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Blockchain in Supply Chain Traceability

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Abstract— Supply chain traceability is one of the most important problems faced by all organizations globally. Tracking any commodity is a tedious job and requires a lot of manual attention. The existing system uses a centralised database system to track a commodity. This approach is not efficient when several participants are involved. The participants in a supply chain do not trust each other hence having a central database can lead to tampering of data and single point of failure. We propose a more reliable and trusted solution, the use of blockchain in supply chain traceability. Blockchain is a decentralised, immutable ledger managed by a cluster of computers. The very nature of blockchain makes it suitable technology for traceability in a supply chain. Blockchain creates immutable records. Once a transaction is stored in the blockchain, it is impossible to tamper it illegally. This immutability of blockchain builds trust among the participants that conduct business in a lack of trust environment. Using consensus protocols, blockchain builds trust between the various participants. Blockchain provides traceability since immutable records are added in blockchain; it is easy to track the source of the product.

Keywords— Blockchain, decentralised, immutable, ledger, traceability

I. INTRODUCTION

The traditional supply chain systems use centralised database management systems. This traditional system can be tempered and records could be altered. The traditional systems are not suitable to track a commodity when various participants are involved. The participants do not trust each other and hence participants can never rely on the record added in the database. The traditional system can experience a single point of failure i.e. if a centralised database is not backed up properly all the data stored in it could be lost forever. For traceability in supply chain several organizations use IOT based solutions integrated with the wireless sensor networks. These solutions are deployed in the heavily centralised cloud infrastructure. Cloud infrastructure may lead to security threats and lack of confidentiality. By using cloud infrastructure, organizations need to rely on third party cloud storage. This still does not solve the problem of lack of trust between the participants in a network.

Hence the potential solution for the above-mentioned problems is to introduce a technology which is immutable, decentralised and trusted. Blockchain is a distributed, immutable ledger managed by a cluster of

computers. The first and most popular implementation of blockchain is bitcoin[5]. Since then a lot of research and advancement has been seen in this field. Developers provided solutions using blockchain technology that can meet the enterprise level needs. This development in blockchain makes it more suitable technology to be used in supply chain traceability.

The structure of the paper is organised as follows. Sec. II presents the overview of blockchain in supply chain traceability. Sec. III presents information about Hyperledger Fabric. Sec. IV describes the system architecture of general application that can be built using blockchain. Sec. V contains the future scope. Sec. VI concludes the paper.

II. BLOCKCHAIN IN SUPPLY CHAIN

A. Blockchain essentials

1.Immutable records: The ability of a blockchain ledger to remain unchanged is called immutability. This is achieved by using cryptography and hashing. The cryptographic hash of the entire block is computed and stored in the transaction block say A. This transaction block A is then added to the blockchain. The transaction block added next to this block say block B contains the cryptographic hash of previous block A as well as the transaction hash in the current block. In this systematic hash chaining there is a link between the blocks that propagates forward in the blockchain. Even if a single block is altered the chain of linked cryptographic hashes breaks, making the current state of the chain inconsistent with the chains on remaining peers. This process of chaining using hashing makes the blockchain immutable.

2.Peer to Peer network: A peer-to-peer (P2P) network comprises of a group of devices that can store and share files between each other. Each device in the network (node) acts as an individual peer. Unlike a master slave network, every peer on the P2P network has equal authority and access rights, and each peer performs the same task in the network. The blockchain thus functions on a peer-to-peer network architecture and acts as a digital ledger that records all activity. In essence, each peer node has a copy of the blockchain ledger, which is compared with the other peer nodes to ensure data integrity. Since multiple copies of the same ledger are distributed across each peer in the network, a malicious attempt to modify the contents on a single peer node is easily detected. Using this decentralized architecture of the peer to peer network, blockchain technology overcomes the problem of the single point of failure that is very common in centralised systems.

3.Consensus Algorithm: With a completely decentralized architecture, it becomes difficult to verify all the blocks that are added to the blockchain network. In order to verify all blocks, a consensus algorithm is used. Consensus algorithm is an integral part of any blockchain network. A consensus algorithm is the mechanism by which all the nodes in a blockchain network agree upon the current state of distributed ledger. The consensus algorithm helps to achieve reliability in the blockchain network. This also builds trust between the peers in a distributed environment. Consensus algorithm ensures reliability and integrity of the ledger by making sure that every block that gets added to the blockchain network is agreed upon by the majority of the nodes in the network and it is one and only version of the truth that is agreed by all the nodes.

B. Blockchain in Supply Chain

1.Traceability: Blockchain is a distributed, immutable ledger managed by a cluster of computers[3][4]. The records once added cannot be modified or deleted, making it an ideal platform for tracing assets. Tracking of an asset can be done since the inception of a transaction to the latest transaction. Asset traceability thus makes blockchain an essential in supply chain management.

2.Immutable records: As stated earlier blockchain contains immutable records. This feature builds trust between the participants that the information in the blockchain is tamperproof.

3.Building trust in trust-less environment: The participants in a supply chain network do not trust each other and they do not trust the record added by other parties. This problem is solved in blockchain technology by introducing the concept of consensus algorithm. As defined earlier, consensus algorithm helps all the participants running on different peers to come to an agreement to accept or reject a transaction block. This capability of blockchain technology enables participants to maintain trust in a trust-less environment.

III. HYPERLEDGER FABRIC

Hyperledger fabric[1] is a distributed ledger software. It has a modular architecture making components pluggable depending on the organisation's requirements. Hyperledger fabric provides high degrees of confidentiality, scalability, resilience and flexibility. Hyperledger fabric provides a permissioned network. Hyperledger thus allows industries to create their own permissioned network where each participant in the network is an authorised participant. This type of network allows restricted access to the information stored in the ledger to the participants. Such network makes hyperledger an ideal platform for developing business

solutions required by private organizations. Hyperledger fabric also provides facilities to run smart contracts known as chaincode in fabric[1].

Hyperledger fabric provides the following advantages:-

1. Permissioned membership
2. Performance, scalability, and levels of trust
3. Data on a need-to-know basis
4. Rich queries over an immutable distributed ledger
5. Modular architecture supporting plug-in components
6. Protection of digital keys and sensitive data

IV. SYSTEM ARCHITECTURE

In this section we present the supply chain traceability for food commodities. This model runs on a permissioned blockchain network. We highly recommend the use of Hyperledger Fabric as it is the most suitable distributed ledger software built for supply chain traceability. The network consists of following:

A. Participants

Participants are members of a business network. They may own assets and submit transactions. This network contains four types of participants

1. Farmers
2. Producers
3. Distributors
4. Retailers

These participants can perform transactions on any food commodity. The number of participants can increase or decrease according to the use case. Figure 1 shows the flow of assets between participants.

B. Asset

In this network an asset can be any tangible entity. It can be anything from crops to vegetables.

C. Transaction

Transactions are the mechanism by which participants interact with assets. In this network participants can make transactions of the commodity they own. These transactions are stored in blockchain after the consensus algorithm is applied.

D. End User

Even though the end user is not part of the network they can track a commodity through an application. This will allow them to view abstracted information about the commodity from its origin as a raw material to the retailer where the final product is sold.

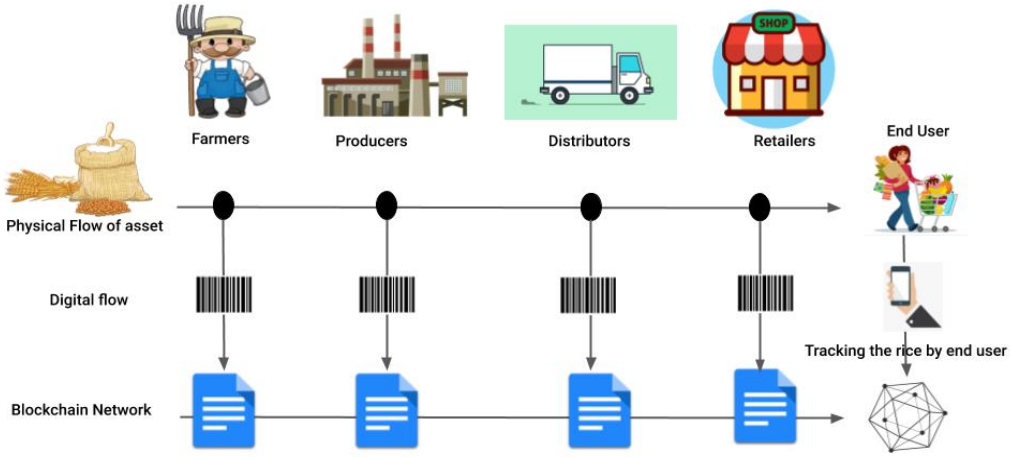

Fig . 1 Traceability for supply chain

V. FUTURE SCOPE

Blockchain is a trending technology and it will soon disrupt the supply chain management industry. One major advancement can be integration of IOT with blockchain for supply chain management [2]. Using IOT data can be wirelessly sent over to the blockchain thereby reducing human intervention. IOT devices such as scanners, sensors are already being used in the supply chain industry. Incorporating IOT can thus automate the entire supply chain ledger, making it more trustable.

VI. CONCLUSIONS

This paper presented a primer on blockchain, it's advantages and how it can disrupt the supply chain management industry. The proposed architecture for food supply chain and tracking can be used to develop business solutions that can replace the existing supply chain management systems. The architecture proposed here leverages the advantages of hyperledger fabric and can be used for further research and development.

REFERENCES

[1]. Androulaki, E., Barger, A., Bortnikov, V., Cachin, C., Christidis, K., De Caro, A., ... & Muralidharan, S. (2018, April). Hyperledger fabric: a distributed operating system for permissioned blockchains. In Proceedings of the Thirteenth EuroSys Conference (pp. 1-15).

[2]. Tian, F. (2017, June). A supply chain traceability system for food safety based on HACCP, blockchain & Internet of things. In *2017* International conference on service systems and service management (pp. 1-6). IEEE.

[3]. Rahmadika, S., Kweka, B. J., Latt, C. N. Z., & Rhee, K. H. (2018, November). A preliminary approach of blockchain technology in supply chain system. In *2018 IEEE International Conference on Data Mining Workshops (ICDMW)* (pp. 156-160). IEEE.

[4]. Salah, K., Nizamuddin, N., Jayaraman, R., & Omar, M. (2019). Blockchain-based soybean traceability in agricultural supply chain. *IEEE Access*, *7*, 73295-73305.

[5]. Nakamoto, S. (2019). Bitcoin: A peer-to-peer electronic cash system. Manubot.

