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A Comprehensive Review on Dynamics of Block Chain Technology and its Applications

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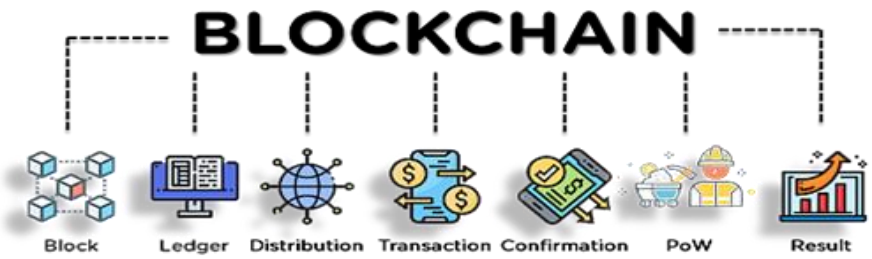
ABSTRACT
Block chain is an encrypted, distributed database that records data or it is digital ledger of any transaction, contracts that needs to be independently recorded. Block chain is the new paradigm, which is for distributing time-stamped digital records. It is a decentralized technology managed by cluster of computers. The decentralized, immutable, secure and transparent nature of block chain technology makes it so fascinating for all researchers. Block chain technology is a trending research area with wider challenges in almost all fields of applications. The paper aims to narrate the importance of this technology for the future, its advantages and its wide applications in various fields. Block chain application list include financial services, government services, health care, cryptography, commercial applications, entertainments and educational sectors etc.
Keywords: Block chain, transparency, distributed, and decentralized

I. INTRODUCTION

Firstly, let us understand the words block and chain. Block refers to a pack of sequence increasing list of digital records. The given blocks of digital records are linked as a linear chain and security is provided using cryptographic hash functions like SHA-256 and are time stamped [1]. Actually, a block chain is a type of data structure that provides secure and valid achievement of distributed agreement of digital ledger. A block, which is a pack of data, is processed using mining techniques for fitting the data as a block and is secured. To the new block that is formed, a hash of the previous block is included and therefore forming a chronologically ordered chain from the first block to the new block. This process repeats with new added blocks and the network is thus maintained.

Block chain technology adapts a distributed environment and the only trust is the consensus among the participants of the network. A transaction on the block chain is immutable, which means that no one in the network can edit it after it was recorded - there are no exceptions. Although if you make a mistake unintentionally, it is impossible to correct or delete it. In order to repair the issue, a new transaction should be created, that will reference the incorrect entry in the database. All recorded data are made visible thus making the entire process transparent. Moreover, block chain is a decentralized digital network as centralized systems suffers from single point of failure due to technical errors and security attacks [2].

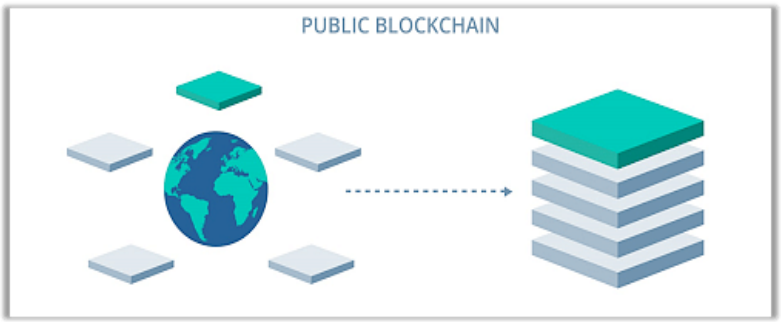


II. 3TYPES OF BLOCK CHAIN

There are majorly four types of Block chain.

1. Public Block chain

It is an unpermitted distributed ledger on which anybody can join and conduct transactions. It is a non-restrictive form of the ledger in which each peer has a copy. This also means that anyone with an internet connection can access the public block chain.



This user has access to historical and contemporary records and the ability to perform mining operations. These complex computations must be performed to verify transactions and add them to the ledger. On the block chain network, no valid record or transaction may be altered. Because the source code is usually open, anybody can check the transactions, uncover problems, and suggest fixes.

Advantages of Public Block chain:

- Trustable: Public Block chain nodes do not need to know or trust each other because the proof-of-work procedure ensures no fraudulent transactions.
- Secure: A public network can have as many participants or nodes as it wants, making it a secure network. The higher the network's size, the more records are distributed, and the more difficult it is for hackers to hack the all network.
- Open and Transparent: The data on a public block chain is transparent to all member nodes. Every authorized node has a copy of the block chain records or digital ledger.

Disadvantages of Public Block chain:

- Lower TPS: The number of transactions per second in a public block chain is extremely low. This is because it is a large network with many nodes, which take time to verify a transaction and do proof-of-work.

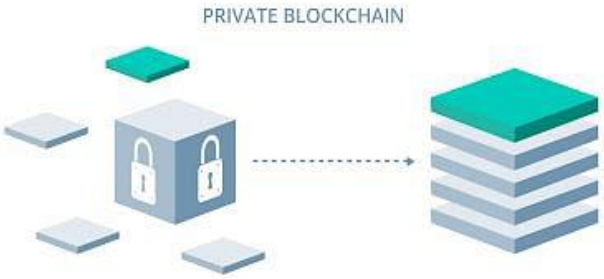
- Scalability Issues: Its transactions are processed and completed slowly. This harms scalability. Because the more we try to expand the network's size, the slower it will become.
- High Energy Consumption: The proof-of-work device is expensive and requires lots of energy. Technology will undoubtedly need to develop energy-efficient consensus methods.

Uses of Public Block chain:

- Voting: Governments can use a public block chain to vote, ensuring openness and trust.
- Fundraising: Businesses or initiatives can use the public Block chain to improve transparency and trust.

2. Private Block chain

A block chain network operates in a private context, such as a restricted network, or is controlled by a single identity. While it has a similar peer-to-peer connection and decentralization to a public block chain network, this Block chain is far smaller.



They are often run on a small network within a firm or organization rather than open to anybody who wants to contribute processing power. Permission block chains and business block chains are two more terms for them.

Advantages of Private Block chain:

- Speed: Private Block chain transactions are faster. because this private block network has a smaller number of nodes, which shortens the time it takes to verify a transaction.
- Scalability: You can tailor the size of your private block chain to meet your specific requirements. This makes private block chains particularly scalable since they allow companies to easily raise or decrease their network size.

Disadvantages of Private Block chain:

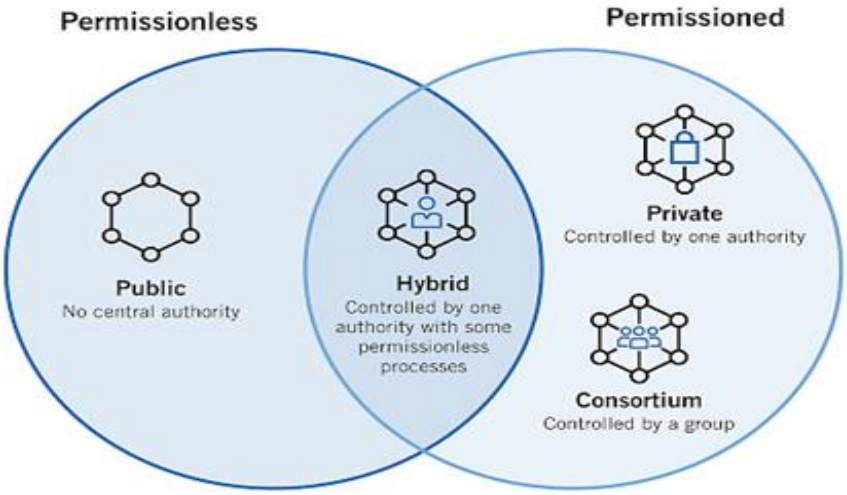
- Trust Building: In a private network, there are fewer participants than in a private network.
- Lower Security: A private block chain network has fewer nodes or members, so it is more vulnerable to a security compromise.
- Centralization: Private Block chains are limited in that they require a central Identity and Access Management (IAM) system to function. This system provides full administrative and monitoring capabilities.

Uses of Private Block chain:

- Supply Chain Management: A private block chain can be used to manage a company's supply chain.
- Asset Ownership: A private block chain can be used to track and verify assets.
- Internal Voting: Internal voting is also possible with a private block chain.

3. Hybrid Block chain

Organizations who expect the best of both worlds use a hybrid block chain, which combines the features of both private and public block chains. It enables enterprises to construct a private, permission-based system alongside a public, permission less system, allowing them to choose who has access to certain Block chain data and what data is made public.



In a hybrid block chain, transactions and records are typically not made public, but they can be validated if necessary by granting access via a smart contract.

Advantages of Hybrid Block chain –

- Secure: Hybrid block chain operates within a closed environment, preventing outside hackers from launching a 51 percent attack on the network.
- Cost-Effective: It also safeguards privacy while allowing third-party contact. Transactions are inexpensive and quick and scale better than a public block chain network.

Disadvantages of Hybrid Block chain:

- Lack of Transparency: Because information can be hidden, this type of block chain isn't completely transparent.
- Less Incentive: Upgrading can be difficult, and users have no incentive to participate in or contribute to the network.

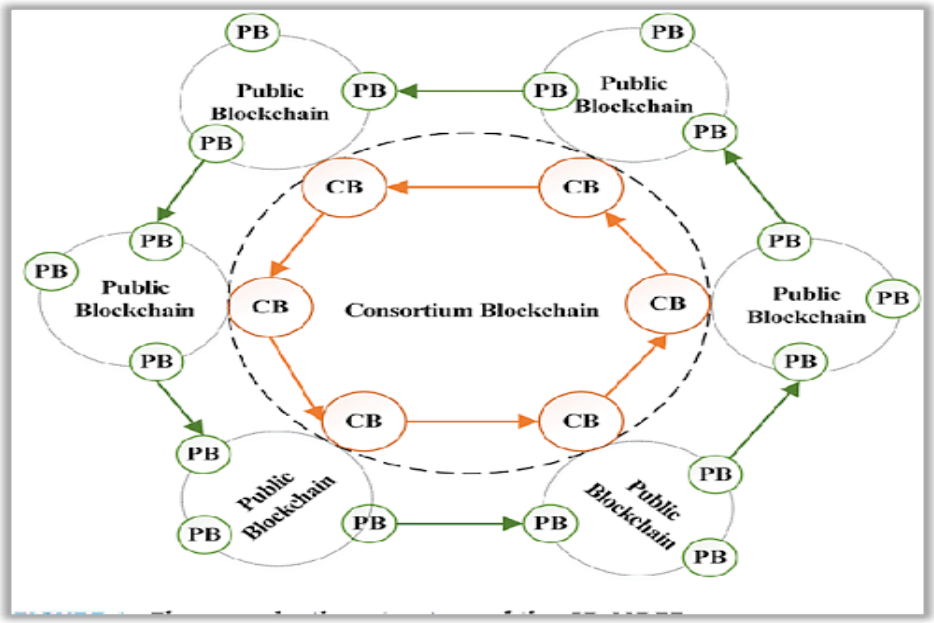
Uses of Hybrid Block chain:

- Real Estate: Real-estate companies can use hybrid networks to run their systems and offer information to the public.
- Retail: The hybrid network can also help retailers streamline their processes.

- Highly Regulated Markets: Hybrid block chains are also well suited to highly regulated areas like the banking sector.

4. Consortium Block chain

Ihe same hybrid block chain has both private and public block chain features, a Consortium block chain, also known as a federated block chain, does. However, it differs because it involves various organizational members working together on a decentralized network.



Predetermined nodes control the consensus methods in a consortium block chain. It has a validator node responsible for initiating, receiving, and validating transactions. Transactions can be initiated or received by member nodes.

Advantages of Consortium block chain.

- Secure: A consortium block chain is more secure, scalable, and efficient than a public block chain network. It, like private and mixed block chains, has access controls.

Disadvantages of Consortium Block chain.

- Lack of Transparency: The consortium block chain has a lower degree of transparency. If a member node is infiltrated, it can still be hacked, and the Block chain's rules can render the network inoperable.

Uses of Consortium Block chain:

- Banking and Payments: A consortium can be formed by a group of banks working together. They have control over which nodes will validate transactions.
- Research: A consortium block chain can be employed to share research data and outcomes.
- Food Tracking: It is also apt for food tracking [3].

III. APPLICATION OF BLOCK CHAIN TECHNOLOGY IN VARIOUS FIELDS

- **Finance**: Block chain technology is being used for fund transfers at domestic and international level. International level financial services are more beneficial as it is decentralized in nature on comparing to domestic one which is more of centralized. Block chain in financial services such as banking sector is believed to be power consuming and uses very less resources for ledger generation, maintenance and storage [4]. The decentralized nature of block chain makes it more secure and recoverable. Moreover, the current practice for fund transfer process at international level is time consuming and has high risks. Use of block chain in fund transfer makes the process immediate secure and transparent.
- **Energy Sector**: Block chain technology is used in energy sectors for the purpose of billing, sales and marketing, grid management and automation control and for providing security [5].
- **Urban development**: It is being used in developing smart city projects on addressing the issues like fraud, liability, and unskilled service providers [6].
- **Property and its Rights**: Block chain systems could be used to track legal ownership of a property. The smart contract system and decentralized nature of the technology may aid in "rewriting the basic tenets of property law, constitutional rights, and even judicial enforcement of law" [7].
- **Education and Innovation**: Various proposals have been made in using block chain technology in education field. The idea is to record the continuous process of education across various Universities. This includes learner's activity, record of innovative creations, marks scored, course completion details, certificate distribution and other management activities [8]
- **Media and Entertainment**: Another use case of block chain is "Intellectual property protection for digital media", for preserving transaction trails and content **Internet of Things (IoT)**: The Internet of Things (IoT) is the connecting of smart gadgets over the internet. The storage of IoT data in shared block chain ledgers allows all parties to track the provenance of components throughout the device's lifetime. Providing this information to regulatory bodies, shippers, manufacturers, and other interested parties is secure, simple, and cost effective [9]. The Internet of Things (IoT) is being utilized to track the level of safety of key machines as well as their maintenance. IoT enabled block chain provides a tamper free ledger of operational data and the resulting maintenance. Modification histories, and provide tamper detection for digital image management and distribution [10].
- **Health and Food safety**: The well-being of a human is taken care by health and food safety and supply chain department. Use of block chain in health care ensures transparency of medical data, improves clinical trial process on imparting secure access methods to data [11]. It improves the system of food chain supply and drug chain supply with resilient methods. This technology also helps people to claim for medical insurance and on the other hand handles false claims [12].
- **Transportation**: Transportation could be made block chain based which include vehicle information management including speed control, goods transportation and management, intelligently managing the road traffic and managing taxi hiring systems [13].
- **Business services**: Use of block chain in business services encourages in building unbreakable smart contracts and allows to store digitally permanent, audit-able records in cloud storage that show stakeholders the state of the product at each value-added step. Electronic voting in business sector is possible with block chain technology [14]. We know that, the product in a market is manufactured using

various components from different suppliers. Supply chain communication could be securely established using block chain.

- **Voting:** Block chain can be used to create secure and transparent voting systems, where each vote is recorded on the block chain and cannot be tampered with. Overall, block chain technology has the potential to transform many industries by increasing transparency, security, and efficiency [15].
- **Smart Contracts**: Block chain can enable the creation of smart contracts, which are self-executing contracts with the terms of the agreement directly written into lines of code. This allows for secure and automated transactions without intermediaries.
- **Digital Identity**: Block chain can help create secure and decentralized digital identity systems, where individuals have control over their personal information and can choose what data they want to share with whom [16].

IV. CONCLUSION

The properties of block chain technology makes it to apply for almost all real time applications and thus making all smart process today a smarter one. The potential of block chain is realized both at academic and industry level. Many block chain techniques are being proposed and is being standardized. But, apart from standardization it is necessary to test the block chain techniques based on various sectors. Therefore testing algorithms are required for block chain techniques. Though block chain is decentralized, it is centralized for a particular organization. It is necessary to make block chain technology fully decentralized. To improve the field of big data analytics, it should be enabled with block chain techniques[5]. Block chain technique proposed should apply a common standard across the various sector of an organization. The research should also focus on the direction that whether block chain implementation will be supportive or affect an organization. Smart city technologies and IoT controlled applications will be more effective, secure and avail transparent operation and maintenance if incorporated with block chain Block chain technology could be applied for handling satellite data communication. Thus this study provides a broader view of emerging block chain technology.

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