Blockchain Technology: An Overview

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Abstract

Change is inevitable in the field of technology and it is what has kept us going to for so long. Digitization has made lifestyle faster, easier and much more efficient. Organizations developed technologies with much higher productivity than their traditional methods. Let us consider the data collection, storage and transmission methods. It provided a much consistent and dependable database management system over the traditional file system. And every day the technology keeps on advancing to a better version of itself. Blockchain Technology is such an example of advanced technological innovation that has provided a whole new branch of technical solutions with much higher productivity. It also introduced a new style of business with cryptocurrencies that have high security due to advanced cryptography.

1. INTRODUCTION

Blockchain also called Distributed Ledger Technology (DLT) is an ingenious innovation of technology that overcomes the database management system's centralized operation. The most basic advantage that blockchain technology has is that it not centralized, unlike the database management system. All users have their secured records of the data. [1] [7]

The complex blockchain technology is a chain of blocks. Here each block is a digital collection of information and the chain represents the public database.

A simple analogy of blockchain can be given using Google Docs. Here when a document is shared, it is distributed rather than shared or transferred.

Blockchain is a revolutionary technology that reduces risk, stamps out fraud and improves transparency. [10]

2. HISTORY

Blockchain Technology which is a comparatively new development has its roots back from 1991. [2]

In chronological order the development of Blockchain technology is as follows:

- 1991

First work on a cryptographically secure chain of blocks by Stuart Haber and W. Scott Stornetta

- 1992

Bayer, Haber, and Stornetta incorporated Merkle trees to the design, the design collecting data using blocks.

- 2008

Satoshi Nakamoto publishes his/their research on "Bitcoin: A Peer to Peer Electronic Cash System"

- 2009

The first Bitcoin transaction was completed between two scientists.

- 2010
  - » A programmer from Florida completes first Bitcoin Purchase
  - » The Bitcoin market cap exceeds $1 million.
- 2011

1BTC = $1, giving cryptocurrency parity with the US Dollar

- 2012
  - » Popular shows include mentions about topics like blockchain and bitcoin.
  - » Magazine launched by early Bitcoin Developer Vatalik Buterin.
- 2013

BTC Market Cap surpasses $1 Billion.

- 2014

Gaming Companies start accepting Bitcoin payment.

- 2015

The number of merchants accepting Bitcoin payment exceeds 1,00,000.

- 2016

IBM announces a blockchain strategy for cloud- based business solutions.

- 2017
  - » Bitcoin reaches $1000/ BTC for the first time
  - » JP Morgan gives the blockchain ledger a vote-of-confidence.
  - » Dubai Government plans on being blockchain-powered by 2020.

- 2018
  - » Facebook to start a blockchain group and its cryptocurrency.
  - » IBM builds a blockchain-based banking system in collaboration with huge banking firms.
- 2019

Developers are looking forward to establishing vast decentralized ecosystem platforms.

- 2020

One of the promising blockchains is BaaS, short for Blockchain As A Service. It is a cloud-based service that allows users to develop their digital products.

3. LITERATURE SURVEY

- "Blockchain Technology – Beyond Bitcoin"

This paper describes how blockchain technology establishes a distributed consensus system. Blockchain is a distributed database of all records, transactions and events available to all the members of the network. Bitcoin is one of the most popular examples that are related to blockchain technology. Blockchain is a very successful technology that can be applied to financial and non-financial applications. One of the most compelling applications of blockchain is Smart Contracts. They are computer programs that can automatically execute the terms of the contract. When a pre-defined condition in the contract is met, all participants of the contract can make payments as per the terms. There are endless opportunities for the application of blockchain. This paper then goes on to describe bitcoin and its working. [5]

- "An Overview of Blockchain Technology: Architecture, Consensus, and Future Trends"

This paper gives an overview of blockchain architectures and their applications. Blockchain technology which is the base of Bitcoin has been a buzzword as of recently. Blockchain technology replaces centralized systems so that the transactions can take place in a decentralized manner. Blockchain-based systems have various applications in numerous branches like finance, non-finance and even IoT. Though there are certain drawbacks of blockchain technology that need to be overcome such as scalability and security. The paper goes through the structure of blockchain and understands its future trends. [6]

4. NEED FOR BLOCKCHAIN

The primary reasons which explain the need of blockchain are:

- Increased digital processing power
- Rapid growth in cybercrimes
- Increased use of bitcoin and cryptocurrency

Blockchain can be used as a shield against cybercrimes. Cybercrimes have increased a great deal in the past few years. Blockchain provides a secure medium for data to be stored and used with much higher security than the traditional database systems.

It also provides a trusted transaction medium which has higher transparency with increased data consistency and security.

It also ensures data security by providing resiliency, integrity, privacy and trust. Due to these features of blockchain, it is being used for the development of huge and reliable ecosystems.

5. ARCHITECTURE

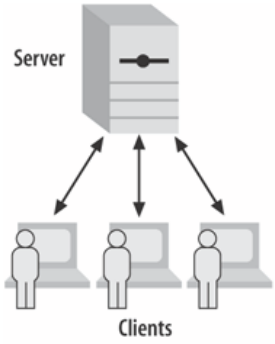
The traditional architecture of Database and WWW uses a client-server model as shown in Figure 1.

The distributed Blockchain Architecture uses a Peer-to- Peer Model as shown in Figure 2 where each participant in the network is allowed to modify the blockchain.

Blockchain consists of two vital structures i.e. pointers and linked lists. A pictorial representation can be seen in Figure 3.

All blockchain structures can be categorized as:

- Public Blockchain architecture
  In this architecture, all the data and access is available to anyone who is a part of it.
- Private Blockchain architecture
  Here the data is available to a set of specific users only.
- Consortium Blockchain architecture
  The procedures are set up and controlled by the



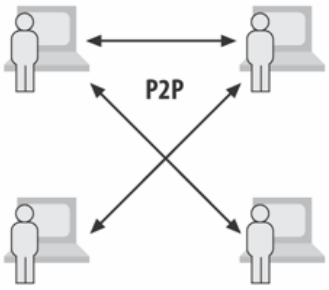


Figure 1: Client-Server Model **Figure 2:** Peer-to-Peer Model

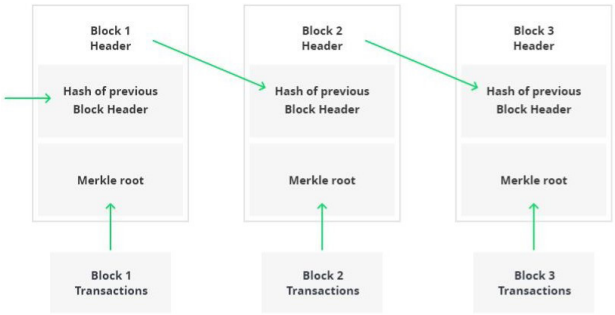


Figure 3: Basic Blockchain Architecture

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preliminary assigned users.

The difference between the three structures is described in the table 1 below:

Table 1: The difference in Blockchain Architectures

Property	Public blockchain	Consortium blockchain	Private blockchain
Consensus determination	All miners	Selected set of nodes	Within one organization
Read permission	Public	Public or restricted	Public or restricted
Immutability level	Almost impossible to tamper	Could be tampered	Could be tampered
Efficiency (use of resources)	Low	High	High
Centralization	No	Partial	Yes

6. SKILLS REQUIRED FOR IMPLEMENTATION OF BLOCKCHAIN

Every technology development has its own set of requirements.

For a developer to be able to create a blockchain system successfully, he/ she should know about the following topics:

- Software Engineering and Development
- Experience in open-source projects
- Working with large codebases
- Data Structure and Algorithms
- Peer-to-Peer network concepts
- Cryptography and Security
- Decentralized Ledgers
- Basic knowledge of Cryptocurrencies
- Data Security

Knowledge of the following programming languages could come in handy:

- C
- C++
- Java
- Python
- Ruby
- HTML
- CSS
- Node JS

7. HOW BLOCKCHAIN WORKS

The core components of the blockchain based on Figure 4 are:

- Node – User or computer in the network
- Transaction – Basic unit of a blockchain
- Block – Data structure used for keeping a set of transactions
- Chain – An ordered sequence of blocks
- Miners – nodes which perform the block verification process before adding it into the architecture
- Consensus Protocol – Set of rules for operations.
- Working of Blockchain

A block in blockchain consists of:

Data – Data depends upon the type of blockchain and the purpose it is used for

Hash of the block – It is generated with the help of a cryptographic hash algorithm. It helps to identify each block in the architecture.

Hash of the previous block – It is the hash from the previous block. This creates a chain of blocks i.e. blockchain.

Any attempt to corrupt blocks can change the data of the blocks and render the blockchain useless. Hence protocols are used to ensure that the blockchain system remains reliable for use.

8. HOW CAN BLOCKCHAIN BE IMPLEMENTED

The primary task is to decide whether the system being developed requires a blockchain system or not. Once we have established that blockchain technology is suitable for the project/ system being developed we then have to find out the architecture suitable for the development. It can be one of the three:

- Public Blockchain
- Private Blockchain
- Hybrid Blockchain

The flowchart shown in Figure 8.1 shows the questionnaire for whether a system requires blockchain or not. Based on the answers for that particular development we can decide

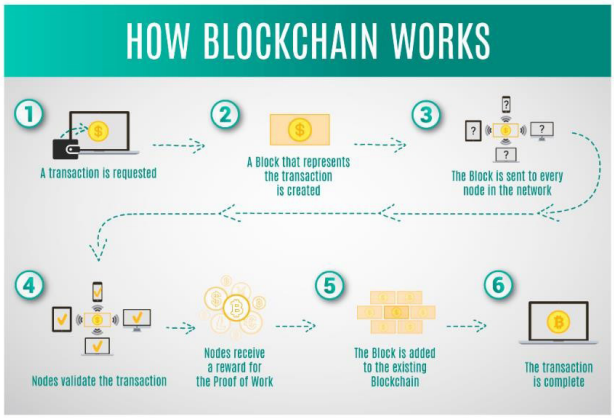

Figure 4. How Blockchain works

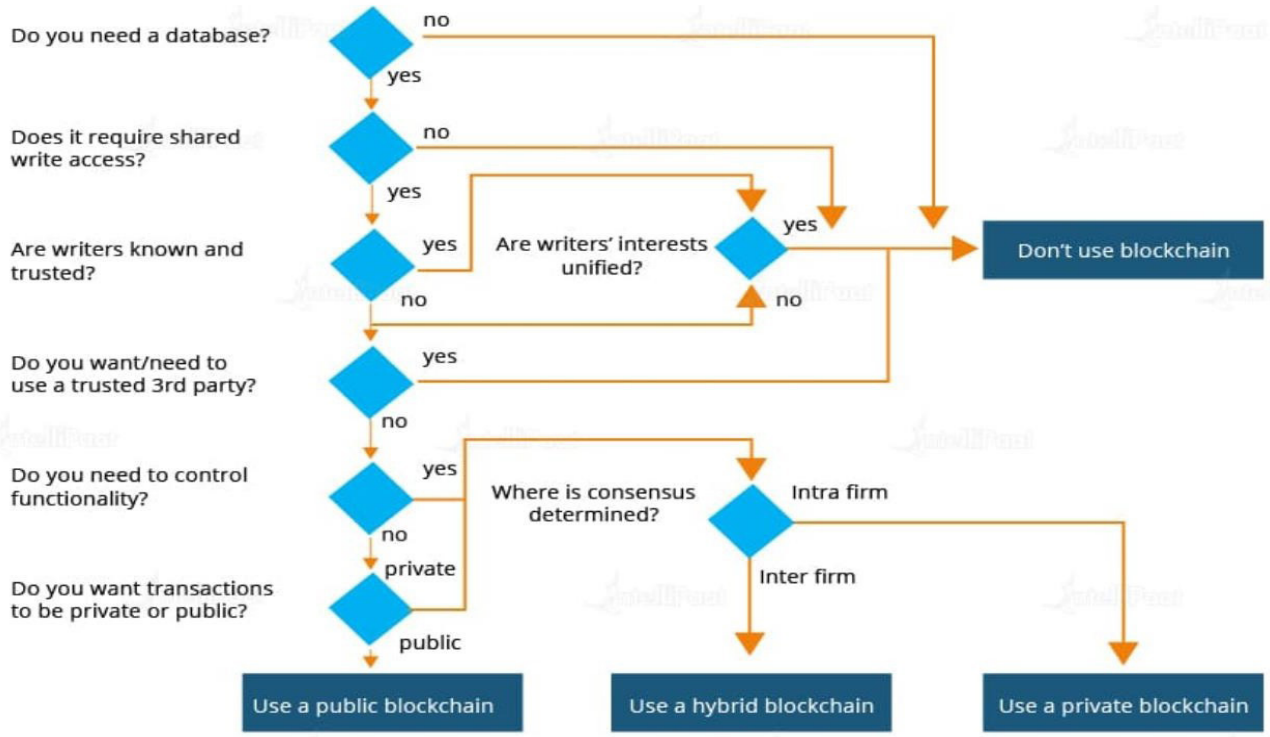

Figure 8.1: Flowchart

how we have to proceed with the development.
The decision parameters are as follows:

- Database Requirement
- Shared Write Access
- Writers/ Nodes Involved and their access level
- 3rd Party Requirements
- Control Functionalities
- Consensus Protocols
- Public or Private Transactions
- Firms involved

9. APPLICATIONS

Blocks in the blockchain are a reliable way to store any type of transaction. Hence it has a wide range of applications in the real world. [10]

- Banks

The banking industry will gain maximum benefit after using blockchain ecosystems. By integrating blockchain in banking transactions, the time required for each transaction will be drastically decreased.

- Cryptocurrency

Blockchain is the basis for cryptocurrencies like Bitcoin. The cryptocurrencies can operate without the need for a central authority due to blockchain. This eliminates transaction fees and reduced fees. [9]

- Healthcare and Medicine

When patient details are stored in a blockchain, the data is available without any difficulty and aids during treatments and medical procedures.

- Blockchain can also be used in

Property dealings, voting systems and supplier systems as it provided easy access to data with consistency and proper security.

10. FUTURE DEVELOPMENTS

Every new technology has various aspects that are yet to be discovered. With proper research, we can make use of the benefits of Blockchain in our everyday work. Major finance firms are investing resources to gain maximum benefits of the technology to gain maximum benefit. It can also be used in Smart contracts and Identity management. Blockchain has countless advantages and some are yet to be explored. [7] [8]

11. CONCLUSION

Blockchain is a buzzword in the technological development area. It is gaining more and more attention due to its unparalleled benefits. Though every technology has its pros and cons, researchers are trying to find maximum benefits and trying to come around the disadvantages of this technology. Through this research paper, we try to explore what blockchain is and understand its history and need. This paper also covers the basic concepts of blockchain by understanding its architecture. It also contains how a

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blockchain can be implemented and how a blockchain system works along with the skills required to implement the same. It also addresses the various fields of application and some are yet to be explored.

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