

Blockchain in supply chain management of medicines

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Blockchain is a decentralized and distributed database that maintains a continuously growing list of secured data records. It is a technology that enables peer-to-peer data to be stored. Blockchain is designed with a little intervention of human unlike data base system/ERP system which need much intensive human efforts for operations.

Distributed system is a series of number of computers (nodes) connected to each other independently and there is no central node. One node downtime does not affect the other node activity. There are three categories of blockchain namely Public, Consortium/Permissioned, and Private Blockchain. All three types of blockchains use cryptography to allow each participant on any given network to manage the ledger in a secured way without the need for a central authority to enforce the rules.

Public and consortium blockchain allows validation of nodes one after another. Both blockchains cannot make the changes in the encrypted information once they added. Only difference is that public blockchain is open to anyone with the rights of validation remains in hands of all nodes and any one can read the data encrypted in blocks while in consortium blockchain, the data is readable by all or limited users along with the validation process depends upon the consortium of certain nodes. In this, mutual consensus of selected nodes is essential. At last the private blockchain driven by the central authority who manages the validation, modification, addition, deletion and the read rights are solely limited by the central authority.

The powerful feature of blockchain is that we can create a platform where data/transaction occurs among non-trusting entities. It is not necessary that the participating nodes in the network need to know each other. All nodes develop a trust on each other because blockchain provides the ability to monitor and validate chain for themselves. The irony is that the mutual distrust among participant is the thing which keeps the blockchain secured and verified based upon the transparency, recording and updating with time stamp of events in chronological order. The technology has certain barriers like availability of skilled blockchain professionals.

Blockchain works through its core components which are:

- Block - a set of data structure used for keeping a set of transactions which is distributed among nodes.
- Chain - interconnected blocks sequence in a specific order through hash techniques.
- Node/player - a user within the blockchain.
- Miners - a node which solves the puzzle preferentially and performs the block verification process.
- Transaction - data transfer in blockchain system through series of blocks.
- Consensus - a set algorithms to operate blockchain.

Hash techniques

Hashing is the process by which a set string of characters transformed into a short-fixed length alphabetic (capital and small letters) - numeric string which represent the entire input of characters. Hash values are generated against the hash keys using the hash algorithm on blockchain platform during all activities of each stakeholder from manufacturer to end user in supply chain. In blockchain, all stakeholders are bonded to each other with the help of hash value because hash values are part of next, previous and current blocks in the chain. The changes in the blockchain are visible to each participant. None other than the partner of blockchain can access the data. These data cannot be modified, altered, added, deleted other than the authorized partner which shows the immutability of data/text, but data cannot modify retroactively. The blockchain has option to use different hash functions like MD5, ripmed160, SHA-1, SHA-256, Keccak-256 converts data into a fingerprint of that input/transaction data. These fingerprint or cryptographic hash sometimes called digest which is kind of "signature" for a text or data file. The digest changes with a small change at any point of addition or deletion during the supply chain.

Blockchain in supply chain of products

Digital technologies can result in greater level of performance in supply chain of products. Blockchain is most effective and systematic when coupled with smart devices, robotics, and Internet of Things (IoT). Blockchain can make tracking items and transactions in the supply chain radically faster and simpler by an estimated 85 per cent when used in conjunction with IoT technology, cutting administrative and logistics timelines in shipping. Supply chain management is the process of managing the transportation of products from point of manufacturing to the end user by maintain the quality and integrity of products.

In case of medical products, it travels from raw material vendor, manufacturer, logistics, distributor, retailer/hospital, and then to patients. However, the current method of managing the supply chain is that each stakeholder of the chain maintaining its own ledger of transaction and piling up the files in soft copies or hard copies but blockchain provides the solution to pain points of supply chain and updating the data/information in real time manner. It can be used to identify the players performing every action.

The blockchain validates and measures the outcomes of the key supply chain management process. Once the input data of transactions data are on a blockchain ledger, they are unable to change retrospectively, or we can say the data are "immutable". Other suppliers in the chain can also track shipments, progress along the way and deliveries.

Blockchain eliminates intermediate burdensome, improves in audit efficiency, and lowering the cost of process. The real time track by every node can be done and balances can be calculated to maintains the integrity of the product quality throughout the supply points of products. The blockchain based medical product supply chain depends on manufacturers, wholesalers, pharmacists and even patients too. In a blockchain based supply chain of the medical products, all medical devices, packets, bottles, strips, boxes and other containers are labelled with serial numbers or QR codes of information where all nodes active in the updated ledger. These QR codes/serial numbers are scanned and recorded on blockchain at every point of journey from manufacturing unit to pharmacy or even patient too.

Consensus mechanism in supply chain

The consensus algorithms are used to bring all nodes on the same note to perform the supply chain activity. All nodes in the blockchain should have to reach on mutual agreement to execute the process of transaction on each node. Thus, it is essential that a consensus should be achieved among all nodes of supply chain to make the authentic transaction and ledger entry. As we know that blockchain is a distributed ledger system which is secured, tamper free, verifiable due to consensus protocol which is a core part of blockchain network. All nodes/actors of the chain should endorse the added transaction/information in their own ledger. It could be done using the consensus algorithm. However, various consensus algorithms i.e. Proof of Work (PoW), Proof of Stake (PoS), Proof of Burn (PoB) and Byzantine Fault Tolerance (BFT) are used for consensus of nodes on blockchain. Whenever the new information gets broadcasted to the blockchain network, actors or all partners have option either to include the information in their ledger or reject/ignore it. When majority of actors are on the single state, consensus is achieved. Once the consensus achieved, all nodes updated the information/data in the ledger and each node able to check the completed transaction to ensure its authenticity and transparency. Each node will have updated information of the product supply. Data information recorded with time stamped transactions for all nodes. In this way the supply chain of medical products can be tracked throughout the supply points any time when needed.

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