

Blockchain Technology for Supply Chain Management

¹Siddarth SM, ²Deepika K

¹Student, ²Assistant Professor,

¹Master Of Computer Application,

¹R V College of Engineering, Bangalore, India.

Abstract: The aim of the research is to discuss what challenges and problems Blockchain can solve in Supply Chain, and what is the future to come for the Supply Chain Management. Blockchain can be defined as a chain of the block that contains information. The technique is intended to timestamp digital documents so that it's not possible to backdate them or temper them. The blockchain is used for the secure transfer of items like money, property, contracts, etc. without requiring a third-party intermediary like bank or government. Once data is recorded in a blockchain, it is very difficult to change it. The implementation of Blockchain Technology can help organizations reduce order quantities, lower selling prices and reduce the target-inventory levels. BCT provides a disruptive and state-of-the-art business solution in a variety of contexts within supply chain management. The main difference between the use of BCT in Finance and SCM lies in their core values. The core value for financial application is information security, whereas the core value for SCM application is system transparency and traceability. Modern supply chains have evolved into highly complex value networks and turned into a vital source of competitive advantage. However, it has become increasingly challenging to verify the source of raw materials and maintain visibility of products and merchandise while they are moving through the value chain network. The application of the Internet of Things (IoT) can help companies to observe, track, and monitor products, activities, and processes within their respective value chain networks. Other applications of IoT include product monitoring to optimize operations in warehousing, manufacturing, and transportation. In combination with IoT, Blockchain technology can enable a broad range of different application scenarios to enhance value chain transparency and to increase B2B trust. A blockchain can transform supply chains, industries and ecosystems. Interestingly, even organizations, like banks and governments, who would seem to be losing out, can see opportunities to use blockchain to streamline their own businesses. An in-depth transformation of supply chains will not happen instantly. However, supply chains can already start using a blockchain for small portions of their operations. Smart Contracts can help eliminate the costly delays and waste that is currently experienced due to the manual handling of paperwork.

Keywords: *Supply chain, Blockchain.*

I. INTRODUCTION

Block chain can be described as an increasing list of records called blocks that are associated using cryptography. Each block includes a cryptographic hash of the previous block, transaction data and timestamp. Block chain makes use of a peer-to-peer network collectively adhering to a protocol having inter-node communication and validating new blocks. It has a distributed database that holds an incrementing list of data records that are secured from any kind of tampering or revisioning hence also called as a digital ledger. The key features of Blockchain technology include features such as transparency where the nodes in the peer-to-peer network have a copy of the distributed digital ledger. To start a new transaction all the nodes in the network check for the validity of the transaction and if a majority of the nodes approve of the transaction, then it is added into the ledger. The decentralized Technology adapted does not have any governing authority or a single person acting as an admin to the whole process instead a group of nodes take care of maintaining the network which makes it decentralized. The Adaptation of Decentralized technology that allows all the nodes access to the distributed ledger provides transaction data along with timestamps where the history of transactions is stored in sequence. This provides easy traceability of the transactions listed in the ledger. The transactions in Block chain Technology are atomic and immutable as every transaction is validated by multiple nodes and when added to the distributed ledger it includes details of the transaction along with their timestamps which makes it difficult for cyber criminals and hackers from tampering data in the ledger or making any changes therefore increasing security. The transaction speed is optimized significantly in Block chain Technology as the transactions are validated by nodes in the P2P network which reduces the processing time and decreases the cost of processing which provides faster settlement of transactions.

Supply chain management (SCM) is the management of flow of goods or raw materials an enterprise needs, to provide a service or create a product and deliver the end product or service to the customers. The purpose of SCM is to improve the quality of supply chain performance. SCM refers to the optimization of a company's supply chain management that directly improves the effectiveness of the supply chain. SCM can provide better customer service, decrease operating costs, and improve a company's financial status. The key features of SCM include Reduced cost operations by reducing

the total supply chain cost from supplying the materials to the manufacturing plants to delivering finished goods to the customers by applying SCM techniques to increase the profit while enhancing the SCM workflow. The implementation of SCM also boosts the confidence of the customer in the service or product provided by the organization based on the quantity and quality of the product or service followed by proper delivery and proper after sales support. The SCM greatly reduces supply chain costs that directly reflect in the increase in profits of the organization therefore increasing the profit leverage. SCM also helps in identifying assets which are resource intensive and help in releasing them to decrease the costs while increasing profits. The SCM greatly reduces the overhead expenses by improving the inventory management system, eliminate damaged resources and improving storage efficiency. The improved collaboration and co-ordination of the vendors, suppliers and consumer companies ultimately increase the business profit. Since the information regarding all the entities is easily available, it allows for easy co-ordination and less confusion. Due to the boost in co-ordination, errors are minimal and the output from all the teams is optimum leading to almost no delay in process. The availability of information and improved co-operation, there is a more stable and enhanced supply chain network. An SCM that has good co-operation and lower delays automatically provides better service which directly affects increase in customer satisfaction.

The scale and complexity of the existing SCM systems include huge transactional costs, errors in paperwork, losses through degradation and theft and tendency of Human errors. The inefficiency of the current SCM can be corrected with the implementation of Block chain Technology for SCM. The fundamental idea of implementing Block chain Technology for SCM is to provide Transparency and Traceability. The areas where implementation of Block chain Technology affects SCM includes the use of a distributed database by implementation of Block chain Technology in SCM, eradicates the need for an intermediary (ex: bank) for any monetary transaction hence leading to faster transaction. The use of nodes to store information of every transaction allows for easy access for accounting information. The blocks store all the transactions therefore allowing the latest transaction to provide the current status of the product. Since the implementation of Block chain Technology in SCM has none/very less human intervention the chances of human error are almost none. information regarding products can be easily accessed to cross verify the time of delivery and the expiry of the product to provide safe delivery. Since the origin and the delivery checkpoints can be traced, counterfeit merchandise can be traced and avoided.

II. APPLICATION

The applications of Blockchain for supply chain management are:

1. Automated supplier payments: Blockchain allows the transfer of funds anywhere in the world without the need for traditional banking transactions, as transactions are made directly between payer and payee. It is also secure and rapid; taking minutes.
2. RFID driven contract bids and execution: RFID tags for cartons or pallets store information on delivery location and date. Logistics partners run applications to look for these tags and bid for a delivery contract. The partner offering optimal price and service gets the business. A smart contract then tracks status and final delivery performance.
3. Electric power micro grids: Smart contracts are being used to redistribute excess power from solar panels. The Transactive Grid is an application running on blockchain to monitor and redistribute energy in a neighborhood micro-grid. The program automates the buying and selling of green energy to save costs and pollution. The process uses the Ethereum blockchain platform, designed specifically for building and executing smart contracts.
4. Cold chain monitoring Food and pharmaceutical products often have specialized storage needs. Moreover, enterprises see the value in sharing warehouses and distribution centers instead of each one paying for its own. Sensors on sensitive products can record temperature, humidity, vibration, and other environmental conditions. These readings can then be stored on a blockchain. They are permanent and tamper-proof. If a storage condition deviates from what is agreed, each member of the blockchain will see it. A smart contract can trigger a response to correct the situation.

III. ARCHITECTURE DIAGRAM

Block Diagram for Working of Blockchain Technology

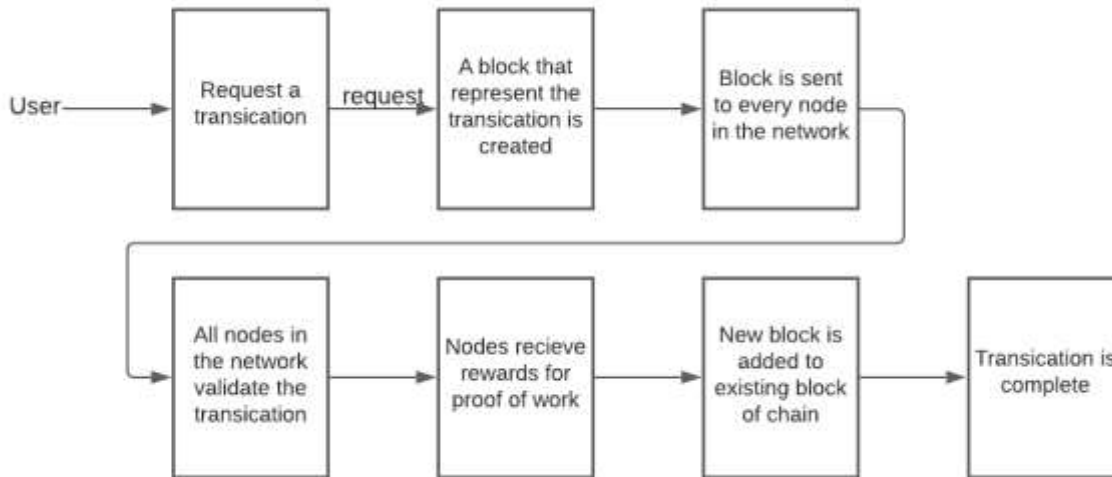


Fig.1: A block diagram of Block chain Technology depicting the flow of how the blockchain works on a higher level.

The user requests a transaction which is forwarded to a new block that is created to represent that transaction, this new block is sent to every node in the network which is validated by all the nodes verifying the transaction, the nodes receive rewards for their validation of transaction, once the transaction is deemed valid, the node is added to the existing block of nodes.

IV. TECHNICAL SIGNIFICANCE

Details of the unresolved domain chosen

The most important challenges faced in SCM include, the increase in rate of fuel prices, higher labor costs affect the pressure on profit margins. Supply chain complexity due to multiple channels where customers have options to choose from multiple channels such as ecommerce websites that sell directly to consumers or third-party marketplaces. Consumer demands needs for improved speed, quality and service, the success of a product depends on the availability, quality and price of the product. Before the products are delivered, they need to be tested for expected functionality along with safety and compliance regulations mandated by law. The Implementation of BCT for SCM can enhance the security of transaction and eradicates fraud by efficient Book keeping. The middleman can be eradicated and improved connectivity among stakeholders. Consider the Application of Block chain Technology for traceability and transparency of a Fruit delivery in SCM

Block Diagram for Implementation of Blockchain for Supply Chain Management

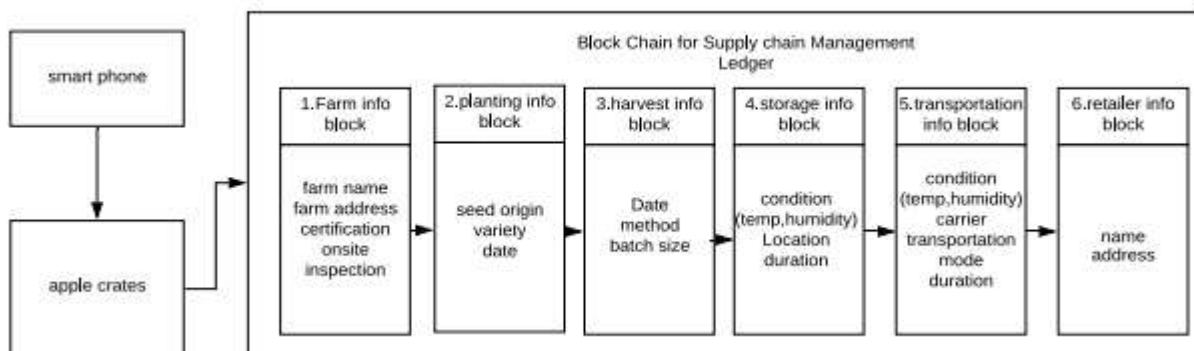


Fig.3.1 A Block Diagram depicting the implementation of Block chain Technology For SCM

The block diagram depicts an apple crate with an IOT device attached to it that can connect to the Blockchain ledger and is also connected to a smart phone via an application. The IOT device processes information and provides it to the application on the smart phone and the application on the smart phone can be used to make transactions that reflect on the block chain. Considering fig.2 as an example of application of Block chain Technology for SCM, the major sources of impact can be determined as: The middlemen who buy the apples at cheaper rates from farmers and sell at costlier rates to retailers are removed. Since all the information is available to all the users, in this case the retailers, hence

minimal need of paper work. Since the data regarding the entity is directly available to all the users as they are updated every time a node/block is added or updated, it rules out ambiguity. Once a trade transaction takes place, it cannot be tampered with as it is immutable, therefore providing security.

V. Tools and Technologies

The various tools used to implement blockchain are:

1.Solidity

Solidity supports the OOP paradigm and is most commonly used for writing smart contracts. With Solidity, Blockchain Developers can write applications that can execute self-enforcing business logic embodied in smart contracts, thereby leaving a non-repudiable, and authoritative record of transactions. This comes in handy for creating contracts for voting, crowdfunding, multi-signature wallets, and blind auctions. It is one of the most popular languages used by Blockchain Developers. Influenced by C++, Python, and JavaScript, it was designed to target the Ethereum Virtual Machine (EVM). Solidity is statically typed, supports inheritance, libraries, and complex user-defined types.

2.Geth

Geth is an Ethereum node implementation built using the Go programming language. It is available in the three interfaces, including JSON-RPC server, command-line, and interactive console. Geth can be leveraged for Blockchain development on all three major operating systems – Windows, Mac, and Linux. Geth is used for a host of different tasks on the Ethereum Blockchain, such as transferring tokens, mining ether tokens, creating smart contracts, and to explore block history. After installing Geth, you can either connect to an existing Blockchain or create your own. The main advantage is that Geth simplifies things by automatically connecting to the Ethereum main net.

3.Mist

Mist is the official Ethereum wallet developed by the creators of Ethereum. When it comes to Ethereum, before you can start using the platform, you must have a designated place where you can store your Ether tokens and execute your smart contracts. It is available for Windows (both 32- and 64-bit), Mac, and Linux (32- and 64-bit). While Mist is particularly suitable for deploying smart contracts, it is a full node wallet where there is a need to download the entire Ethereum blockchain, which is larger than 1TB.

4.Remix

Remix IDE is a browser-based Blockchain tool used for the creation and deployment of smart contracts. Written in JavaScript (so it can be accessed via any modern browser), Remix can be used for writing, testing, debugging, and deploying smart contracts written in Solidity. It can be used either locally or in the browser

VI. Conclusion

The implementation of Block chain Technology in SCM provides Traceability and transparency which improve the efficiency of SCM by reducing the excessive costs, minimalizing the paperwork, reducing the intervention of human and avoiding errors. The traceability and transparency aspect helps in identifying the source of the product and also provides detailed information regarding the supply of the product and also unambiguous information. The implementation of Block chain Technology for SCM provides for more security as the Immutability property of Block chain Technology i.e. Once a transaction takes place, information about it cannot be altered. The Implementation of Block chain Technology for SCM also provides faster transactions by eradicating an Intermediary, thus reducing processing time.

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