Blockchain Technology for Supply Chain, Health Care, Intellectual Property Rights, E-voting

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Abstract: Blockchain technology (BT) is probably going to produce ground-breaking changes in supply chains, healthcare, IPR etc. BT provide better transparent methods to remove various issues faced in these areas. It improves the benefits by adapting the BT in various fields. It improves health management, identify fake drugs sold in the market, etc. The improved technology of BT can be used in various legal areas like improve IP rights management, working of IP offices etc. In this paper we look into the brief about how BT can be used in the above area.

Keywords: Blockchain Technology, Supply Chain, Healthcare, Counterfeit Drug, e-voting, Intellectual Property, Copyright Management.

1.   Introduction

Blockchain technology uses a group of people or community to validate, synchronize, the digital ledger which is distributed over multiple users. The blockchain technology was introduced by Satoshi Nakamoto, through his white paper on the well-known cryptocurrency Bitcoin [1]. It has the characteristics of being decentralized, transparent, and to stay anonymous in the network. The transactions in bitcoin and blockchain are validated by the peers in the network which can be individuals or other agents. All the valid transactions are timestamped chronologically and then broadcasted to all the participants in that network. They are then stored cryptographically in the blocks.

Blockchain uses a decentralized consensus to validate transactions requested, executed, created etc. The peer nodes in the network follows a consensus protocol that ensures the nodes are appended to the shared digital ledger in proper order making the records transparent and traceable. The immutable and secure blockchain ledger is obtained by the irreversible one-way cryptographic hash functions. This consensus helps in generating trust in the system. This makes it very tough for the attacker to tamper this record. [2]

A transaction is essentially a data structure carried on a block. Each block has at least two unique components: the block header, which contains a unique hash (called the merkle root) that uniquely identifies A transaction in a blockchain is a data structure stored in a block. Every block stored in the leger contains a block header, a Merkle root -the unique hash which identifies the block uniquely.

the block header contains a unique hash called the Merkle root that uniquely identifies a block, the timestamp of the transaction, a nonce, the hash of the previous block and the transaction list, which contains new transactions. The Merkle tree makes the verification of the transaction easier. The transactions between the users also differ from each other. The block that wins the race for mining will be added into the existing block and other competing candidates are rejected. This happens in every 10 minutes. [5]
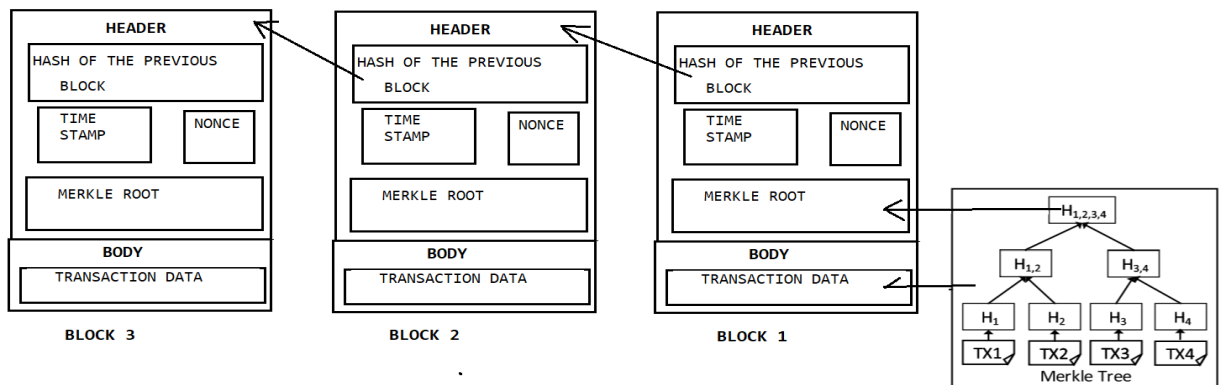

Figure 1. The Structure of a Blockchain

Work Flow of Blockchain:

1.　A transaction is started and announced to other nodes
2.　Other nodes confirm the transaction and mining to create a new block and store the transaction
3.　A new block is successfully created by a miner which is then and advertised to other nodes
4.　Other nodes validate the new block and add to its local copy of blockchain ledger
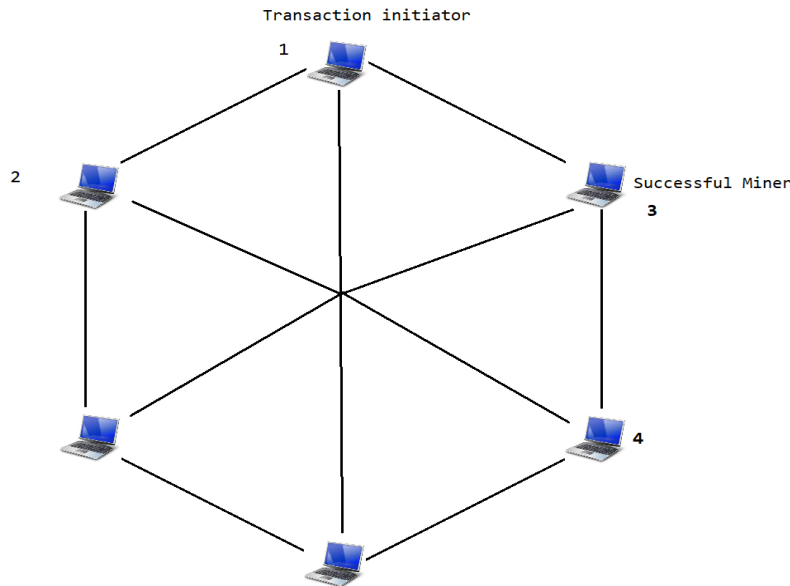

Figure 2. The Work Flow of a Blockchain Network

BCs are used in various bids like supply chain, medical field, identification, IP protection etc. BCs can be used as public BCs or permission less and private BCs or permissioned BCs. In publics BCs anyone is allowed to be the part but in the private BCs require the permission.

2.　Use of Blockchain in Manufacturing, Procurement, Distribution Domain of Supply Chain

In a typical supply chain, the raw material, money etc flow through distribution centre, vendors etc. Transaction happen between these vendors, the distribution centres and the creators of the product. Trust related issues can happen between them in financial matters. The double entry problem can be solved with blockchain. It will be easy to keep track of who started the transaction.

The ability of BT enables to record all the activities by which it can improve the supply chain visibility and transparency. [4] It can in turn manage resources, decrease inventory cost understand the demand of the product. Along with Big Data analytics the companies can capture and analyse data and make real time decisions

BT has a huge role in procurement cycle of SCM. In traditional system, the product delivery, invoice generation, payment etc is taking a lot of time. The BTs smart contracts can reduce this payment gap by the use of digital contracts between the partners involved and banks. This smart contract forms a rule book for the transactions. managing the purchase order, enquiry, origin of goods etc can be maintained without hassle in BT technology.

BT plays a good role in the manufacturing area of SCM. Data generated from the first step of obtaining the best raw materials to the use of tools to improving the product can be validated using BT. The use of smart contracts can help in bringing huge automation of plants. Currently robotics and Big data analytics along with the blockchain can help in better documentation with which better decision can be made. By providing a unique id, the entry of counterfeit items into the supply chain can be reduced by checking at every point of manufacturing [3].

The broader is the supply chain, chances for disparity occurring in flow of information, product quality etc increases. This makes a huge difference in customer satisfaction. Integration of RFID devices, GPS in vehicle supply chain can provide information for BT. These data once integrated in BT can't be changed and further be used in future analytics.

Organisations are implementing BT in their supply chains. These data must be now analysed and the adoption area must be studied.
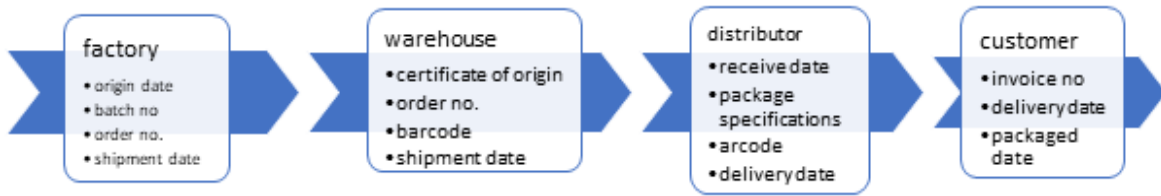

Figure 3. Blockchain in Supply Chain

3. Blockchain Technology in Healthcare

Blockchain technology is used to collect and exchange the clinical, research and useful data related to healthcare. This allows the clinical researchers, doctors, pharmacists, and other healthcare providers to obtain medical data in a faster and secured manner. This also allows the authorities to use information and combine business and professionals. The BT helps in providing the related information in a transparent manner. This also helps in reducing the usage of outdated information and providing proper treatment.[4] It can be used to keep track of all the past consultations of the patient with doctors providing a clear view about the patients to the doctor.

Wearables can be used to determine the health parameters like blood pressure heart rate etc which is retrieved through an app. This data can then be used and stored in BC. This data can also be used to treat the patient and also medical research. The patients sharing their data for medical research can be given financial support.

BT can help to put a lock on the counterfeit drugs produced. According to World Health Organization around10%-30% of the drugs are forged. [5].16% of such drugs contain wrong ingredients or wrong levels of necessary ingredients. They are different from original product in quality because of incorrect levels of active ingredients. To ensure authenticity and traceability of the drugs the companies can register a product on the Blockchain These drugs affects the treatment of disorders like cardiovascular, cancer to lifestyle medicines for supplements. These fake drugs contain the ingredients in too low or too high percentage which can turn dangerous to humans. The hyperledger of BT can add a timestamp when each drug is produced, we can then get when, where and who produced these drugs. This can be used to identify the ownership of the drugs and will be transparent to everyone from the manufactures till the patient using the drug.
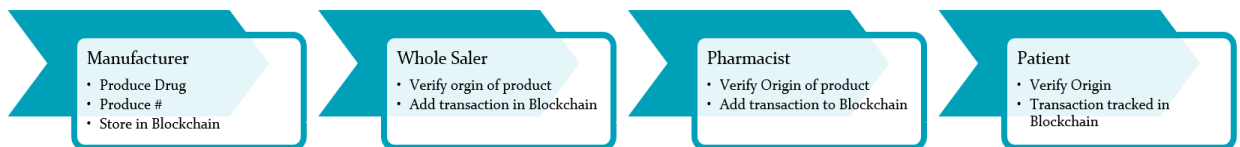

Figure 4. Blockchain in Health Care

Currently there is no method to track drugs. The users do not have complete vision of the drug's origin. The presence of the company access in the drug Blockchain is proof that drug they produced is authentic. If a problem is detected and batch is to be withdrawn from market, Blockchain technology makes it easy to find the product and avoid complication. It allows to track the product down the supply chain. Blockchain also allows the labs to act in case of any problem by identifying the location of the drug.

Table 1. Blockchain based healthcare system

Name	Blockchain Used
MedRec	Ethereum
Estonia Healthcare	KSI Blockchain
Hashed Health	Ethereum, Hyperledger
Tamarin.health	Ethereum

4. Blockchain Technology in Intellectual Property Rights

BT is a good tool for implementing judicial affairs, Intellectual property rights and in other government offices. It can store data which can be used a legal evidence. BT can collect exact data in real-time while the event is happening. Once BT is combined with the system, no process can bypass its mechanism. Any data including date and time of the event, participating persons, etc can be integrated into the BT data. This can also help the authorities to identify the fake items [8]

The BT technology along with artificial intelligence can completely automate the system. By using CAD, the design, trademarks, patent, etc are stored as CAD files, in the blockchain, then by using AI based software official can validate whether they are already existing, or anyway similar to the available data.

BT can also help in managing the copyrights. As these rights are owned by different legal individuals. Identifying the legal owner and payment to them when their creations are used offer great challenge. These data are not stored in any public database as the maintenance of these are expensive. Thus, implementing from scratch using blockchain will make it cheaper and easier. Identifying the owners also will be easy through BT. [9]

Using BT the authenticity of goods can be verified. By providing barcode, QR codes or RFID codes, and recording them in a blockchain will help in tracing the products after selling them. The real-time data about how many pieces sold, how many available in the stock with supplier and retailer can provide future better flexibility to the market. This will make the whole process easier and cost effective.[9] This also makes efficient tracking of goods even after the sales and produce spare parts as per requirement. The use of RFIDs on goods enables the tracking of goods on highways by scanning them using RFID scanners and there by detecting the fake items at that very moment.

Table 2. Blockchain based Notary System

Name	Blockchain Used	Features
https://notary.bitcoin.com/	BitcoinCash	Creates your own universal timestamped proof of a document's existence.
https://www.acronis.com/en-us/blockchain-data-authentication/	Ethereum	Preserves the authenticity of the personal and business data
https://stampd.io/#/notarize	Bitcoin, Ethereum	allow a public verification of the issue history
https://stampery.com/	Bitcoin, Ethereum	process up to 10^9 data sets/second,

5. Blockchain Technology in Electronic-voting

E-VOTING is another area which can be ordered by BT. The Blockchain enabled e-voting BCEV provides all e-voters a wallet or a coin with user credentials. Using this wallet user can cast the vote whom he supports. [6] This coin can be used only once. These e-voters can cast their votes through smart phones anonymously. BCEV uses biometrics, government issued ids like driving licence, passports and real time ID along with encryption to provide verification of voters. Each vote casted is stored in the BTs immutable ledger and verified by peer to peer network. Its audit checks no vote is changed, and there are no fraud votes. [7] The BT can also speed up the election process. The decentralized nature of blockchain makes it difficult for the bad voters to tamper the election system. Also, the voters are made anonymous offering secure and confidential election process.

In the last 3 years many blockchain based e-voting proposals had come up. The BitCongress was one of the BC based voting system implemented. It used colored token of BitCoin along with Counterparty which authenticates voters. It also used Ethereum based smart contracts to count the votes. Unfortunately this venture closed down.

Another proposal is FollowMyVote using the Bitcoin fork, Bitshares. This system was weak as the blockchain used was not very strong. This also need a centralized authorization to check the voters identity. Open Vote Network, Polys are implemented on private Ethereum fork.

Another system was based on Shamir's secret sharing scheme which implemented PayToScriptHAsh based on bitcoin. This used multiple signature scripts. CircleShuffle based on CoinsShuffle was also used to decouple the input of transaction happened in the blockchain

Table 3. Blockchain based E-voting System

Name	Blockchain Used
BitCongress	BitCoin
FollowMyVote	Bitcoin fork
Polys	Ethereum fork
Votem	Ethereum
PayToScriptHAsh	BitCoin

6.   Tools Used in Blockchain

Let look into some of the tools used to implement blockchain

Geth

Geth is implemented using Go programming language for Ethereum node. It acts as a Ethereum node in blockchain. It can be used to mine tokens, transfer tokens, Create smart contracts etc on Ethereum Virtual machine. It is the most widely used client implementation to establish p2p communication. It allows to join an already available network or to create a new one. Geth van be started in 3 different modes:

- Full mode allows to download all the blocks and executes every block for creating states
- Fast mode which is also the default mode downloads the blocks and validates the headers. The states are also downloaded which is then verified against the headers.
- Light mode downloads the block headers, block data and checks them randomly.

Remix

Remix is an open source tool which helps in writing Solidity contracts from the browser. It is written in Java Script which allows to be used locally and in the browser. It allows the smart contracts to be tested, debugged and deployed.

Truffle

Truffle provides environment for development, testing blockchain in Ethereum blockchain. It help in building easy decentralized applications. It allows to link, deploy, compile built in smart contracts. It provide network management of private and public networks.

Ganache

Ganache is an Ethereum blockchain used for distributed applications. It allows the development, deployment and testing of distributed applications in a safe environment also in a deterministic way. It cost zero transaction fees. The gas prices and speed of mining can also be changed.

7.   Conclusion

In above discussions we saw BT has immense potential to eliminate the role of a 3rd party. In the future these intermediates can be ignored and the interactions can be can be improved through BT. As described above BT has vast openings in supply chain, BEV, healthcare IPR etc. It can ensure security, counterfeit goods, drugs can be controlled, more accurate election results can be produced, paper based elections can be reduced. BT improves the faith between the participants of the trade. It also improves the swiftness and security of the transactions. Few countries like turkey allows the use of timestamped BC records as evidence. If the courts approve those claims then IPR right holders can be create and conserve the evidence for their IP claims which can be stored in a unified database.

In the course it is sure that Blockchain Technology is highly useful in supply chains, health care, IPR even the longterm promise of it need histrionic changes and many difficulties are on the way which will need immense effort and discussions.

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