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Blockchain and it's Applications

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ABSTRACT

Blockchain technology, first introduced as the underlying technology for Bitcoin in 2008, has evolved into a transformative force across various industries. Blockchain is a decentralized, distributed ledger that records transactions securely, transparently, and immutable. Its core attributes— transparency, security, immutability, and decentralization— make it highly attractive for applications beyond cryptocurrency. One of the most notable applications of blockchain is finance, where it enables peer-to-peer payments, reduces fraud, and enhances security in digital transactions. Smart contracts, self-executing contracts with terms directly written into code, have found applications in legal agreements, insurance, and supply chain management. Blockchain is also being explored in healthcare to secure patient records, in voting systems to ensure election transparency, and in supply chain management to track the provenance of goods from production to delivery. In addition to finance, healthcare, and supply chains, blockchain is used in industries like real estate, energy, and gaming. Its decentralized nature allows for more equitable systems where trust is distributed among participants, reducing the reliance on intermediaries. As the technology matures, challenges like scalability, regulatory hurdles, and energy consumption are being addressed, paving the way for broader adoption. In conclusion, blockchain has the potential to revolutionize industries by providing secure, transparent, and decentralized solutions, with applications expanding rapidly as technology and regulatory frameworks evolve.

Keywords: Distributed Ledger, Consensus, Cryptography, Smart Contracts

HISTORY OF BLOCKCHAIN

Blockchain as we have seen is a buzzing technology a new technology but actually the concept on which the blockchain is built is not new.

The journey of blockchain from 1991 till 2018 is from Blockchain 1.0 then 2.0 and currently we are living in an era of Blockchain 3.0.

In 1991 the cryptographic technique was used to make a secured block to store the data. The first work of time stamp control was done in 1991 by Stuart Haber.

In 1998 the first decentralized digital currency was introduced by the name of bit gold. It was made by Nick Szabo.

In 2000 the first theoretical concept of cryptography secured chain of block which we call a blockchain was introduced by Stefan Konst.

In 2008 Satoshi Nakamoto released a paper on Blockchain in finance in that he introduced a term known as bitcoin. Bitcoin was an application of blockchain which was the first digital cryptocurrency, and it becomes so famous because it solved the problem of double spending and there was a drastic change in financial institutions.

In 2014 the system changed from 1.0 to blockchain 2.0 many new cryptocurrencies came into the market like ripple, ether etc. and there were many others which came, and the focus was still on cryptocurrencies, but work shifted from cryptocurrencies to smart contracts due to Ethereum. In 2013 Ethereum was developed and in 2015 Ethereum was finally launched by Vitalik Buterin and the concept changed from bitcoin to smart contracts.

In 2015 a major project which is known as an enterprise blockchain. Hyper ledger an open source blockchain project was started by Linux which allowed many industries to focus on blockchain project.

In 2018 The complete picture changed. The concept from bitcoin, smart contracts was shifted to application oriented. In 2018 the blockchain 3.0 had come into existence. It was used for different type of applications whether it is health, wealth, Supply chain, Finance or in medical line or government records like land registers etc.

Blockchain 3.0 the era where we are currently living is came in existence in 2018.

INTRODUCTION

Blockchain is a distributed ledger technology that enables the creation of a secure and transparent record of transactions. It is most commonly known as the technology behind cryptocurrencies like Bitcoin, but its potential applications extend far beyond digital currencies.

What is Blockchain?

At its core, a blockchain is a chain of blocks, where each block contains a list of transactions. These transactions are recorded in a public or private ledger and are validated by a network of computers (known as nodes). Once a block is added to the chain, it is nearly impossible to alter, making blockchain a secure and immutable record-keeping system.

Blockchain Definition:

Blockchain is a cryptographically secured, record of transactions stored on a decentralized network. Where each block contains various transactions which is approved after a complex consensus algorithm.

Key Terms in the Blockchain:

- i. Distributed Ledger
- ii. Consensus
- iii. Cryptography
- iv. Smart Contracts

i. Distributed Ledger

It is a data structure which is keeping the record of the transactions.

It is possible that in a Blockchain there is only one ledger or depending upon the applications, there can be many ledgers.

ii. Consensus or Mutual agreement

The integrity of data is maintained in the transaction by hashing the transactions by storing it at a Merkle hash.

The different nodes in the blockchain are keeping the same data because of the consensus mechanism algorithm.

Complex algorithms which when solved then only the transactions become the part of the block and the block is committed. It joins the chain only after approval of those complex consensus mechanism algorithms.

Example of consensus mechanism:

- Proof of Work
- Proof of stake
- Proof of elapsed time
- Proof of burn
- Proof of capacity
- Proof of Activity
- Proof of Authority
- Proof of History
- Proof of Importance
- Proof of Contribution
- Proof of Space-time

iii. Cryptography

Blockchain uses the traditional cryptographic algorithms, but it focuses on hashing.

Cryptographic hashing technique makes this blockchain secure and there are two levels of security.

The transactions are stored in the form of a Merkle tree. The root hash is stored in the block.

Security is achieved when one block joins to the previous block by using the hash of the previous block.

So, these two hashes which are used in blockchain added security feature. This cryptography added security to the blockchain platform.

iv. Smart Contract

The Smart Contract is a self-executable code which executes itself on every transaction processing.

Whenever a transaction occurs this smart contract is executed at the background, and it is a part of every blockchain platform.

In every transaction processing the smart contract does the Enrichment, Executing the transaction, verifying and finally validating.

TYPES OF BLOCKCHAIN PLATFORMS

Public Blockchain Platform

Private Blockchain Platform

Consortium Blockchain Platform

Public Blockchain Platform:

Permissionless:- No permission is needed anyone can join and read, write and participate in consensus mechanism algorithm.

Fully Decentralized

Open for all

Participate in Consensus

Anonymous Nature

Transparency

Slow transaction speed

High transaction cost

Private Blockchain Platform

- Permissioned
- Single Organization
- Partially decentralization:- The content can be changed, or it can delete the block
- Abide rules:- Who is reading and who is writing they has to follow the rules.
- Low transaction fees
- Fast transaction speed

Consortium Blockchain Platform

Consortium Blockchain Platform is similar to a Private Blockchain Platform with only difference is that in the private blockchain platform it is a Single organization which is dealing with whereas in Consortium blockchain platform more than one organization collaborate together.
It is fully decentralized because more than one organization is controlled.

Open or Close Blockchain Platform

These are used for who can read the transactions in the blockchain.

Here,

Open means Anyone can read

Closed means Restricted to read

On base of it we have,

Public Open:- It is open to write, and open to read.

Public Closed:- It is open to write and closed to read. Only who get the permission they can read it.

Private Open:- Writing permission is private but reading is open so anyone can read.

Private Closed:- Writing permission is private and even reading permission is also restricted.

TYPES OF APPLICATIONS OF BLOCKCHAIN

Different blockchain platforms is used in different sectors.

Public and Closed

- Voting
- Voting records
- Whistle blower

Public and Open

- Currencies
- Betting
- Video games

Private and Closed

- Construction
- National Defence
- Law enforcement
- Military
- Tax returns

Private and Open

- Supply Chain
- Government financial records
- Corporate earnings statements.

MYTHS IN THE BLOCKCHAIN

Blockchain is a Bitcoin or any other Cryptocurrencies.

Anything and Everything in the world cannot be solved using the Blockchain.

Blockchain did not prevent from fraud and corruption. Blockchain is also a technology, and it have its own advantages and limitations.

Note: For some applications database technology is good and for some applications Blockchain technology is good.

Some people mess-ups between blockchain and distributed database. So, people think of that distributed database can be replace with the help of a blockchain and it is not like that.

Blockchain is not a distributed database.

Note

So, we need to carefully think of that what we can put in a blockchain and how we can utilize better to solve the problem .

So, it is not like that we can store any data on a blockchain. It has its limitations . if anyone plan to store large files on a blockchain that is not potentially a good use case for blockchain.

There are problems for which we can apply blockchain . so, we need to carefully analyse the trade-off of blockchain and accordingly try to apply this blockchain.

What is the right place to use the blockchain?

What is decentralization truly means?

Let us understand these two things with the help of a use case.

Use case

Supply chain in petroleum industry:-

Let us look into that how the petroleum industry work with different kinds of products and different kinds of middleman in the entire end-to-end path.

It all starts with crude purchase.

Purchasing the crude oil.

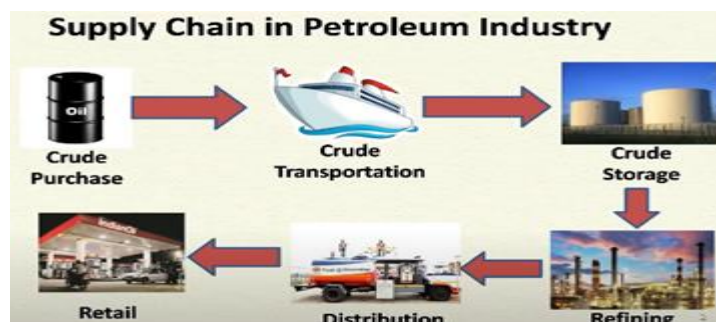
Crude oil is transported to certain crude storages.

From storage it is sent to the refinery for refining the crude oil.

After refining the crude oil, we get different types of products like petrol, diesel and other subsidiary products etc.

Finally, these products distributed to different retailers.

This is the overview of petroleum supply chain.



Who are the players in this entire end to end petroleum supply chain in India:-

Ministry of petroleum and natural gas

Under the ministry we have three bodies they are

- I. Up stream
- II. Industry body
- III. Down stream

I. Upstream Operators

Upstream Operators are mostly in the exploration and the production of crude oil and then supply that crude oil to the corresponding storage and they are the downstream operators.

Upstream operators are

ONGC

OVL

Oil India Ltd

Private Exploration & Production company.

II. Downstream Operators

Downstream Operators are who basically refine the crude oil and take care of the marketing the different products which are basically extracted from the crude oil.

Downstream operators are

Indian Oil is the refining company and CPCL & BRPL is taking care about the marketing.

Bharat Petroleum is the refining and NRL who takes care of marketing.

Reliance India Ltd takes care about both refining and marketing.

Hindustan Petroleum is taking care of refining and the MRPL is taking care of marketing.

III. Industry bodies

These different Industry bodies act in between the upstream and downstream operators.

These industry bodies associated with this entire petroleum supply chain.

Industry bodies are-

petroleum Planning and Analysis Cell

Centre for High Technology

PRCA

Petro Fed

Oil industry Safety Directorate

Petroleum India International

Requirements for a successful supply chain

Minimization of material procurement

Maximization of manufacturing capacity and sales

Meet demand numbers

Respond quickly to market opportunity by purchasing the production shortfall from other players

Objective of each production unit would be to maximize the throughput and its margin

Procurement would purchase the feedstock with not the best yields at lowest cost

The interesting facts here is that the objective of each of these production units is to maximize the individual profits and their margin.

So, we look into the requirements of this kind of complete supply chain management we have a kind of proper supply chain architecture, and all these different players need to coordinate with each other.

Need strong coordination among the players

Need a kind of strong coordination among all these players at different level of supply chain starting from the production of the crude oil to its distribution, then refining, then marketing and finally going to the final retail in this entire end-to-end part need a kind of strong coordination.

Here question comes that who is going to establish this coordination.

Everyone has their objectives. So, they are competitors of each other.

Everyone tries to manage a kind of proper demand supply and so on.

So, what way we can design a kind of architecture or a design a kind of platform through which we can coordinate with each other in a successful way. This is basically a kind of decentralized architecture, where we have multiple different organization, everyone has their own governing structure, everyone has their policy of doing a marketing but at the end of the day they are working on a common product, working on a common marketplace and in that way, they can collaborate with each other or coordinate with each other in some way everyone might get benefited out of it.

So, this the kind of decentralized architecture that we are talking about.

How we obtain the real time information from the stakeholders.

We have multiple options they are

A web-based portal:-

Problems of decentralization in web-based portal

What is the guarantee that the information is submitted to that portal is correct.

Who is going to manage this portal.

In this entire business we do not have any central coordination

who is going to validate the information is correct.

And another problem which might arise that what if someone denies that information later on.

So, this is the kind of challenges the kind of problems that we have.

So, we need a decentralized solution.

That means no one trust each other, they should cooperate with each other.

To solve this problem BLOCKCHAIN is the answer.

So, blockchain can specifically solve this particular problem of decentralization in this context.



CONCLUSION

Blockchain is a revolutionary technology with the potential to transform a wide range of industries. Its ability to provide secure, transparent, and decentralized record-keeping opens up new possibilities for innovation and efficiency. As blockchain technology continues to evolve, its applications are likely to expand, offering new opportunities for businesses and individuals alike.

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