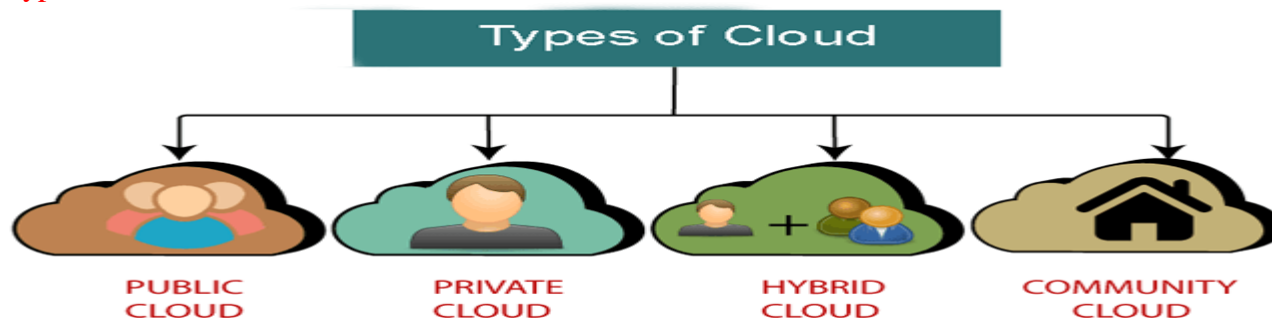
- **For example**, Suppose you click on a photo that you want to send it to another person, so you can simply attach that photo to an email, type the receiver email address and send it. The other person will receive the photo, and you think it would end, but it is not. Now, we have two copies of photo, one is a simple email, and another is an original file which is still on my computer. Here, we send the copy of the file of the photo, not the original file. This issue is commonly known as the double-spend problem.
- The double-spend problem provides a challenge to determine whether a transaction is real or not. How you can send a bitcoin to someone over the internet without needing a bank or some other institution to certify the transfer took place. The answer arises in a global network of thousands of computers called a Bitcoin Network and a special type of decentralized ledger technology called **blockchain**.
- In Bitcoin, all the information related to the transaction is captured securely by using maths, protected cryptographically, and the data is stored and verified across the entire network of computers.

- In other words, instead of having a centralized database of the third-party such as banks to certify the transaction took place. Bitcoin uses blockchain technology such as a decentralized network of computers to securely verify, confirm and record each transaction.
- Since data is stored in a decentralized manner across a wide network, there is no single point of failure. This makes blockchain more secure and less prone to fraud, tampering or general system failure than keeping them in a single centralized location.

Cloud Computing

- Most powerful & most expensive computer.
- **Cloud Computing** is defined as storing and accessing of data and computing services over the internet.
- It doesn't store any data on your personal computer.
- It is the on-demand availability of computer services like servers, data storage, networking, databases, etc.
- The main purpose of cloud computing is to give access to data centers to many users.
- Users can also access data from a remote server. **Examples of Cloud Computing Services:** AWS, Azure, Google

Types of Cloud



Public Cloud

Public cloud is **open to all** to store and access information via the Internet using the pay-per-usage method. In public cloud, computing resources are managed and operated by the Cloud Service Provider (CSP).

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

- **Advantages of Public Cloud -**

- Public cloud is owned at a lower cost than the private and hybrid cloud.
- Public cloud is maintained by the cloud service provider, so do not need to worry about the maintenance.
- Public cloud is easier to integrate. Hence it offers a better flexibility approach to consumers.
- Public cloud is location independent because its services are delivered through the internet.
- Public cloud is highly scalable as per the requirement of computing resources.
- It is accessible by the general public, so there is no limit to the number of users.

- **Disadvantages of Public Cloud**

- Public Cloud is less secure because resources are shared publicly.
- Performance depends upon the high-speed internet network link to the cloud provider.
- The Client has no control of data.

Private Cloud

Private cloud is also known as an **internal cloud** or **corporate cloud**. It is used by organizations to build and manage their own data centers internally or by the third party. It can be deployed using Opensource tools such as Openstack and Eucalyptus. Based on the location and management, National Institute of Standards and Technology (NIST) divide private cloud into the following two parts-

- On-premise private cloud
- Outsourced private cloud

- **Advantages of Private Cloud**
 - Private cloud provides a high level of security and privacy to the users.
 - Private cloud offers better performance with improved speed and space capacity.
 - It allows the IT team to quickly allocate and deliver on-demand IT resources.
 - The organization has full control over the cloud because it is managed by the organization itself. So, there is no need for the organization to depend on anybody.
 - It is suitable for organizations that require a separate cloud for their personal use and data security is the first priority.
- **Disadvantages of Private Cloud**
 - Skilled people are required to manage and operate cloud services.
 - Private cloud is accessible within the organization, so the area of operations is limited.
 - Private cloud is not suitable for organizations that have a high user base, and organizations that do not have the prebuilt infrastructure, sufficient manpower to maintain and manage the cloud.

Hybrid Cloud

- Hybrid Cloud is a combination of the public cloud and the private cloud. we can say:
- ***Hybrid Cloud = Public Cloud + Private Cloud***
- Hybrid cloud is partially secure because the services which are running on the public cloud can be accessed by anyone, while the services which are running on a private cloud can be accessed only by the organization's users.
- **Example:** Google Application Suite (Gmail, Google Apps, and Google Drive), Office 365 (MS Office on the Web and One Drive), Amazon Web Services.

Hybrid Cloud

- **Advantages of Hybrid Cloud**
 - Hybrid cloud is suitable for organizations that require more security than the public cloud.
 - Hybrid cloud helps you to deliver new products and services more quickly.
 - Hybrid cloud provides an excellent way to reduce the risk.
 - Hybrid cloud offers flexible resources because of the public cloud and secure resources because of the private cloud.
- **Disadvantages of Hybrid Cloud**
 - In Hybrid Cloud, security feature is not as good as the private cloud.
 - Managing a hybrid cloud is complex because it is difficult to manage more than one type of deployment model.

- In the hybrid cloud, the reliability of the services depends on cloud service providers.

Community Cloud

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

Example: Health Care community cloud

- **Advantages of Community Cloud**

- Community cloud is cost-effective because the whole cloud is being shared by several organizations or communities.
- Community cloud is suitable for organizations that want to have a collaborative cloud with more security features than the public cloud.
- It provides better security than the public cloud.
- It provides collaborative and distributive environment.
- Community cloud allows us to share cloud resources, infrastructure, and other capabilities among various organizations.

- **Disadvantages of Community Cloud**

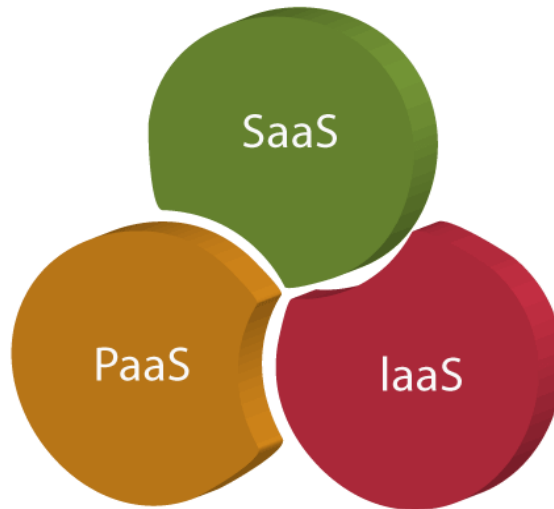
- Community cloud is not a good choice for every organization. – Security features are not as good as the private cloud.
- It is not suitable if there is no collaboration.
- The fixed amount of data storage and bandwidth is shared among all community members.

Difference Table

Parameter	Public Cloud	Private Cloud	Hybrid Cloud	Community Cloud
Host	Service provider	Enterprise (Third party)	Enterprise (Third party)	Community (Third party)
Users	General public	Selected users	Selected users	Community members
Access	Internet	Internet, VPN	Internet, VPN	Internet, VPN
Owner	Service provider	Enterprise	Enterprise	Community

Cloud Service Model

- There are the following three types of cloud service models –
 - [Infrastructure as a Service \(IaaS\)](#)
 - [Platform as a Service \(PaaS\)](#)
 - [Software as a Service \(SaaS\)](#)



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.

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.

Software as a Service (SaaS)

SaaS is also known as "**on-demand software**". It is 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.

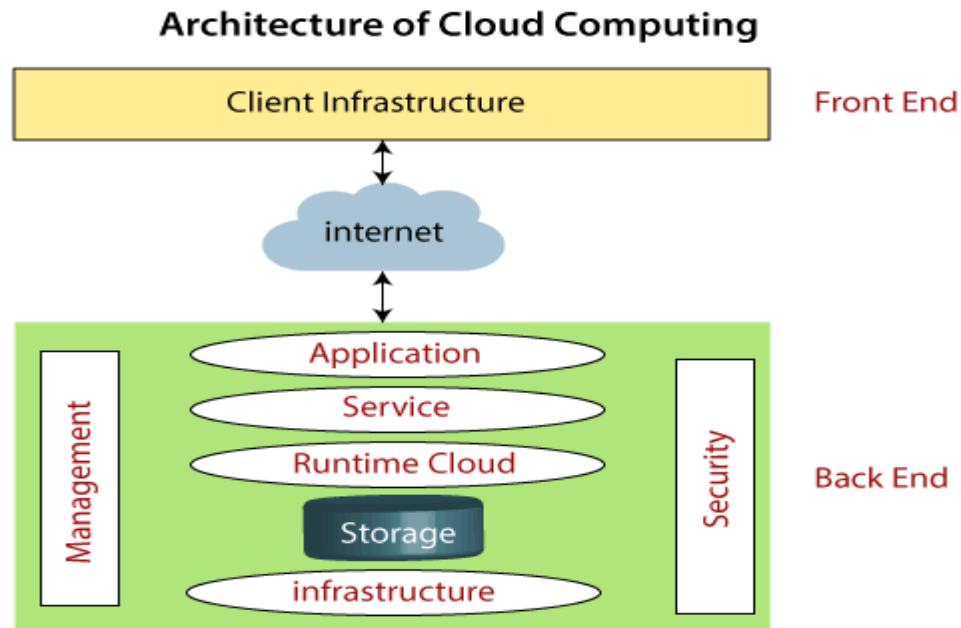
Difference between IaaS, PaaS, and SaaS

IaaS	PaaS	SaaS
It provides a virtual data center to store information and create platforms for app development, testing, and deployment.	It provides virtual platforms and tools to create, test, and deploy apps.	It provides web software and apps to complete business tasks.
It provides access to resources such as virtual machines, virtual storage, etc.	It provides runtime environments and deployment tools for applications.	It provides software as a service to the end-users.
It is used by network architects.	It is used by developers.	It is used by end users.
IaaS provides only Infrastructure.	PaaS provides Infrastructure+Platform.	SaaS provides Infrastructure+Platform+Software.
It provides a virtual data center to store information and create platforms for app development, testing, and deployment.	It provides virtual platforms and tools to create, test, and deploy apps.	It provides web software and apps to complete business tasks.

Cloud Computing 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 diagram shows the architecture of cloud computing -



- **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.

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.