

Supply Chain Management System Using Blockchain and IOT

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Abstract -The more traditional strategy to the supply chain was always a website that had to be set up or hosted by a supplier on a server. The supply chain data is centralized here, which means that the company only gets the information provided to it by the hosting company, and most of the important data is not received by the company in some cases which results in a conflict between the company and the customer on the hosting's expense. So, our idea is to implement the supply chain using block chain technology along with IOT, this idea will enable the company to share the necessary data with the manufacturers, suppliers and the customers, hence, inducing transparency of data within the company. IOT also plays an important role in this, IOT ensures that there are no inconsistencies during the process and enables automation. So, our basic idea is to implement supply chain management using block chain to reduce complexity and induce transparency by hosting a server of its own and IOT for automation.

Keywords- supply chain, blockchain, IOT.

I. INTRODUCTION

The Blockchain technology can provide an immutable ledgers solution for this traditional problem. The critical features of blockchain are that it is distributed, verified, and immutable (Hackius& Petersen, 2017). Distributed architecture means that the system does not depend on any central authority but instead they are a peer-to-peer connection of different computers connected together, thus, the control of data does not depend on a single system/server but a collection of servers maintained by decentralized group of owners.

However, blockchain can maintain security as each transaction is verified by using public-private-key cryptography, and once accepted as part of the table chain, the transaction record in the blocks can not be altered because they are connectd to each other.If any tampering occurs with the transaction all the computers connected in the peer group would be notified, this ensures immutability.

The internet-Of-Things is an interconnected system that is used for monitoring, report on and send and exchange data. Internet of Things devices in the supply chain are an efficient way of tracking and authenticating products and shipments using GPS and other techniques. They can also monitor product storage circumstances that improve quality management across the supply chain. To support Blockchain in supply chain management we require

Smart Contracts. Smart contracts is a condition of operation written on the code. Smart contracts automatically execute a transaction and store the information into the ledger without any human help. Thus, by combining Blockchain technology along with IOT, the supply chain management would be transparent and less complex.

II. WHAT IS SUPPLY CHAIN? AND THE DRAWBACKS OF TRADITIONAL SUPPLY CHAIN.

Lummuns and Albert (1997) conceptualize the supply chain as a network of entities in which material flows. Those entities may include different suppliers, transformers or processors, distribution centers, retailers and final customers. Supply chain is a basic network of all the companies, institutions and organizations that deals with the processing of a particular product from its manufacturing, packaging, ordering, processing and delivery.

The supply chain segment involved in the delivery of a product from the manufacturer to the customer is called the distributed channel. Each organization involved follows the same supply chain for a product. Day by day, the complexity of the supply chains has increased and the complexity is causing a lot of problems that the traditional supply chains can't handle, this results in security issues and reduced transparency. So, in modern days these supply chains have been combined with Blockchain, IOT

and Smart contracts to reduce their complexity and make it more secure. Given below is an example of a supply chain for laptop:

The drawbacks of traditional supply chain are:

1. **Complexity:** Due to the increasing demands, the supply chains have become vaster and harder to manage. This results in a more complex system of supply chain.
2. **Security:** The supply chain is managed by a third-party company, so all the essential data and information must be sent to the third-party company, this results in data leaks and makes the system insecure.
3. **Transparency:** Due to the involvement of centralized system, all the transactions are fully controlled by them and thus all the information like orders, updates, changes and tracking details are provided to the company through the centralized system, thus, reducing transparency.
4. **Human Intervention:** The traditional supply chain requires a lot of human input at all stages, thus making the system human dependent and hence, causing many problems.

III. WHAT IS BLOCKCHAIN?

A blockchain is a distributed ledger that records and shares all transactions that occur within the blockchain network. The blockchain network consists of multiple nodes that maintain a set of shared state and perform transactions modifying the states (Anh, 2017). Transactions must be validated by the majority of network nodes, before being ordered and packaged into a timestamped block. The blockchain has three main features: distributed, immutable and verified. The blockchain is a peer-to-peer connection of computers connected together to form a decentralized system, the data is shared by all the systems connected in the system and each system has equal admin rights to access and edit data. This creates a transparent system and security is maintained.

The features of Blockchain technology are:

1. Increased Capacity

This is an essential feature of blockchain system, we have a large number of computers connected in a peer-to-peer group, this results in an increased capacity.

2. Better Security

Blockchain has the tightest security and is the safest and the most secure chain for transactions. All the online portals nowadays are also using blockchain technology to secure their transactions. There is no chance of shutting down of the entire system, as there are a large number of computers connected.

3. Immutability

Creating immutable ledgers is one of the main values of Blockchain. The blockchain is a decentralized system and that there is no third party involved, and hence, there is zero chance of theft and fraud.

4. Faster Settlement

The traditional supply chains may be slow to process the data but with the help of blockchain technology the transactions can be processed at a faster rate and thus, consumes less time.

5. Decentralized System

In a decentralized system, the computers are connected in a peer-to-peer group. A large number of computers are connected together giving the control to the company involved and not the third-party computing. This creates a transparent system.

SHA-256 is a cryptographic hash function that takes input of any length and gives the output of a fixed length. It is a one-way process, i.e. the input ID can be converted to hash but the hash can't be converted back to the input ID. Thus, each transaction of the blockchain has a unique hash. This cryptographic hashing makes each transaction in the blockchain more secure. There are two main functions of SHA-256.

6. Mining: it is the process of inserting a new transaction block in the existing blockchain. To be able to add a transaction to the existing blockchain, first the mining node is created. After this mining node is successfully created, we can proceed with the creation of candidate blocks, these candidate blocks are used for checking the validity of the transaction. To create a block there are 6 parameters that need to be fulfilled:

Version: version number of the block.

Previous block hash: used to refer the hash of the previous block.

Merkle root: gives us the hash of all the blocks in the blockchain.

Timestamp: the creation time of the block.

Target: provides with the proof of work algorithm.

Nonce: it is the variable that is used in the target algorithm (proof of work algorithm).

Creation of block address: we get a public key for the new block. This public key is obtained from the private key, this private key is any random number selected, this random number is multiplied using elliptic curve. This obtained public key is put through SHA-256 and RIPEMD-160 hashing algorithms.

$$X = \text{RIPEMD160}(\text{SHA-256}(Y))$$

Where X = public key and Y = block address

7. Internet of things

The internet of things is a system of interrelated computing services, mechanical and electrical devices and others to make our day to day life easier. The IOT has applications in various fields like:

- Industrial applications: manufacturing, agricultural.
- Infrastructural applications: metropolitan scale applications
- Energy management: environmental monitoring, living lab

- Commercial applications: medical and healthcare, smarter home, building and applications.

- The exact location of your goods
- The exact time of delivery of your goods.

The different layers of IOT architecture include:

1. **Create:** the sensors and other devices attached create the data and trigger the flow of information.
2. **Communicate:** the network of IOT devices is very large i.e. the entire internet, the sensors used is connected to the internet and the information flow takes place. It includes the hardware, software and messaging protocols.
3. **Aggregate:** aggregates the sensor data and integrates it with other external data for analysis.
4. **Analyze:** it is improved intelligence, that is, it requires downstream raw information, analyzes it and generates actionable ideas.

Act: IOT provides data to initiate changes in human and machine behavior automatically.

IV. THE USE OF BLOCKCHAIN AND IOT IN SUPPLY CHAIN MANAGEMENT

The Blockchain Trust Accelerator (2018) understands that blockchain is well suited for use in supply chains in part because the technology has the potential to provide an unprecedented level of transparency.

Through blockchain technology, the transaction of data will take place at a faster rate and with more security.

The main features of blockchain and IOT assisted supply chains are:

1. **Continuous flow of information:** The sharing of information between the various stakeholders on the global chain can take place through the immutability of the blockchain. This ensures traceability and safety of data.
2. **Accessibility of information:** Through the fast information processing of the blockchain system, the necessary information may be accessed anytime in the future to leverage the huge quantity of information generated along the supply chain.
3. **Link between physical and information flows:** With the help of IOT, the information of all the physical goods can be accessed at any stage of the supply chain at any time.
4. **Code of conduct violations and fraud detection:** the need to ensure human rights is taken into consideration and are respected long the different levels of blockchain and any fraud or theft in data will be detected easily as the system is not centralized, the fraud in one computer will alert all the other computers in the peer group immediately, thus making it a transparent system. Thus, the blockchain and IOT may give us information about:
 - Origin of goods.
 - The details of the manufacturer.
 - Information on your payment.

VII. CONCLUSIONS

The blockchain is under bitcoin's core that possesses the key features enabling to solve various current problems in financial as well as non-financial fields and the most important problem that the blockchain has solved the problem with the supply chain management system, the traditional supply chain management systems were slow and not secure, but with the help of blockchain and IOT these traditional supply chains have become faster and more secure than ever.

Through the blockchain system the transactions are done without human intervention through a very secure peer-to-peer channel and through IOT automation is made possible. The adoption of supply chain management using blockchain and IOT has not been welcomed by a lot of companies. Many companies still prefer those traditional systems and are skeptical of the new systems and prefer to use those dilated systems over the faster autonomous ones. So, the knowledge of blockchain is esoteric and the people who are polymath on blockchain are being valued the most by these companies.

Nevertheless, the traditional supply chain technology will be replaced by the smarter supply chains using blockchain due to the increase in demand by the customers, the customers these days need all the information about their transaction and to keep up with these increases in demands smarter technologies are required and hence, the blockchain and IOT are perfect technologies that can be implemented in these traditional supply chains to meet these demands. The blockchain and IOT enabled supply chain provides – quality, security, immutability and other advantages. Thus, by using blockchain and IOT in supply chain we can create a smarter and reliable supply chain.

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