UNIT-IV

What is Blockchain?

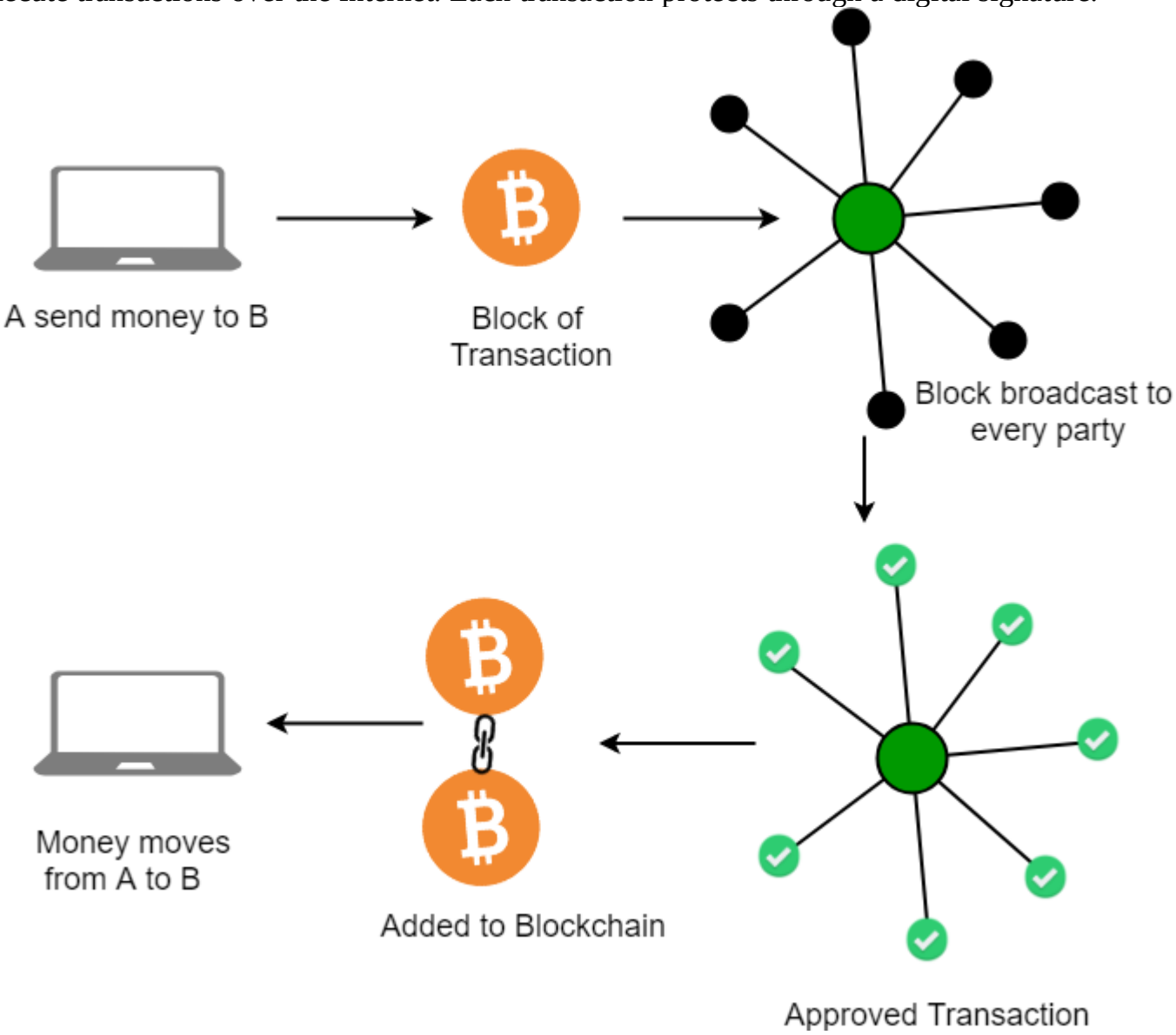
The blockchain is a distributed database of records of all transactions or digital events that have been executed and shared among participating parties. Each transaction is verified by the majority of participants of the system.

It contains every single record of each transaction. Bitcoin is the most popular cryptocurrency an example of the blockchain. Blockchain Technology first came to light when a person or group of individuals name 'Satoshi Nakamoto' published a white paper on "*BitCoin: A peer-to-peer electronic cash system*" in 2008.

Blockchain Technology Records Transaction in Digital Ledger which is distributed over the Network thus making it incorruptible. Anything of value like Land Assets, Cars, etc. can be recorded on Blockchain as a Transaction.

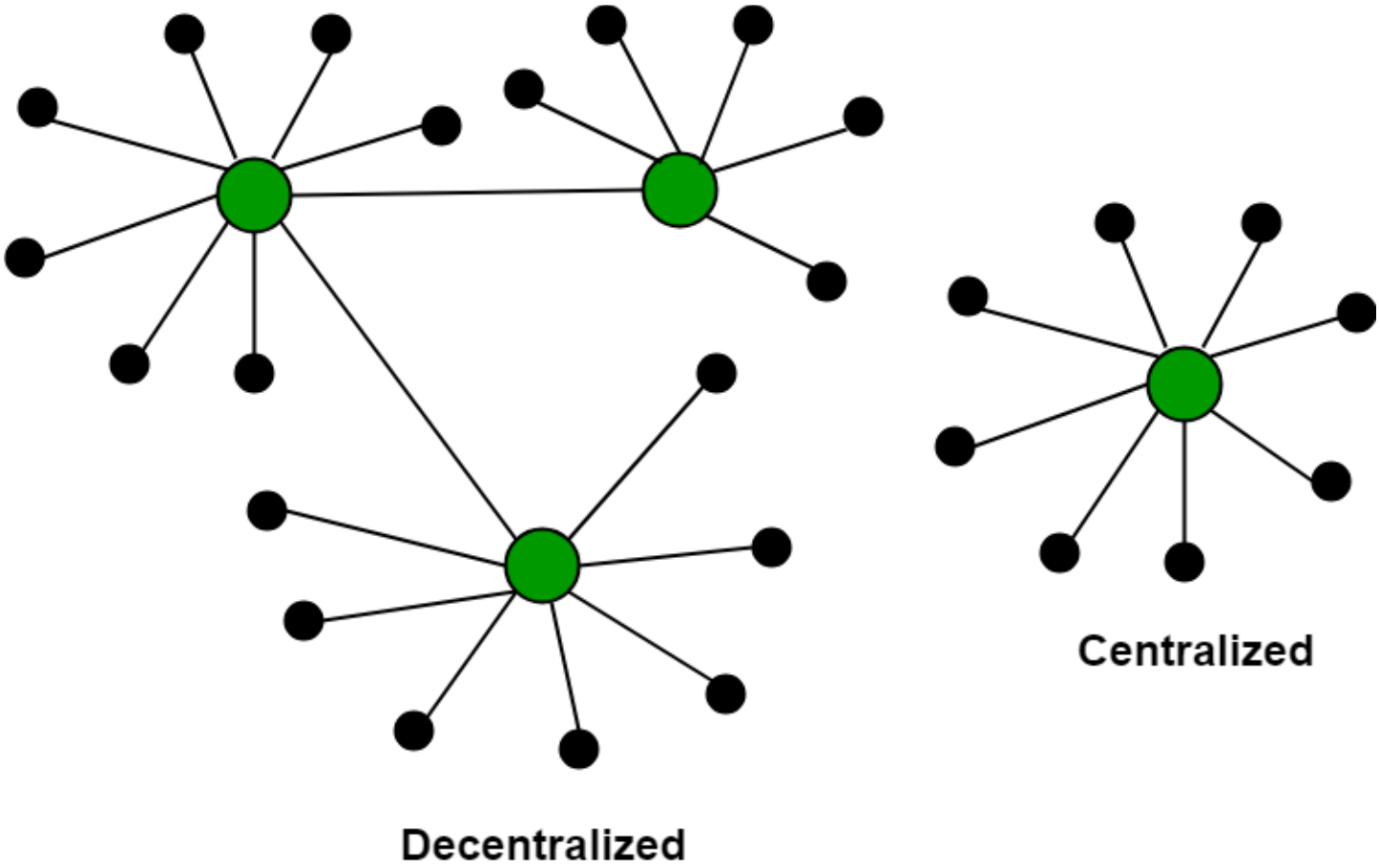
How does Blockchain Technology Work?

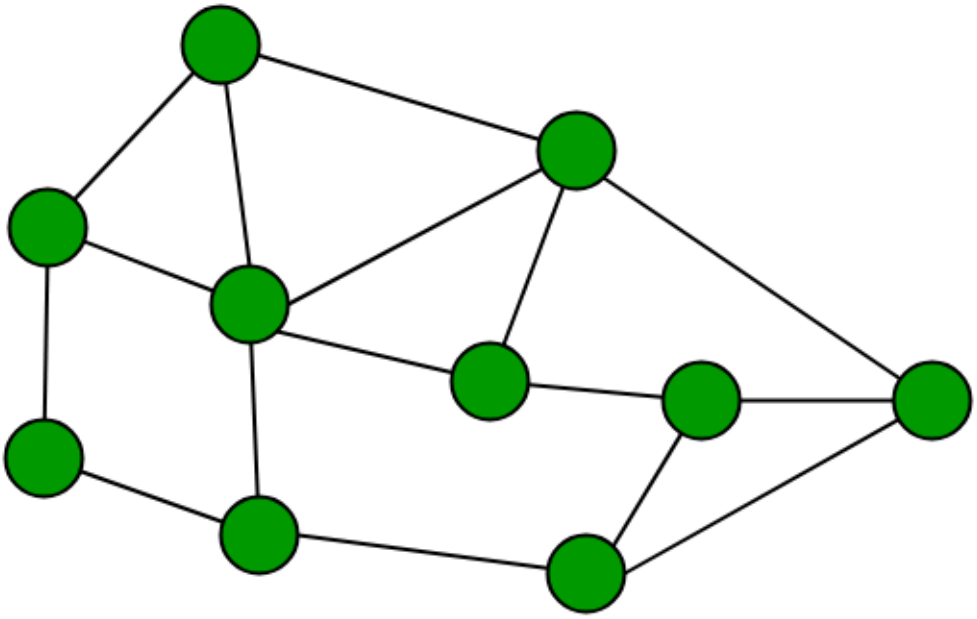
One of the famous use of Blockchain is Bitcoin. Bitcoin is a cryptocurrency and is used to exchange digital assets online. Bitcoin uses cryptographic proof instead of third-party trust for two parties to execute transactions over the Internet. Each transaction protects through a digital signature.



Blockchain Decentralization

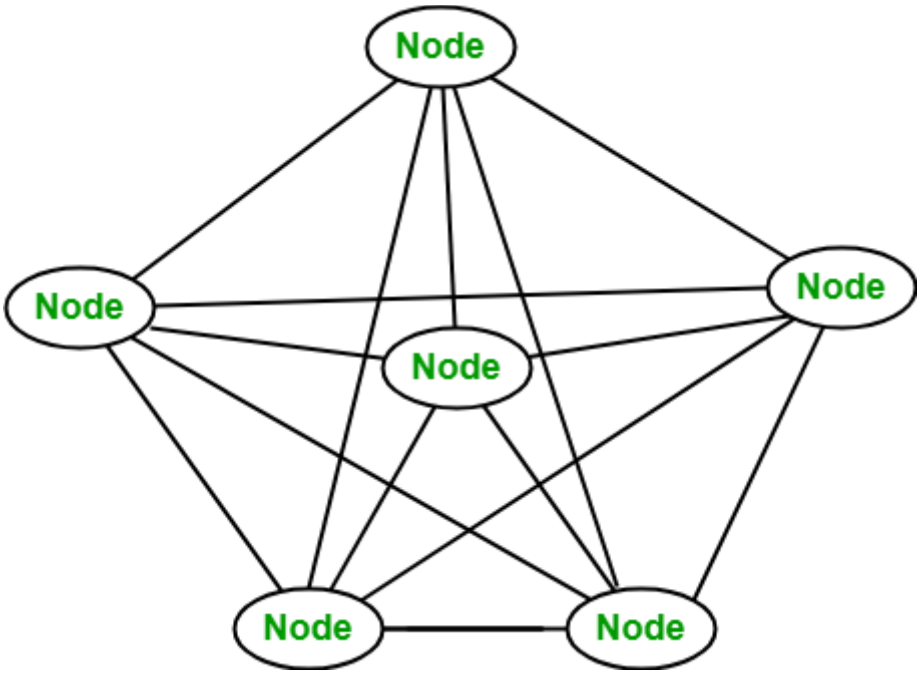
There is no Central Server or System which keeps the data of the Blockchain. The data is distributed over Millions of Computers around the world which are connected to the Blockchain. This system allows the Notarization of Data as it is present on every Node and is publicly verifiable.





Blockchain nodes

A node is a computer connected to the Blockchain Network. Node gets connected with Blockchain using the client. The client helps in validating and propagating transactions onto the Blockchain. When a computer connects to the Blockchain, a copy of the Blockchain data gets downloaded into the system and the node comes in sync with the latest block of data on Blockchain. The Node connected to the Blockchain which helps in the execution of a Transaction in return for an incentive is called Miners.



Disadvantages of the current transaction system:

- Cash can only be used in low-amount transactions locally.
- The huge waiting time in the processing of transactions.
- The need for a third party for verification and execution of Transactions makes the process complex.
- If the Central Server like Banks is compromised, the whole system is affected including the participants.
- Organizations doing validation charge high process thus making the process expensive.

Building trust with Blockchain: Blockchain enhances trust across a business network. It's not that you can't trust those who you conduct business with it's that you don't need to when operating on a Blockchain network. Blockchain builds trust through the following five attributes:

- **Distributed:** The distributed ledger is shared and updated with every incoming transaction among the nodes connected to the Blockchain. All this is done in real time as there is no central server controlling the data.
- **Secure:** There is no unauthorized access to Blockchain made possible through Permissions and Cryptography.
- **Transparent:** Because every node or participant in Blockchain has a copy of the Blockchain data, they have access to all transaction data. They themselves can verify the identities without the need for mediators.
- **Consensus-based:** All relevant network participants must agree that a transaction is valid. This is achieved through the use of consensus algorithms.
- **Flexible:** Smart Contracts which are executed based on certain conditions can be written into the platform. Blockchain Networks can evolve in pace with business processes.

What are the benefits of Blockchain?

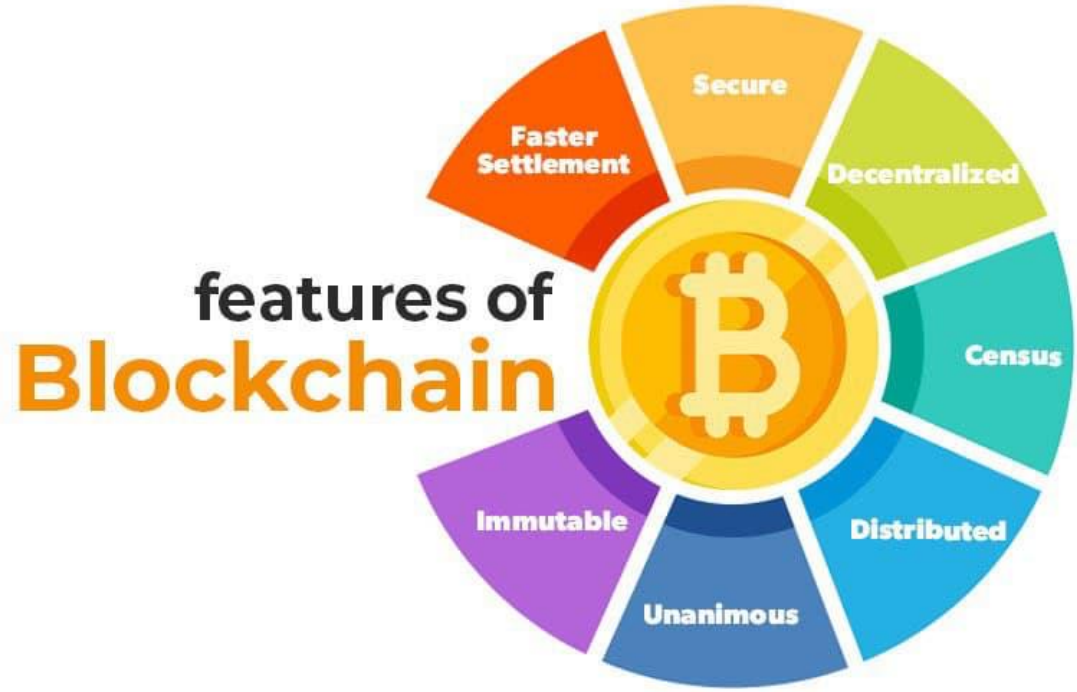
- **Time-saving:** No central Authority verification is needed for settlements making the process faster and cheaper.
- **Cost-saving:** A Blockchain network reduces expenses in several ways. No need for third-party verification. Participants can share assets directly. Intermediaries are reduced. Transaction efforts are minimized as every participant has a copy of the shared ledger.
- **Tighter security:** No one can tamper with Blockchain Data as it is shared among millions of Participants. The system is safe against cybercrimes and Fraud.
- **Collaboration:** It permits every party to interact directly with one another while not requiring third-party negotiation.
- **Reliability:** Blockchain certifies and verifies the identities of every interested party. This removes double records, reducing rates and accelerating transactions.

Application of Blockchain

- Leading Investment Banking Companies like Credit Suisse, JP Morgan Chase, Goldman Sachs, and Citigroup have invested in Blockchain and are experimenting to improve the banking experience and secure it.
- Following the Banking Sector, the Accountants are following the same path. Accountancy involves extensive data, including financial statements spreadsheets containing lots of personal and institutional data. Therefore, accounting can be layered with blockchain to easily track confidential and sensitive data and reduce human error and fraud. Industry Experts from Deloitte, PwC, KPMG, and EY are proficiently working and using blockchain-based software.
- Booking a Flight requires sensitive data ranging from the passenger's name, credit card numbers, immigration details, identification, destinations, and sometimes even accommodation and travel information. So sensitive data can be secured using blockchain technology. Russian Airlines are working towards the same.
- Various industries, including hotel services, pay a significant amount ranging from 18-22% of their revenue to third-party agencies. Using blockchain, the involvement of the middleman is cut short and allows interaction directly with the consumer ensuring benefits to both parties. Winding Tree works extensively with Lufthansa, AirFrance, AirCanada, and Etihad Airways to cut short third-party operators charging high fees.
- Barclays uses Blockchain to streamline the Know Your Customer (KYC) and Fund Transfer processes while filling patents against these features.
- Visauses Blockchain to deal with business-to-business payment services.
- Unilever uses Blockchain to track all their transactions in the supply chain and maintain the product's quality at every stage of the process.
- Walmart has been using Blockchain Technology for quite some time to keep track of their food items coming right from farmers to the customer. They let the customer check the product's history right from its origin.
- DHL and Accenture work together to track the origin of medicine until it reaches the consumer.
- Pfizer, an industry leader, has developed a blockchain system to keep track of and manage the inventory of medicines.
- The government of Dubai looking forward to making Dubai the first-ever city to rely on entirely and work using blockchain, even in their government office.
- Along with the above organizations, leading tech companies like Google, Microsoft, Amazon, IBM, Facebook, TCS, Oracle, Samsung, NVIDIA, Accenture, and PayPal, are working on Blockchain extensively.

Features of Blockchain

Let's have a look at the primary features of the blockchain technology:



1. Immutable

Immutability means that the blockchain is a permanent and unalterable network. Blockchain technology functions through a collection of nodes. Once a transaction is recorded on the blockchain, it cannot be modified or deleted. This makes the blockchain an immutable and tamper-proof ledger that provides a high degree of security and trust.

- Every node in the network has a copy of the digital ledger. To add a transaction every node checks the validity of the transaction and if the majority of the nodes think that it is a valid transaction then it is added to the network. This means that without the approval of a majority of nodes no one can add any transaction blocks to the ledger.
- Any validated records are irreversible and cannot be changed. This means that any user on the network won't be able to edit, change or delete it.

2. Distributed

All network participants have a copy of the ledger for complete transparency. A public ledger will provide complete information about all the participants on the network and transactions. The distributed computational power across the computers ensures a better outcome.

Distributed ledger is one of the important features of blockchains due to many reasons like:

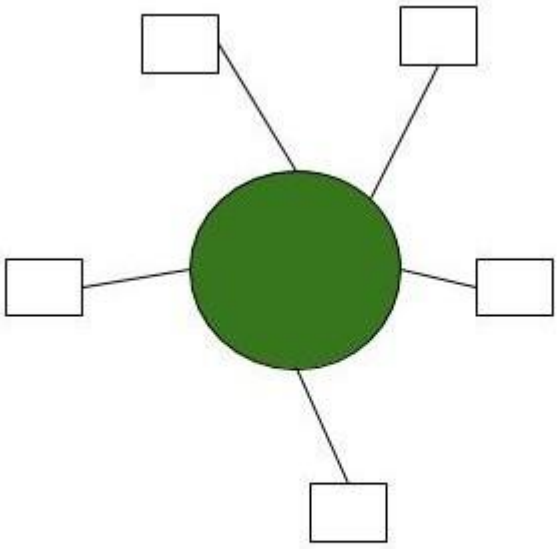
- In distributed ledger tracking what's happening in the ledger is easy as changes propagate really fast in a distributed ledger.
- Every node on the blockchain network must maintain the ledger and participate in the validation.
- Any change in the ledger will be updated in seconds or minutes and due to no involvement of intermediaries in the blockchain, the validation for the change will be done quickly.
- If a user wants to add a new block then other participating nodes have to verify the transaction. For a new block to be added to the blockchain network it must be approved by a majority of the nodes on the network.
- In a blockchain network, no node will get any sort of special treatment or favors from the network. Everyone will have to follow the standard procedure to add a new block to the network.

3. Decentralized

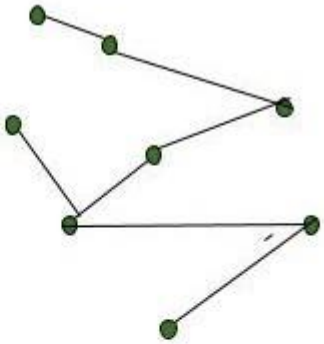
Blockchain technology is a decentralized system, which means that there is no central authority controlling the network. Instead, the network is made up of a large number of nodes that work together to verify and validate transactions. Each and every node in the blockchain network will have the same copy of the ledger.

Decentralization property offers many advantages in the blockchain network:

- As a blockchain network does not depend on human calculations it is fully organized and fault-tolerant.
- The blockchain network is less prone to failure due to the decentralized nature of the network. Attacking the system is more expensive for the hackers hence it is less likely to fail.
- There is no third-party involved hence no added risk in the system.
- The decentralized nature of blockchain facilitates creating a transparent profile for every participant on the network. Thus, every change is traceable, and more concreate.
- Users now have control over their properties and they don't have to rely on third-party to maintain and manage their assets.



Centralised Network



Decentralised network

4. Secure

All the records in the blockchain are individually encrypted. Using encryption adds another layer of security to the entire process on the blockchain network. Since there is no central authority, it does not mean that one can simply add, update or delete data on the network. Every information on the blockchain is hashed cryptographically which means that every piece of data has a unique identity on the network. All the blocks contain a unique hash of their own and the hash of the previous block. Due to this property, the blocks are cryptographically linked with each other. Any attempt to modify the data means to change all the hash IDs which is quite impossible.

5. Consensus

Every blockchain has a consensus to help the network to make quick and unbiased decisions. Consensus is a decision-making algorithm for the group of nodes active on the network to reach an agreement quickly and faster and for the smooth functioning of the system. Nodes might not trust each other but they can trust the algorithm that runs at the core of the network to make decisions. There are

many consensus algorithms available each with its pros and cons. Every blockchain must have a consensus algorithm otherwise it will lose its value.

6. Unanimous

All the network participants agree to the validity of the records before they can be added to the network. When a node wants to add a block to the network then it must get majority voting otherwise the block cannot be added to the network. A node cannot simply add, update, or delete information from the network. Every record is updated simultaneously and the updations propagate quickly in the network. So it is not possible to make any change without consent from the majority of nodes in the network.

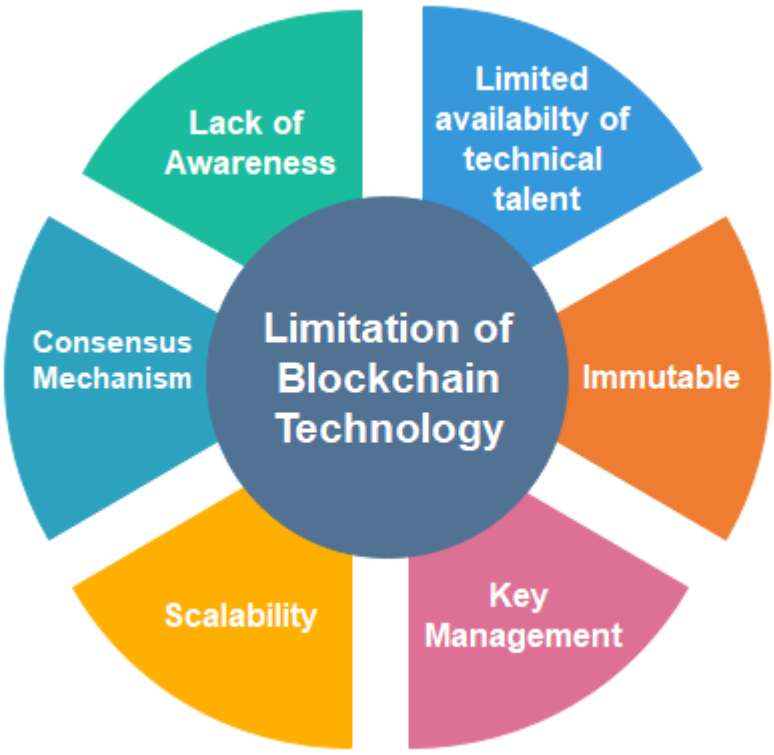
7. Faster Settlement

Traditional banking systems are prone to many reasons for fallout like taking days to process a transaction after finalizing all settlements, which can be corrupted easily. On the other hand, blockchain offers a faster settlement compared to traditional banking systems. This blockchain feature helps make life easier.

Blockchain technology is increasing and improving day by day and has a really bright future in the upcoming years. The transparency, trust, and temper proof characteristics have led to many applications of it like bitcoin, Ethereum, etc. It is a pillar in making the business and governmental procedures more secure, efficient, and effective.

Limitation of Blockchain Technology

Blockchain technology has enormous potential in creating trustless, decentralized applications. But it is not perfect. There are certain barriers which make the blockchain technology not the right choice and unusable for mainstream application. We can see the limitations of blockchain technology in the following image.



Lack of Awareness

There is a lot of discussion about blockchain, but people do not know the true value of blockchain and how they could implement it in different situations.

Limited availability of technical talent

Today, there are a lot of developers available who can do a lot of different things in every field. But in the blockchain technology, there are not so many developers available who have specialized expertise in blockchain technology. Hence, the lack of developers is a hindrance to developing anything on the blockchain.

Immutable

In immutable, we cannot make any **modifications** to any of the records. It is very helpful if you want to keep the **integrity** of a record and make sure that nobody ever tampers with it. But immutability also has a drawback.

We can understand this, in the case, when you want to make any revisions, or want to go back and make any reversals. **For example**, you have processed payment and need to go back and make an amendment to change that payment.

Key Management

As we know, blockchain is built on cryptography, which implies that there are different keys, such as public keys and private keys. When you are dealing with a private key, then you are also running the risk that somebody may lose access to your private key. It happens a lot in the early days when bitcoin wasn't worth that much. People would just collect a lot of bitcoin, and then suddenly forgot what the key was, and those may be worth millions of dollars today.

Scalability

Blockchain like bitcoin has consensus mechanisms which require every participating node to verify the transaction. It limits the number of transactions a blockchain network can process. So bitcoin was not developed to do the large scale volumes of transactions that many of the other institutions are doing. Currently, bitcoin can process a maximum of **seven transactions per second**.

Consensus Mechanism

In the blockchain, we know that a block can be created in every 10 minutes. It is because every transaction made must ensure that every block in the blockchain network must reach a common consensus. Depending on the network size and the number of blocks or nodes involved in a blockchain, the back-and-forth communications involved to attain a consensus can consume a considerable amount of time and resources.

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 ledge provides 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 contacts 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 wearing 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 it's insane popularity. One of the many advantages of cryptocurrency using blockchain as it has no geographical limitations. So crypto coins 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 Brief History of Cryptocurrency

In the caveman era, people used the barter system, in which goods and services are exchanged among two or more people. For instance, someone might exchange seven apples for seven oranges. The barter system fell out of popular use because it had some glaring flaws:

- People's requirements have to coincide—if you have something to trade, someone else has to want it, and you have to want what the other person is offering.
- There's no common measure of value—you have to decide how many of your items you are willing to trade for other items, and not all items can be divided. For example, you cannot divide a live animal into smaller units.
- The goods cannot be transported easily, unlike our modern currency, which fits in a wallet or is stored on a mobile phone.

Traditional Currencies vs. Cryptocurrencies

Imagine a scenario in which you want to repay a friend who bought you lunch, by sending money online to his or her account. There are several ways in which this could go wrong, including:

- The financial institution could have a technical issue, such as its systems are down or the machines aren't working properly.
- Your or your friend's account could have been hacked—for example, there could be a denial-of-service attack or identity theft.

- The transfer limits for your or your friend’s account could have been exceeded.

What is Cryptocurrency?

A cryptocurrency is a coded string of data representing a currency unit. Peer-to-peer networks called blockchains monitor and organize cryptocurrency transactions, such as buying, selling, and transferring, and also serve as secure ledgers of transactions. By utilizing encryption technology, cryptocurrencies can serve as both a currency and an accounting system.

A cryptocurrency is a digital or virtual currency that is meant to be a medium of exchange. It is quite similar to real-world currency, except it does not have any physical embodiment, and it uses cryptography to work.

Because cryptocurrencies operate independently and in a decentralized manner, without a bank or a central authority, new units can be added only after certain conditions are met. For example, with Bitcoin, only after a block has been added to the blockchain will the miner be rewarded with bitcoins, and this is the only way new bitcoins can be generated. The limit for bitcoins is 21 million; after this, no more bitcoins will be produced.

Applications of Cryptocurrency

1. Pionex

For investors looking for automated trading options, Pionex is one of the best options for cryptocurrency applications. This cross-platform programme has 16 free built-in trading bots that make auto trading possible.

One of the most secure cryptocurrency programmes available is Pionex, which has gained a solid reputation in the industry. The platform gathers liquidity close to ticket prices from sites like Huobi and Binance.

2. Webull

Webull may be one of the greatest cryptocurrency applications for this use if you're on a tight budget or only seeking to risk a modest amount of money.

Importantly, not only can you open a Webull account without making a minimum deposit, but you can also buy and sell cryptocurrencies for as little as $1 each transaction. This enables you to learn the ropes of cryptocurrency trading with a little investment.

Webull provides all of its markets on a spread-only basis in terms of fees and charges. We discovered that cryptocurrency transactions had a minimum spread of 1%, which isn't

particularly competitive. You have two options for funding your Webull account: ACH or a bank wire.

3. Coinbase

Coinbase is the next option, and it's conceivably among the finest cryptocurrency applications for newcomers. You will immediately note how user-friendly the UI is after the programme has been downloaded on your device. As a result, if you have never purchased or traded cryptocurrency before, the Coinbase app may be suitable for you.

The fact that you will be charged a lot of money in exchange for ease is the biggest problem we have with this beginner-friendly trading programme.

For instance, Coinbase's basic trading costs, which do not include the spread, are 1.49 percent per slide. You will be charged a hefty 3.99 percent if purchasing cryptocurrency using the app with a debit/credit card.

4. Binance

One of the best cryptocurrency applications is Binance, which offers the fundamental functions of sending and receiving, as well as staking and investing in cryptocurrencies. Over 500 cryptocurrencies and tokens are available for trading pairings between cryptocurrencies via the programme.

You might want to take Binance into consideration if you're a trader who is looking for a cryptocurrency software that has a tonne of low-cost marketplaces.

Tens of billions of dollars' worth of trading activity is made possible by this well-known trading software every day. With charges of only 0.10 percent every slide, you may discover incredibly narrow spreads on hundreds of cryptocurrency pairings.

Depending on where you live, you have different choices and costs for financing your account. For instance, US customers benefit from an excellent bargain here because debit/credit card deposits are only 0.5 percent.

Users from other countries can pay as much as 4% for the identical transaction, though. On iOS and Android smartphones, the Binance app may be downloaded for free.

5. Gemini

Gemini could be the ideal cryptocurrency app for you if you consider yourself a seasoned trader who regularly invests substantial quantities to your trades. One of the few cryptocurrency platforms

to hold a license from the New York State Department of Financial Services, this top-rated exchange is highly regulated in the US.

If you choose to install this cryptocurrency software on your phone, you will have access to a number of insurance plans and security measures of an institutional caliber.

Having said that, the app supports a rather small number of crypto assets, and the fees are fairly hefty. On any trades exceeding $200, for example, you will be charged a regular fee of 1.49 percent each slide.

6. Aqru

Due to the fact that it is not focused on providing trading services, Aqru stands out from other cryptocurrency applications. Aqru, on the other hand, is among the greatest cryptocurrency-based interest-earning platforms. Investors who deposit their Bitcoin or Ethereum tokens into the Aqru app will receive a very generous APY of 7%.

Users are not required to agree to any minimum redemption duration by the application, thus they are free to withdraw their digital tokens whenever they choose without incurring any fees.

7. CoinSmart

Using credit cards, SEPA, wire transfers, e-transfers, and direct crypto deposits are all options for customers to purchase cryptocurrency with CoinSmart. Users may also trade it on the spot market. Derivatives markets are absent from it.

A small number of advanced orders are supported by the exchange, which handles almost 20 cryptocurrencies. It is most popular for exchanging virtual currency for real money and for purchasing virtual currency with cash.

Cloud Computing

Cloud computing refers to the use of hosted services, such as data storage, servers, databases, networking, and software over the internet. The data is stored on physical servers, which are maintained by a cloud service provider. Computer system resources, especially data storage and computing power, are available on-demand, without direct management by the user in cloud computing.

What is Cloud Computing

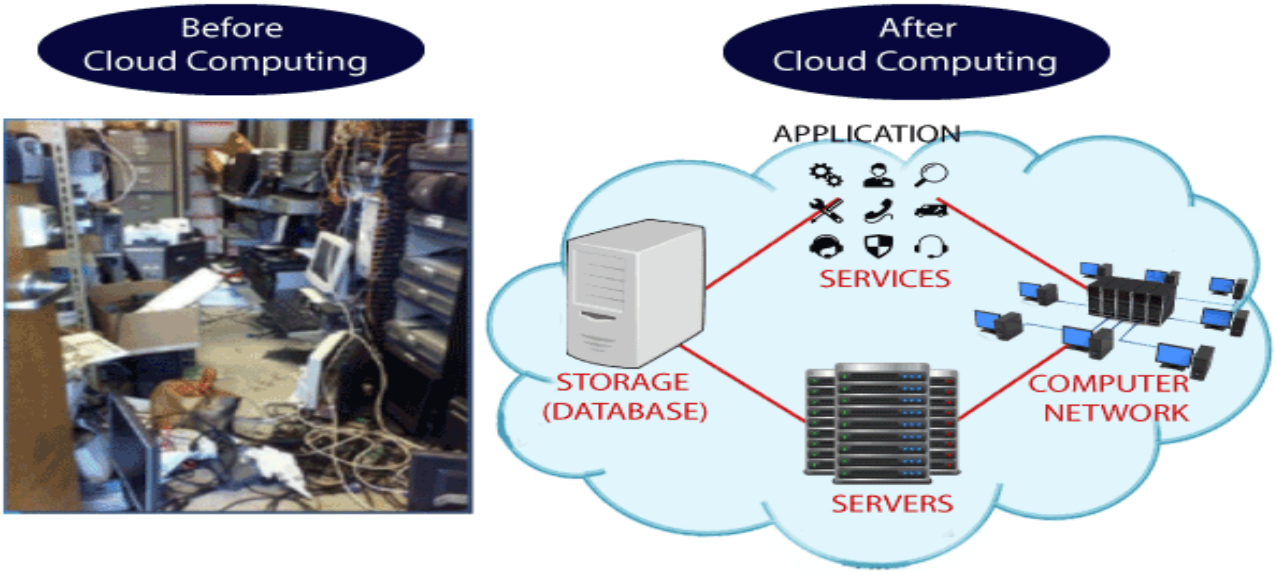
The term cloud refers to a network or the internet. It is a technology that uses remote servers on the internet to store, manage, and access data online rather than local drives. The data can be anything such as files, images, documents, audio, video, and more.

There are the following operations that we can do using cloud computing:

- Developing new applications and services
- Storage, back up, and recovery of data
- Hosting blogs and websites
- Delivery of software on demand
- Analysis of data
- Streaming videos and audios

Why Cloud Computing?

- Small as well as large IT companies, follow the traditional methods to provide the IT infrastructure. That means **for any IT company, we need a Server Room that is the basic need of IT companies**.
- In that server room, there should be a database server, mail server, networking, firewalls, routers, modem, switches, QPS (Query Per Second means how much queries or load will be handled by the server), configurable system, high net speed, and the maintenance engineers.
- To establish such IT infrastructure, we need to spend lots of money. To overcome all these problems and to reduce the IT infrastructure cost, Cloud Computing comes into existence.



Characteristics of Cloud Computing

The characteristics of cloud computing are given below:

1) Agility

The cloud **works in a distributed computing environment**. It shares resources among users and works very fast.

2) High availability and reliability

The availability of servers is high and more reliable because the **chances of infrastructure failure are minimum**.

3) High Scalability

Cloud offers **"on-demand" provisioning of resources on a large scale**, without having engineers for peak loads.

4) Multi-Sharing

With the help of cloud computing, **multiple users and applications can work more efficiently** with cost reductions by sharing common infrastructure.

5) Device and Location Independence

Cloud computing enables the users to access systems using a web browser regardless of their location or what device they use e.g. PC, mobile phone, etc. **As infrastructure is off-site** (typically provided by a third-party) **and accessed via the Internet, users can connect from anywhere**.

6) Maintenance

Maintenance of cloud computing applications is easier, since they **do not need to be installed on each user's computer and can be accessed from different places**. So, it reduces the cost also.

7) Low Cost

By using cloud computing, the cost will be reduced because to take the services of cloud computing, **IT company need not to set its own infrastructure** and pay-as-per usage of resources.

8) Services in the pay-per-use mode

Application Programming Interfaces **(APIs) are provided to the users so that they can access services on the cloud** by using these APIs **and pay the charges as per the usage of services**.

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Advantages of Cloud Computing

As we all know that Cloud computing is trending technology. Almost every company switched their services on the cloud to rise the company growth.

Here, we are going to discuss some important advantages of Cloud Computing-

1) Back-up and restore data

Once the data is stored in the cloud, it is easier to get back-up and restore that data using the cloud.

2) Improved collaboration

Cloud applications improve collaboration by allowing groups of people to quickly and easily share information in the cloud via shared storage.

3) Excellent accessibility

Cloud allows us to quickly and easily access store information anywhere, anytime in the whole world, using an internet connection. An internet cloud infrastructure increases organization productivity and efficiency by ensuring that our data is always accessible.

4) Low maintenance cost

Cloud computing reduces both hardware and software maintenance costs for organizations.

5) Mobility

Cloud computing allows us to easily access all cloud data via mobile.

6) IServices in the pay-per-use model

Cloud computing offers Application Programming Interfaces (APIs) to the users for access services on the cloud and pays the charges as per the usage of service.

7) Unlimited storage capacity

Cloud offers us a huge amount of storing capacity for storing our important data such as documents, images, audio, video, etc. in one place.

8) Data security

Data security is one of the biggest advantages of cloud computing. Cloud offers many advanced features related to security and ensures that data is securely stored and handled.

Disadvantages of Cloud Computing

A list of the disadvantage of cloud computing is given below -

1) Internet Connectivity

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

2) Vendor lock-in

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

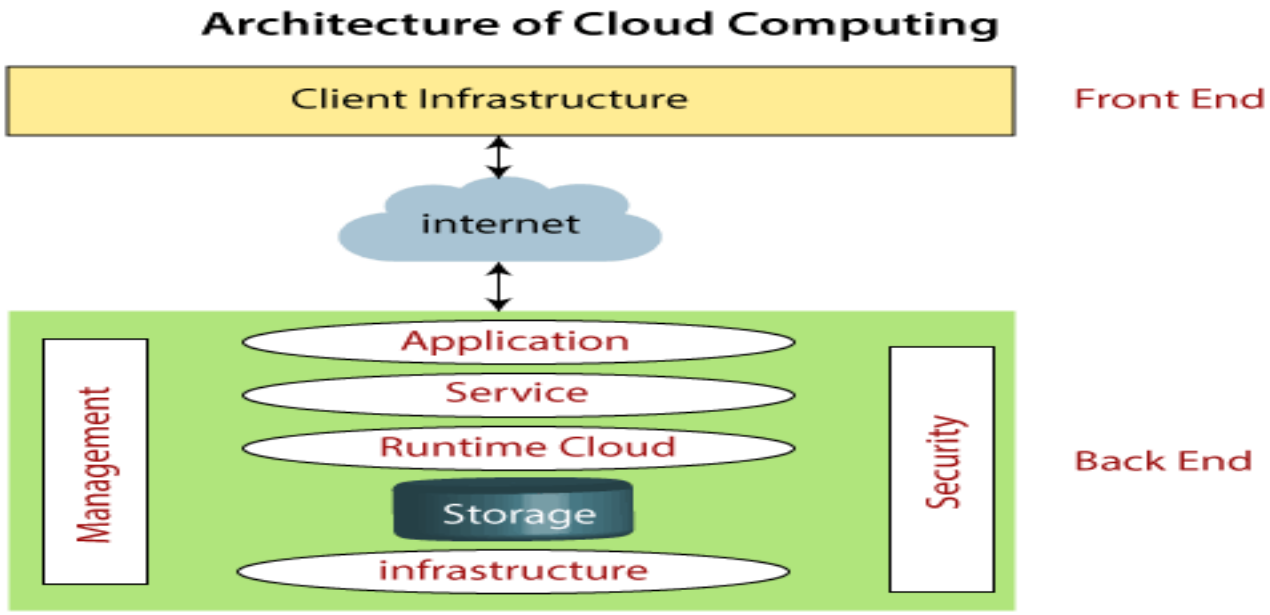
3) Limited Control

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

4) Security

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

Cloud Computing Architecture



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.

What is AWS?

- AWS stands for **Amazon Web Services**.
- The AWS service is provided by the Amazon that uses distributed IT infrastructure to provide different IT resources available on demand. It provides different services such as infrastructure as a service (IaaS), platform as a service (PaaS) and packaged software as a service (SaaS).

- Amazon launched AWS, a cloud computing platform to allow the different organizations to take advantage of reliable IT infrastructure

Uses of AWS

- A small manufacturing organization uses their expertise to expand their business by leaving their IT management to the AWS.
- A large enterprise spread across the globe can utilize the AWS to deliver the training to the distributed workforce.
- An architecture consulting company can use AWS to get the high-compute rendering of construction prototype.
- A media company can use the AWS to provide different types of content such as ebox or audio files to the worldwide files.

Pay-As-You-Go

- Based on the concept of Pay-As-You-Go, AWS provides the services to the customers.

AWS provides services to customers when required without any prior commitment or upfront investment. Pay-As-You-Go enables the customers to procure services from AWS.

- Computing
- Programming models
- Database storage
- Networking

Advantages of AWS

1) Flexibility

- We can get more time for core business tasks due to the instant availability of new features and services in AWS.
- It provides effortless hosting of legacy applications. AWS does not require learning new technologies and migration of applications to the AWS provides the advanced computing and efficient storage.

- AWS also offers a choice that whether we want to run the applications and services together or not. We can also choose to run a part of the IT infrastructure in AWS and the remaining part in data centres.

2) Cost-effectiveness

AWS requires no upfront investment, long-term commitment, and minimum expense when compared to traditional IT infrastructure that requires a huge investment.

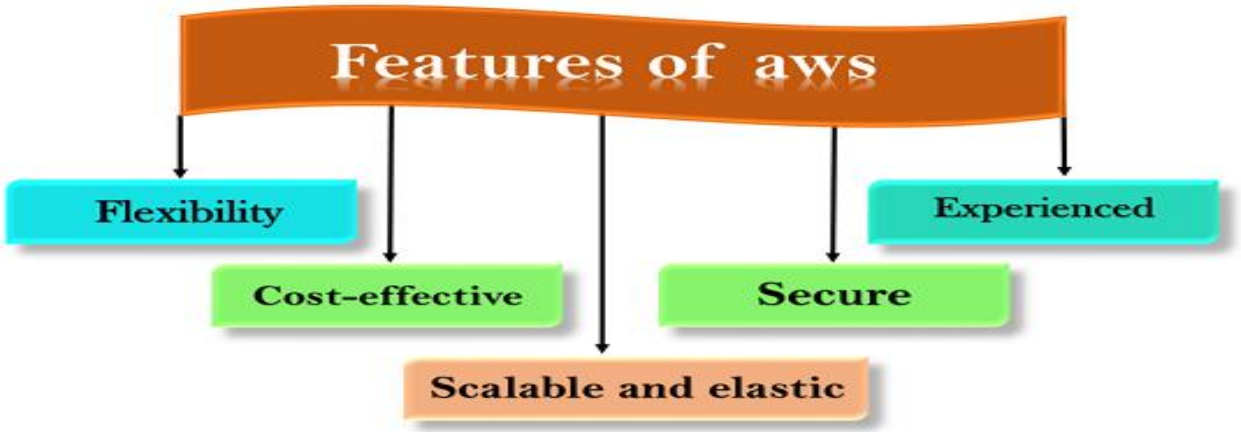
3) Scalability/Elasticity

Through AWS, autoscaling and elastic load balancing techniques are automatically scaled up or down, when demand increases or decreases respectively. AWS techniques are ideal for handling unpredictable or very high loads. Due to this reason, organizations enjoy the benefits of reduced cost and increased user satisfaction.

4) Security

- AWS provides end-to-end security and privacy to customers.
- AWS has a virtual infrastructure that offers optimum availability while managing full privacy and isolation of their operations.
- Customers can expect high-level of physical security because of Amazon's several years of experience in designing, developing and maintaining large-scale IT operation centers.
- AWS ensures the three aspects of security, i.e., Confidentiality, integrity, and availability of user's data.

Features of AWS



1) Flexibility

- The difference between AWS and traditional IT models is **flexibility**.
- The traditional models used to deliver IT solutions that require large investments in a new architecture, programming languages, and operating system. Although these investments are valuable, it takes time to adopt new technologies and can also slow down your business.

- The flexibility of AWS allows us to choose which programming models, languages, and operating systems are better suited for their project, so we do not have to learn new skills to adopt new technologies.
- Flexibility means that migrating legacy applications to the cloud is easy, and cost-effective. Instead of re-writing the applications to adopt new technologies, you just need to move the applications to the cloud and tap into advanced computing capabilities.
- Building applications in aws are like building applications using existing hardware resources.
- The larger organizations run in a hybrid mode, i.e., some pieces of the application run in their data center, and other portions of the application run in the cloud.
- The flexibility of aws is a great asset for organizations to deliver the product with updated technology in time, and overall enhancing the productivity.

2) Cost-effective

- Cost is one of the most important factors that need to be considered in delivering IT solutions.
- For example, developing and deploying an application can incur a low cost, but after successful deployment, there is a need for hardware and bandwidth. Owing our own infrastructure can incur considerable costs, such as power, cooling, real estate, and staff.
- The cloud provides on-demand IT infrastructure that lets you consume the resources what you actually need. In aws, you are not limited to a set amount of resources such as storage, bandwidth or computing resources as it is very difficult to predict the requirements of every resource. Therefore, we can say that the cloud provides flexibility by maintaining the right balance of resources.
- AWS provides no upfront investment, long-term commitment, or minimum spend.
- You can scale up or scale down as the demand for resources increases or decreases respectively.
- An aws allows you to access the resources more instantly. It has the ability to respond the changes more quickly, and no matter whether the changes are large or small, means that we can take new opportunities to meet the business challenges that could increase the revenue, and reduce the cost.

3) Scalable and elastic

- In a traditional IT organization, scalability and elasticity were calculated with investment and infrastructure while in a cloud, scalability and elasticity provide savings and improved ROI (Return On Investment).
- Scalability in aws has the ability to scale the computing resources up or down when demand increases or decreases respectively.
- Elasticity in aws is defined as the distribution of incoming application traffic across multiple targets such as Amazon EC2 instances, containers, IP addresses, and Lambda functions.
- Elasticity load balancing and scalability automatically scale your AWS computing resources to meet unexpected demand and scale down automatically when demand decreases.
- The aws cloud is also useful for implementing short-term jobs, mission-critical jobs, and the jobs repeated at the regular intervals.

4) Secure

- AWS provides a scalable cloud-computing platform that provides customers with end-to-end security and end-to-end privacy.
- AWS incorporates the security into its services, and documents to describe how to use the security features.
- AWS maintains confidentiality, integrity, and availability of your data which is the utmost importance of the aws.

Physical security: Amazon has many years of experience in designing, constructing, and operating large-scale data centers. An aws infrastructure is incorporated in AWS controlled data centers throughout the world. The data centers are physically secured to prevent unauthorized access.

Secure services: Each service provided by the AWS cloud is secure.

Data privacy: A personal and business data can be encrypted to maintain data privacy.

5) Experienced

- The AWS cloud provides levels of scale, security, reliability, and privacy.
- AWS has built an infrastructure based on lessons learned from over sixteen years of experience managing the multi-billion dollar Amazon.com business.
- Amazon continues to benefit its customers by enhancing their infrastructure capabilities.
- Nowadays, Amazon has become a global web platform that serves millions of customers, and AWS has been evolved since 2006, serving hundreds of thousands of customers worldwide.

What is Google?

Google is the world's well-known internet search engine, which is originally called BackRub. Sergey Brin and Larry Page established it as a search effort in 1996. They started this initiative to find files on the Internet while Ph.D. students at Stanford University. **Larry and Sergey** created a search engine algorithm that prioritised Web pages based on how many other Web pages connected to them, rather than the content and keywords. As compared to other search engines, this strategy produced more useful results and caused to quickly increase Google's Web search market share.

- Web search became Google's main tool; other services also provided by the company. These include: **Image Search:** Helps in search for images on the Web
- **Froogle:** Useful in price comparison shopping
- **Google Groups:** Use for online discussion forums
- **Blogger:** It offers a free blogging service
- **Google Maps:** Maps and directions
- **Google Toolbar:** A downloadable search tool
- **Google Answers:** It provides answers to questions on the basis of a bidding system
- **AdWords:** It helps in Advertising services for advertisers
- **AdSense:** It helps in Advertising services for Web publishers
- **Gmail:** Web-based e-mail with several gigabytes of storage

Google Software

There are various popular web-based productivity software's of Google; some are as follows:

- **Gmail:** Gmail is a free email service or web-based email service run by Google. With the help of G Suite, Google also provides premium services to businesses. Gmail mobile app and Gmail Basic are the HTML version of Gmail. Gmail is reliable and comes with 15 GB of storage space to hold your information. It stores your information online, which means you can access it everywhere through the internet.

- **Google Drive:** Google Drive is a cloud-based storage and office application that was launched by Google in April 2012. It is a storage solution where you can store your files online and access them anywhere with the help of a computer, tablet, or smartphone via an internet connection. Although it is mainly used for storing files online, it also offers functionalities in terms of a tool for project collaboration by individuals, schools, and businesses.

- **Google Docs:** Google Docs is a free Web-based application that allows online word processing and document creation. It is a part of Google Drive that is offered by and associated with Google. It is the most popular online word processor in which files can be accessed anywhere by any computer that has complete features of web browser and internet connection. Working with documents, such as creating documents, saving, uploading, sharing, and more, is very easy with Google Docs. Additionally, instead of formatting options, they can be created and modified with an impressive selection.

- **Google Chrome:** Google Chrome is a free full-featured web browser. It is the most popular web browser of choice worldwide as of May 2020, which is used to access web pages on the internet. On 11 December 2008, it was developed by Google. It is also a cross-platform browser that includes multiple features like tabbed browsing, spell check of web pages, synchronization with Google services and accounts, and automatic translation. Additionally, it is available with different versions that work on different mobile devices, computers, and OS (operating system).

- **Google Play:** Google Play is the official Android app store. It is also a storefront for other media like games, music, movies, and e-books. It allows the users to download content directly on an Android device. The Google Play Store also knows an Android Market contains millions of apps and games, and it is available on every Android device by default. Also, it can be installed on Chrombases, Chromeboxes, and other compatible Chrome OS devices.

Google Products

Google also develops hardware as well as software. Although there are numerous Google products, some are as follows:

Google Pixel

The Google Pixel is an Android smartphone, which was released by Google on 20 October 2016, and runs the stock version" of Android. The primary objective of developing the Pixel phones was to replace the Nexus. These phones are the official flagship Android devices and accept updates as soon as they are released, whereas other Android phones may delay updates for some time periods. Pixel phones provide its user's facility to store

unlimited pictures as it offers unlimited photo storage on Google Photos. The below image is an example of a Google Pixel phone.

Chromebook

A Chromebook is a cloud-based laptop or netbook computer that runs the Google Chrome operating system, which was first released in 2011. Chromebooks need internet connectivity and run almost everything from the cloud; however, the offline capabilities of Chromebooks have developed. Therefore, they are different from other laptops or computers. A Chromebook can usually accomplish activities such as web browsing, documents and spreadsheets, email, and saving files, but through a cloud-based approach. Generally, Chromebooks are not as powerful as a laptop with Windows or macOS. The below picture is an instance of a Chromebook.

Google Home

Google Home is a voice-activated smart speaker that works with Google Assistant. The tasks include: making calls, setting timers, answering questions, scheduling events, or playing music. It was released by Google in 2017 and included Google Home, Google Home Mini, Google Home Hub, and more. Generally, it is a line of smart speakers that is activated when the users say **"Hey Google"** or **"Ok Google."** The *larger Google Home Max* and the *smaller Google Home Mini* are other versions of the speaker. The below image is an example of a Google Home smart speaker.

Waymo driverless cars

A self-driving car is a vehicle that has the ability to travel between destinations without human input. It uses a combination of cameras, sensors, artificial intelligence, and radar to move. Waymo is a company that is at the forefront in the field of the self-driving car, which has ambitious plans for a driverless, ride-hailing service. Also, in dozens of cities, it has real-world testing underway. Below, a picture is given that represents the Waymo driverless car.

Google Services

By Google, there are various services that are provided for consumers and businesses; some are as follows:

Google Stadia: Google Stadia is a cloud gaming platform that marks a significant change in the gaming industry. Google debuted it in November of this year. It includes two primary elements; first: the client that sends input and displays graphics; second: the servers in the background that streams the game to users.

Google Fi: Google Fi is a mobile virtual network carrier that is based in the United States. It offers many services such as SMS, mobile broadband, and voice calling services. The three carriers, T-Mobile, Sprint, and US Cellular, are used by Google Fi. Mainly, it has partnered with U.S.-based cellular carriers. It can be used for international calling as well as international data.

Google AdSense: Google AdSense is an advertising platform that allows publishers to make money by running ads and monetizing their content from Google AdWords. It is an open-source platform for most website owners in which ads generate on the basis of the content the visitor is viewing or searching for. It is also unified into YouTube platforms and Google's Blogger. If you have a website that includes any type of content, which is useful for users, you can use AdSense for advertising anything on your website that helps to make money for you. When any user visits your website and clicks on the Ad post or link you uploaded, you will get money from Google. How much money you will get depends on Google what percentage they charged for the ad

YouTube TV: **YouTube TV is Google's product, which is an online streaming service for live televisions. On your phone, computer, or other appropriate device, you may watch live television on YouTube TV. People who wish to cut the cord and get rid of their cable or**

satellite subscriptions should use YouTube TV. YouTube TV offers a unique set of services to users, making it a compelling platform. However, there are various other live streaming services available that are much like YouTube tvs, such as Hulu + Live, Sling TV, and AT&T TV Now. Some other Google services and products

Below, a list is given that contains Google services and products with their brief explanation.

- **Android:** Android is an operating system that is commonly used with smartphones. It is a free Linux-based platform, which was initially founded by Andy Rubin in October 2003. Later on, on 17 August 2005, it was acquired by Google.
- **Blogger:** It is used for creating and viewing personal blogs.
- **G Suite:** G Suite, formerly known as Google Apps for Your Domain, is a service provided by Google. It's a cloud-based software suite for enterprises.
- **Chrome OS:** It is an operating system for portable computers and laptops, which was developed by Google on November 19, 2009. It was mainly designed to work with online web applications.
- **Google Ads:** It is a Google advertising service, also known as Google AdWords. On the Google search engine, it allows website publishers to post advertisements with the help of Google AdSense.
- **Google Analytics:** It is a freemium service from Google that allows users to analyze their website in terms of how much traffic is on their website.
- **Google Assistant:** It is a digital assistant service that is capable of answering your voice requests. In addition, to answer questions, it has the ability to control electrical devices in the home.
- **Google Books:** One of another interesting service that has a lot of different kinds of books. This service is offered by Google, which provides users an option to search all available books.
- **Google Calendar:** It is a service offered by Google that enables you to organize your schedule, share events, set reminders to remember events like birthdays.
- **Google Classroom:** It is a free service that was released by Google in 2014. It gives students and teachers the opportunity to take part in a digital class. It is utilised in schools and universities, as well as in institutions.
- **Google Allo:** It was a mobile app released by Google. It was developed for iOS and Android mobile operating systems, including a web client on Opera, Mozilla Firefox, and Google Chrome.
- **Google Duo:** Google Duo allows users to make audio and video calls as it is a cross-platform video calling service for Android smartphones as well as Google and third-party operating systems.
- **Google Earth:** Google Earth is a useful application program that helps users to get directions, to view almost all places on the earth, find interesting places or shops, and much more.
- **Google Express:** It is an e-commerce platform that provides delivery services in most states. On 25 September, it was originally released by Google as a Google Shopping Express.
- **Google Fuchsia:** It is an open-source operating system that was released as a real-time OS by Google on **15 August 2016.**

- **Google Hangouts:** Google Hangouts is a communication platform that allows members for video chat, messaging, SMS, and VoIP, either one-on-one or in a group. It is also available for Android and iOS devices and built into Google+ and Gmail.
- **Google Lens:** Google Lens was originally introduced in 2017, which is an image recognition technology. With the help of Google Search, it identifies objects and displays information about them. Identifying real-life objects is a technique that can be used with a smartphone's camera.
- **Google Moon:** In general, Google Lunar is a browser application that was produced by Google as a part of Google Earth with a map of our Moon and each of the moon landings. It allows for the exploration of the Moon and shows satellite images.
- **Google Now:** Google Now was a feature of Google Search commonly used by mobile users. It provides the most relevant information on the basis of users' search habits and other factors.
- **Google Play Music:** A very common application and website, introduced by Google on 16 November 2011. Users can create and listen to radio stations, as well as stream, download, buy, and upload music. But now it has been discontinued, and YouTube Music has come on the market that is an alternative for Google Play Music.
- **Google Sheets:** Google Sheets is a spreadsheet web application that is an online free solution from Google. It contains almost all functionalities of a traditional spreadsheet program like Microsoft Excel, which was released on 9 March 2006.
- **Google Translate:** Google Translate is a free service provided by Google that allows users to convert text from one language to another. For example, if you want to translate any English sentence into Hindi, you can copy or write that sentence on the Google Translate page to quickly translate it.
- **Google Wallet:** It was a Google payment service that allowed users to send and receive money from others. It was available for Android smartphones, developed by Google.
- **Wing:** Wing is a service owned by Google that delivers packages or lightweight items with the help of drones. It has been approved as of April 2019. In Australia and Virginia, it is starting operations in particular locations.
- **Google News:** Another service provided by Google, Google News presents great news organized from thousands of publishers and magazines. It is available for Web, iOS, and Android as an app.
- **Google Shopping:** Google Shopping is a search service invented by Craig Nevill-Manning. It enables users to find products on the basis of location, prices, type, etc. Formerly, it was also known as Google Products, Google Product Search, and Froogle.
- **Google Slides:** s Google offers users Google Sheets service that has all capabilities of a traditional spreadsheet program like Microsoft Excel. Similarly, it also provides a service; Google Slides that is a presentation program and contains all features like Microsoft PowerPoint.
- **Google Street View:** One of Google's finest offers is Google Street View, an interactive 360-degree picture that allows users to drive through streets all around the world.

A brief history of Google

- In **1995,** Larry Page and Sergey Brin, both computer science students at Stanford University, started working on a search engine called BackRub. It was a computer program that leveraged record data and

backlink analysis to track on the internet. The name of a search engine, BackRub, was inspired by the algorithms ranking. An algorithm that calculated how many back-links are included in a web page.