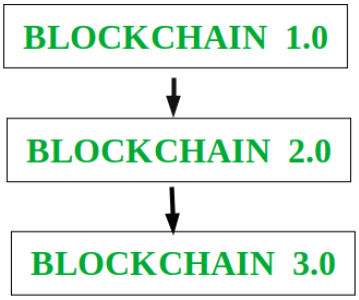
UNIT – 5 : TIERS & TYPES OF BLOCKCHAIN TECHNOLOGY

Versions / Tiers of Blockchain Technology:

There are Three Versions/Generations of BlockChain as depicted below :



1. BlockChain 1.0 (Cryptocurrency):

BlockChain Version 1.0 was introduced in 2005 by Hall Finley, who implements DLT (Distributed Ledger Technology) represents its first application based on Crypto currency. This allows Financial Transaction based on BlockChain technology or DTL which is executed with the help of BitCoin. This type of Version is permissionless as any participant will perform valid transaction of Bitcoin. This type is mainly used in Currency and Payments. Blockchain 1.0 or Blockchain Version 1.0 aimed to introduce a transparent, publicly accessible, completely decentralised, immutable ledger and distributed system of transactions in the global financial market. Blockchain 1.0 is developed over the idea and structure of Bitcoin. It primarily focused on the development and creation of new cryptocurrencies. Blockchain 1.0 is often termed a digital, decentralised, distributed ledger that records transactions in a database shared by all nodes, updated by blockchain miners and maintained and monitored by everyone with no individual ownership.

2. BlockChain 2.0 (Smart Contracts):

The new Version of BlockChain come because there is a problem in version 1.0 which was Mining of BitCoin was Wasteful and there was also lack of Scalability of Network in it. So problem is improved in Version 2.0. In this version, the BlockChain is not just limited to Cryptocurrencies but it will extend up to Smart Contracts.

Thus, Small Contracts are Small Computer's which live in the Chains of Blocks. These Small Computers are free computer programs that executed automatically, and check the condition defined earlier like facilitation, verification or enforcement and reduce transactions cost efficiency.

In BlockChain 2.0, Bitcoin is replaced with Ethereum. Thus, BlockChain 2.0 was successfully processing high number of Transactions on Public network rapidly.

3. BlockChain 3.0 (DApps):

After Version 2.0, new version was introduced which includes DApps which is known as Decentralized Apps. A DApp is like a conventional app, it can have frontend written in any language that makes calls to its backend, and its backend code is running on decentralized Peer-To-Peer Network. It makes use of decentralized storage and communication which can be Ethereum Swarm etc. DApps is decentralised, i.e. no single owner/authority that ensures transparency, improved security, data accessible to all, no censorship and flexible development. DApps brings many benefits such as zero downtime, ensuring privacy, data integrity and trustless yet secure communication (business, transaction, etc.).

There are many decentralized Applications like BitMessage, BitTorrent, Tor, Popcorn, etc.

Difference Between Blockchain 1.0, Blockchain 2.0 & Blockchain 3.0:

Feature	**Blockchain 1.0**	**Blockchain 2.0**	**Blockchain 3.0**
Focus	Digital Currency	Smart Contracts	Beyond Cryptocurrencies and Smart Contracts
Key Example	Bitcoin	Ethereum	Cardano, Polkadot, EOS
Primary Use Case	Decentralized Peer-to-Peer Currency	Programmable Transactions and DApps	Advanced Applications in Various Industries
Consensus Mechanism	Proof of Work (PoW)	Proof of Work (PoW), evolving to Proof of Stake (PoS)	Delegated Proof of Stake (DPoS), BFT, Hybrid Models
Smart Contract Support	No	Yes	Yes
Scalability	Limited	Moderate	High
Interoperability	None	Limited	High
Sustainability	Low (high energy consumption)	Moderate (improving with PoS)	High (optimized consensus mechanisms)
Governance	Centralized development	Decentralized with some centralization	Decentralized and often on-chain governance
Transaction Speed	Slow	Faster than Blockchain 1.0	Fast

Examples of Applications	Financial Transactions	Decentralized Finance (DeFi), Supply Chain	Healthcare, IoT, Government, Enterprise Solutions
Privacy and Security	Basic	Enhanced with smart contracts	Advanced, including enhanced privacy features
Innovation	Introduction of Decentralized Currency	Introduction of Smart Contracts and DApps	Scalability, Interoperability, Diverse Applications
Adoption	Mainly financial transactions	Finance, Supply Chain, Real Estate	Broad industry applications including healthcare, IoT, government

Permissionless Blockchain:

It is also known as trustless or public blockchains, are available to everyone to participate in the blockchains process that use to validate transactions and data. These are used in the network where high transparency is required.

Characteristics:

- Permissionless blockchain has no central authority.
- The platform is completely open-source.
- Full transparency of the transaction.
- Heavy use of tokens.

Advantages:

- Everyone can participate only requirement is good hardware and internet.
- Bring trust among users or entities.
- It has a high level of transparency as it's a larger network.
- Broader decentralization of access to more participants.

Disadvantages:

- Poor energy efficiency due to large network.
- Lower performance scalability.
- Less privacy as many of the things is visible.

Permissioned Blockchain:

These are the closed network only a set of groups are allowed to validate transactions or data in a given blockchain network. These are used in the network where high privacy and security are required.

Characteristics:

- A major feature is a transparency based on the objective of the organization.
- Another feature is the lack of anatomy as only a limited number of users are allowed.
- It does not have a central authority.
- Developed by private authority.

Advantages:

- This blockchain tends to be faster as it has some nodes for validations.
- They can offer customizability.
- Strong Privacy as permission is needed for accessing transaction information.
- As few nodes are involved performance and scalability are increased.

Disadvantages:

- Not truly decentralized as it requires permission
- Risk of corruption as only a few participants are involved.
- Anytime owner and operator can change the rules as per their need.

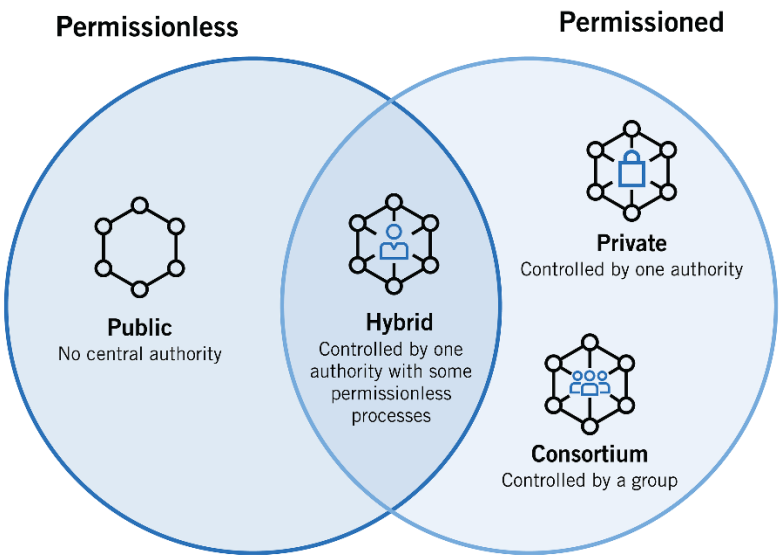
Types of Blockchain:

There are 4 types of blockchain:

- Public Blockchain.
- Private Blockchain.
- Hybrid Blockchain.
- Consortium Blockchain.

Permissionless Blockchain: Public Blockchain

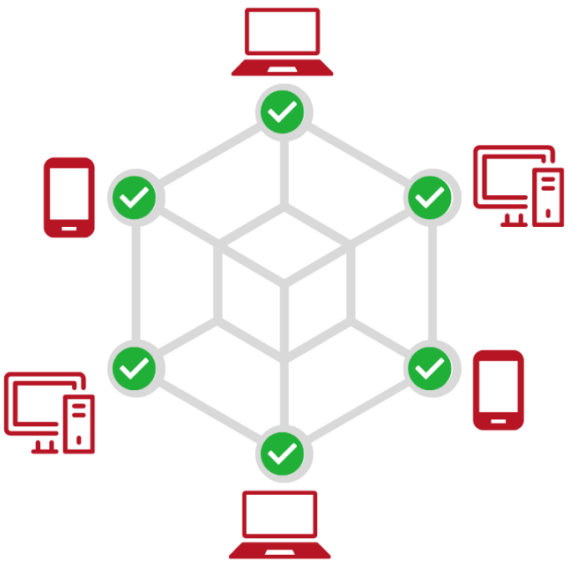
Permissioned Blockchain: Private Blockchain & Consortium Blockchain



1. Public Blockchain:

These blockchains are completely open to following the idea of decentralization. They don't have any restrictions, anyone having a computer and internet can participate in the network.

- As the name is public this blockchain is open to the public, which means it is not owned by anyone.
- Anyone having internet and a computer with good hardware can participate in this public blockchain.
- All the computer in the network holds the copy of other nodes or block present in the network
- In this public blockchain, we can also perform verification of transactions or records



Advantages:

- **Trustable:** There are algorithms to detect no fraud. Participants need not worry about the other nodes in the network
- **Secure:** This blockchain is large in size as it is open to the public. In a large size, there is greater distribution of records
- **Anonymous Nature:** It is a secure platform to make your transaction properly at the same time, you are not required to reveal your name and identity in order to participate.
- **Decentralized:** There is no single platform that maintains the network, instead every user has a copy of the ledger.

Disadvantages:

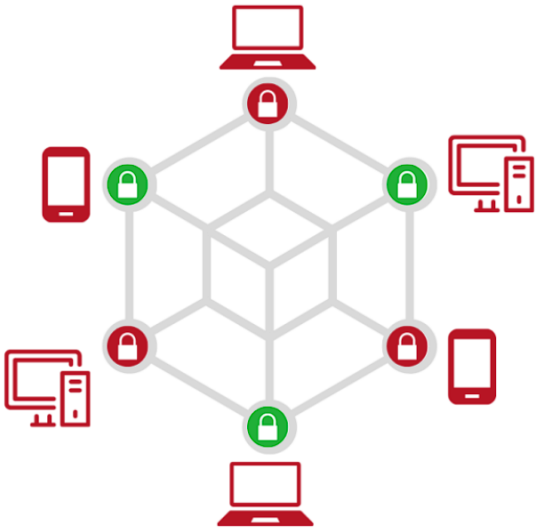
- **Processing:** The rate of the transaction process is very slow, due to its large size. Verification of each node is a very time-consuming process.
- **Energy Consumption:** Proof of work is high energy-consuming. It requires good computer hardware to participate in the network
- **Acceptance:** No central authority is there so governments are facing the issue to implement the technology faster.

Use Cases: Public Blockchain is secured with proof of work or proof of stake they can be used to displace traditional financial systems. The more advanced side of this blockchain is the smart contract that enabled this blockchain to support decentralization. Examples of public blockchain are Bitcoin, Ethereum.

2. Private Blockchain:

These blockchains are not as decentralized as the public blockchain only selected nodes can participate in the process, making it more secure than the others.

- These are not as open as a public blockchain.
- They are open to some authorized users only.
- These blockchains are operated in a closed network.
- In this few people are allowed to participate in a network within a company/organization.



Advantages:

- **Speed:** The rate of the transaction is high, due to its small size. Verification of each node is less time-consuming.
- **Scalability:** We can modify the scalability. The size of the network can be decided manually.
- **Privacy:** It has increased the level of privacy for confidentiality reasons as the businesses required.
- **Balanced:** It is more balanced as only some user has the access to the transaction which improves the performance of the network.

Disadvantages:

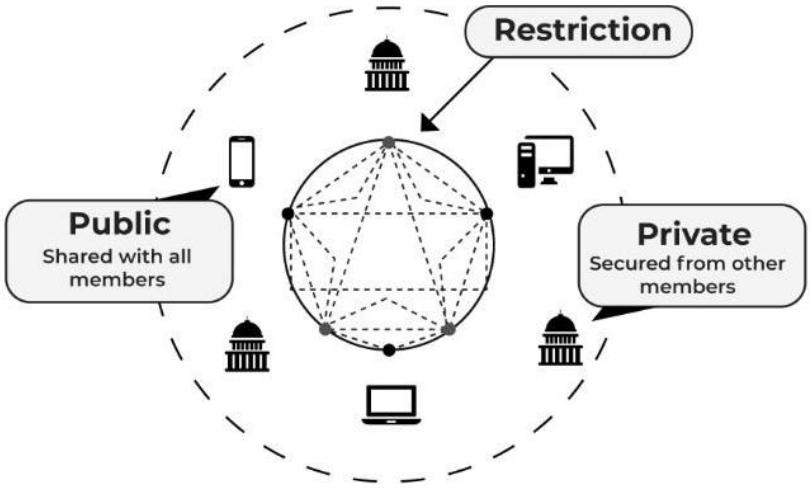
- **Security**- The number of nodes in this type is limited so chances of manipulation are there. These blockchains are more vulnerable.
- **Centralized**- Trust building is one of the main disadvantages due to its central nature. Organizations can use this for malpractices.
- **Count**- Since there are few nodes if nodes go offline the entire system of blockchain can be endangered.

Use Cases: With proper security and maintenance, this blockchain is a great asset to secure information without exposing it to the public eye. Therefore, companies use them for internal auditing, voting, and asset management. An example of private blockchains is Hyperledger, Corda.

3. Hybrid Blockchain:

It is the mixed content of the private and public blockchain, where some part is controlled by some organization and other makes are made visible as a public blockchain.

- It is a combination of both public and private blockchain.
- Permission-based and permissionless systems are used.
- User access information via smart contracts
- Even a primary entity owns a hybrid blockchain it cannot alter the transaction



Advantages:

- **Ecosystem:** Most advantageous thing about this blockchain is its hybrid nature. It cannot be hacked as 51% of users don't have access to the network
- **Cost:** Transactions are cheap as only a few nodes verify the transaction. All the nodes don't carry the verification hence less computational cost.
- **Architecture:** It is highly customizable and still maintains integrity, security, and transparency.
- **Operations:** It can choose the participants in the blockchain and decide which transaction can be made public.

Disadvantages:

- **Efficiency:** Not everyone is in the position to implement a hybrid Blockchain. The organization also faces some difficulty in terms of efficiency in maintenance.

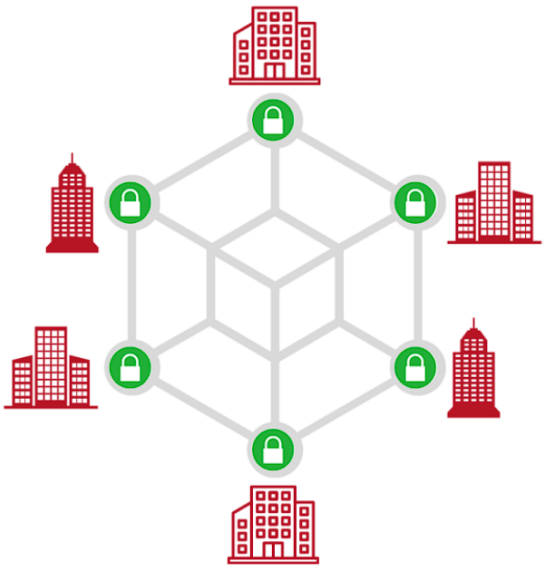
- **Transparency:** There is a possibility that someone can hide information from the user. If someone wants to get access through a hybrid blockchain it depends on the organization whether they will give or not.
- **Ecosystem:** Due to its closed ecosystem this blockchain lacks the incentives for network participation.

Use Case: It provides a greater solution to the health care industry, government, real estate, and financial companies. It provides a remedy where data is to be accessed publicly but needs to be shielded privately. Examples of Hybrid Blockchain are Ripple network and XRP token.

4. Consortium Blockchain:

It is a creative approach that solves the needs of the organization. This blockchain validates the transaction and also initiates or receives transactions.

- Also known as **Federated Blockchain**.
- the consensus process is controlled by a pre-selected set of nodes
- Some part is public and some part is private.
- In this type, more than one organization manages the blockchain.



Advantages:

- **Speed:** A limited number of users make verification fast. The high speed makes this more usable for organizations.
- **Authority:** Multiple organizations can take part and make it decentralized at every level. Decentralized authority, makes it more secure.

- **Privacy:** The information of the checked blocks is unknown to the public view. but any member belonging to the blockchain can access it.
- **Flexible:** There is much divergence in the flexibility of the blockchain. Since it is not a very large decision can be taken faster.

Disadvantages:

- **Approval:** All the members approve the protocol making it less flexible. Since one or more organizations are involved, there can be differences in the vision of interest.
- **Transparency:** It can be hacked if the organization becomes corrupt. Organizations may hide information from the users.
- **Vulnerability:** If few nodes are getting compromised there is a greater chance of vulnerability in this blockchain

Use Cases: It has high potential in businesses, banks, and other payment processors. Food tracking of the organizations frequently collaborates with their sectors making it a federated solution ideal for their use. Examples of consortium Blockchain are Tendermint and Multichain.

Difference Between Types of Blockchain:

Aspect	**Public Blockchain**	**Private Blockchain**	**Hybrid Blockchain**	**Consortium Blockchain**
Access Control	Public	Private	Mixed	Shared
Participation	Open to anyone	Limited access	Mixed participation	Restricted access
Governance	Decentralized	Centralized	Varied	Shared
Transparency	High	Variable	Variable	Variable
Consensus Mechanism	Proof of Work/ Stake	Various (e.g., BFT, PoA)	Combination of mechanisms	Consensus among pre-selected nodes
Examples	Bitcoin, Ethereum	Hyperledger Fabric, Quorum	Dragonchain, Ardor	R3 Corda, Hyperledger, Iroha

Semi-Private Blockchain:

Semi-private blockchains are run by a single company who grants access to any user who qualifies, and they typically target business-to-business users. They will be similarly managed as a company would manage private web applications.

Examples of semi-private blockchains could include ones for government entities for record-keeping, land titles, public records, etc.

Advantages:

- Launching a semi-private blockchain more closely resembles how a company runs a website.
- The business case is typically well planned ahead of and supports existing business, thus lowering the risk of failure.
- Companies can more easily integrate blockchain features into this article, I will provide a short explanation how each blockchain network works, along with what are the advantages of each network.

Disadvantage:

- **Limited Decentralization:** Control by a single entity raises centralization concerns.
- **Potential for Bias:** Single-entity control can lead to bias or manipulation.
- **Scalability Challenges:** Centralized control may hinder scalability.
- **Dependence on Controlling Entity:** Participants rely on the entity for access and governance.
- **Risk of Fragmentation:** Multiple independent networks may lack interoperability.

Use Cases:

- Supply Chain Management
- Healthcare Data Management
- Identity Verification
- Real Estate Transactions
- Regulatory Compliance

Sidechains:

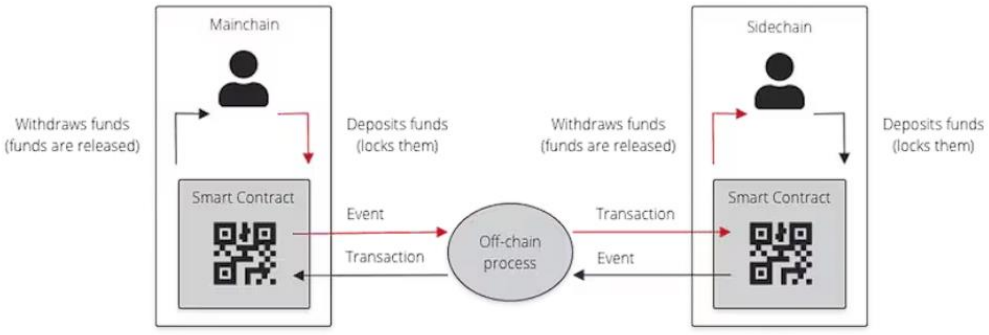
- Sidechains are parallel independent blockchains connected to the main blockchain via a two-way bridge, allowing the transfer of assets between them.
- They can operate autonomously with unique consensus mechanisms and block parameters, enabling efficient processing of transactions and customization for specific purposes.
- Sidechains offer scalability, flexibility, and EVM compatibility but come with trade-offs, including potential decentralization challenges and the need for robust security measures.

How Sidechains Work?

The operation of sidechains involves several key components, including a two-way peg and smart contracts.

The **two-way peg** is essential for facilitating the transfer of digital assets between blockchains. It allows digital assets to be locked on the mainnet and an equivalent amount to be unlocked on the sidechain, and vice versa.

Smart contracts play a crucial role in validating and verifying the transfer of digital assets between the parent chain and the sidechain. They enforce honesty among the validators involved in the two-way pegged operation, minimizing the risk of fraudulent transfers or halted transactions.



Mainnet to Sidechain illustration (Ulam.io)

Pros:

- **Scalability**: Sidechains provide a scalable solution by offloading some transaction processing from the main chain, reducing congestion and enhancing performance.
- **Flexibility**: The autonomy of sidechains allows for experimentation with different consensus mechanisms and parameters, fostering innovation and customization.
- **EVM compatibility:** EVM-compatible sidechains offer a seamless transition for developers, enabling them to deploy existing Ethereum smart contracts on the sidechain.

Cons:

- **Decentralization trade-offs:** Achieving high throughput on sidechains often involves sacrificing a degree of decentralization. This can lead to a concentration of power among a few validating nodes, potentially impacting the security of the chain.
- **Security Concerns:** Sidechains are responsible for their own security. Although a compromise in the security of a sidechain does not directly affect the main chain, this independence may introduce more security risks.
- **Complexity**: Implementing and maintaining sidechains requires significant effort and resources. The initial setup complexity and ongoing maintenance might pose challenges for adoption.

Examples of Sidechain Projects:

Several projects have embraced the concept of sidechains, each offering unique features and addressing specific needs within the blockchain ecosystem. Some notable examples include:

1. Polygon: Polygon employs a mix of sidechains to enhance Ethereum scalability using the Plasma framework. It aims to provide fast and low-cost transactions for decentralized applications (DApps).

2. SKALE: SKALE leverages elastic sidechains to offer developers a platform for building decentralized applications with high performance and scalability. It focuses on providing a developer-friendly environment.

3. Gnosis: Gnosis Chain utilizes the xDai sidechain to facilitate fast and stable transactions. It emphasizes usability and is often chosen for applications requiring quick and affordable transactions.

4. Loom Network: Loom Network specializes in creating scalable games and social applications on the blockchain. It uses DPoS (Delegated Proof-of-Stake) as its consensus mechanism to achieve high throughput.