

BLOCKCHAIN TECHNOLOGY FOR SUPPLY CHAIN

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ABSTRACT

Blockchain technology provides important opportunities for the supply chain. This report shows the employment of blockchain technology in the field of the supply chain. This technology has been widely associated with cryptocurrencies, non-financial applications such as supply chain, power and food industry. Blockchain can provide a permanent, shareable, auditable record of products through their supply chain, which improves product traceability, authenticity, and legality in a more cost-effective way. In this report the improvement expectations via blockchain technology for the case of automotive manufacturing supply chain were discussed.

KEYWORDS: Blockchain, supply chain.

INTRODUCTION

BLOCKCHAIN

Blockchain is essentially a digital ledger of transactions that is duplicated and distributed across the entire network of computer systems on the blockchain. Each block in the chain contains a number of transactions, and every time a new transaction occurs on the blockchain, a record of that transaction is added to every participant's ledger.

DISTRIBUTED LEDGER TECHNOLOGY

The decentralised database managed by multiple participants is known as Distributed Ledger Technology

SMART CONTRACT

Smart contracts are simply programs stored on a blockchain that run when predetermined conditions are met. They typically are used to automate the execution of an agreement so that all participants can be immediately certain of the outcome, without any intermediary's involvement or time loss. They can also automate a workflow, triggering the next action when conditions are met.

HASH

Hash is a mathematical function that converts an input of arbitrary length into an encrypted output of a fixed length, regardless of the original amount of data or file size involved, its unique hash will always be the same size. Moreover, hashes cannot be used to reverse-engineer the input from the hashed output, since hash functions are one-way

SUPPLY CHAIN

A supply chain is a network between a company and its suppliers to produce and distribute a specific product to the final buyer. This network includes different activities, people, entities, information, and resources. The supply chain also represents the steps it takes to get the product or service from its original state to the customer

BENEFITS OF BLOCKCHAIN IN SUPPLY CHAIN

- **DECENTRALIZATION**

Decentralization refers to the transfer of control and decision-making from a centralized entity to a distributed network. Decentralized networks strive to reduce the level of trust that participants must place in one another, and deter their ability to exert authority or control over one another in ways that degrade the functionality of the network

- **TRANSPARENCY**

It is a system of recording data in a way that makes it difficult to change or cheat the network. It also makes the data available to everyone at any time, so that all transactions are transparent.

- **SECURITY**

Blockchain technology have inherent security qualities because they are based on consensus, cryptography, and decentralization principles. Each new block of information connects to all the previous blocks in a way that it's nearly impossible to tamper with. In addition, all transactions in a block get validated and agreed on by a consensus mechanism (authorized users), guaranteeing that each transaction is true and accurate. Thus, there is no point of failure, and a user can't change transaction records.

- **TRACEABILITY**

Blockchain has emerged as a possible solution to implement traceability by creating an information trail while ensuring security and data immutability. Blockchain-based traceability enables secured information sharing, facilitates product quality monitoring/control, operation monitoring/control, real-time data acquisition, transparency and visibility throughout the supply chain

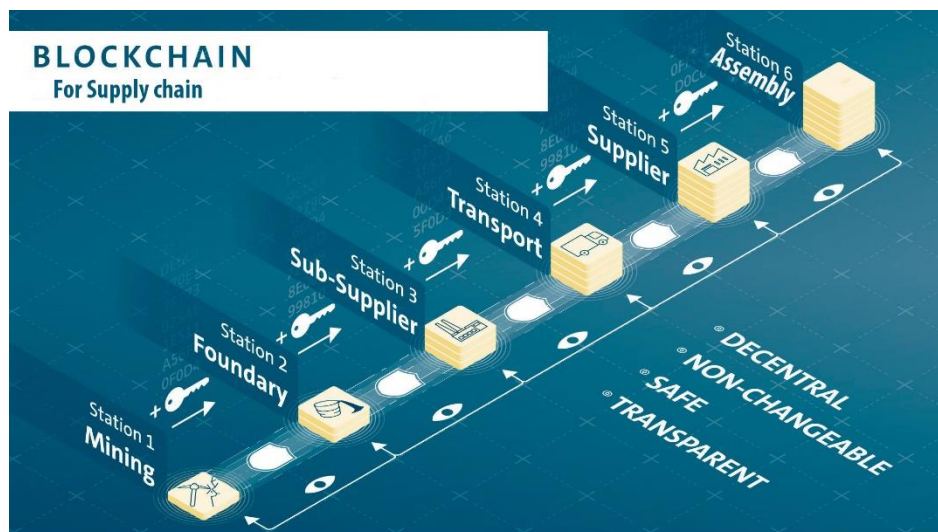
AIM AND PROBLEM DEFINITION

PROBLEM DEFINITION

Supply chain transparency is a major issue in many industries, including the automotive sector. Responsible raw material procurement is fundamental for sustainable mobility. By using blockchain, the technology behind various cryptocurrencies, to ensure more transparency and security in the supply chain. Which will help us to trace the supply chain from the point of origin to the factory.

Hence the solution is to built a blockchain that guarantees the security of the sensitive supply chain data despite the opensource approach. where blockchain contains generally accessible information and data blocks which cannot subsequently be changed. The advantage private blockchain is that everyone in the blockchain from point of origin to factory can works with one system, even if several supply chains are involved

This creates a common digital infrastructure that allows the transparent exchange of information. Digitalization provides important technological instruments that enable us to track the path of materials in supply chains in great detail



AIM

To create a decentralised, transparent and Non changeable supply chain using Blockchain technology

GITHUB: <https://github.com/srivijaykrishna/Blockchain-for-Supply-chain>

PROCEDURE

PREREQUISITES

- Sublime text editor
- Google chrome console
- Postman Application
- Linux terminal

PACKAGES

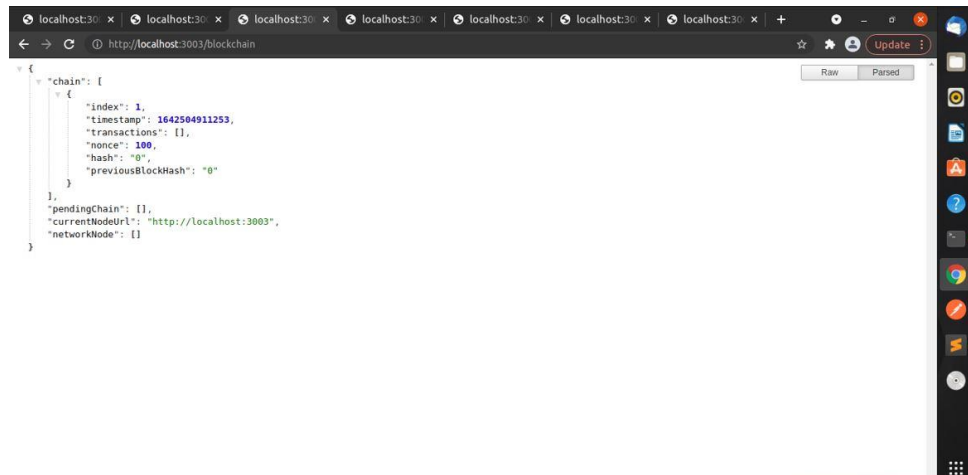
- express.js (To communicate with blockchain)
- app post (Post transaction from postman)
- body parser (any data in the form of json it moves to body parser and parsed so we can use data in any endpoint)
- Node SHA256 (hashing algorithm)
- Express (API call)
- Nodemon-npm (restart server automatically)
- Postman – calls, post, data, endpoints without request
- UUID (create unique address)
- Request promises (request all other networks in node)

BLOCKCHAIN

- Create a Function called Blockchain (Constructor Function)
- Create New Block (Initial Block for empty block storage)
- Get Last block (Used to verify the previous hash)
- Create new Transaction (for initializing the supply chain data storage)
- Create hash block (Hash by SHA256)
- Create a proof of work (Verify the block is correct by current block data and previous block hash)
- Create genesis block (initial block without previous block)

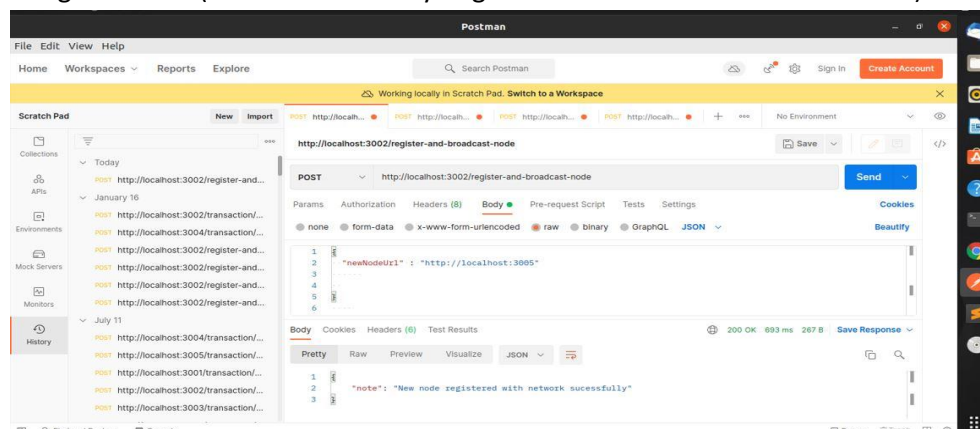
NETWORK NODE

- get blockchain (call blockchain endpoint), (to read – Json formatter in chrome extension)



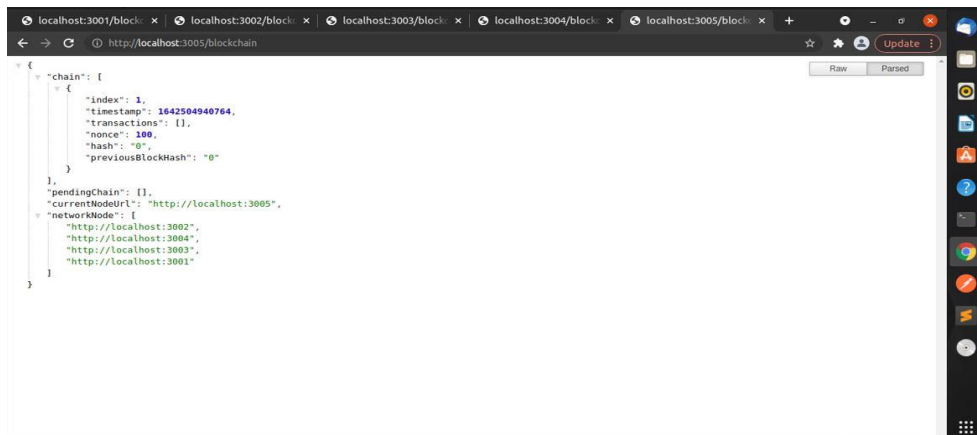
(Above figure shows the data of the blockchain in chrome console)

- get mine (by using proof of work method)
- create port (process.argv)
- Number of nodes – by calling port numbers and their URL
- create current node URL
- app.post (This command register and broadcast node by passing URL)- it acts as a medium from new to already available nodes by adding URL in the server)
- Create register node (this command only Register to the other nodes in the chain)



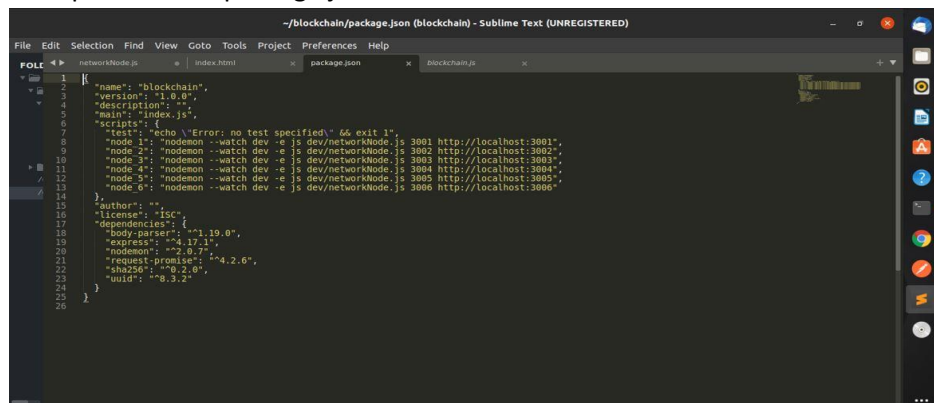
(Above figures shows that the nodes are registered and broadcasted into the network)

- Create register bulk (this command register all the nodes in the newly joining node)



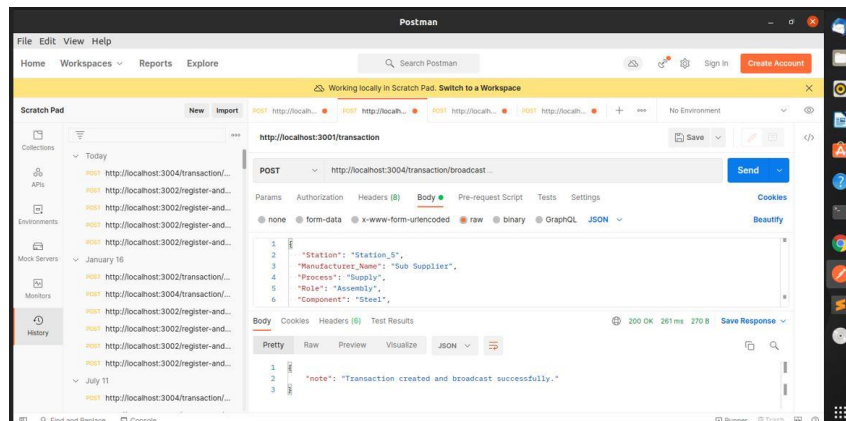
(Above figure shows that all the nodes are connected together in the blockchain)

- Call via request promise
- Synchronizing the network
- Refactoring create transaction method
- Create node address (unique ID for transaction)
- Add the pending elements to the blockchain
- Post transaction broadcast
- Creating a decentralized chain for the multiple nodes
- Create process.argv (arg variable for multiple port variable)
- Create multiple nodes at package json



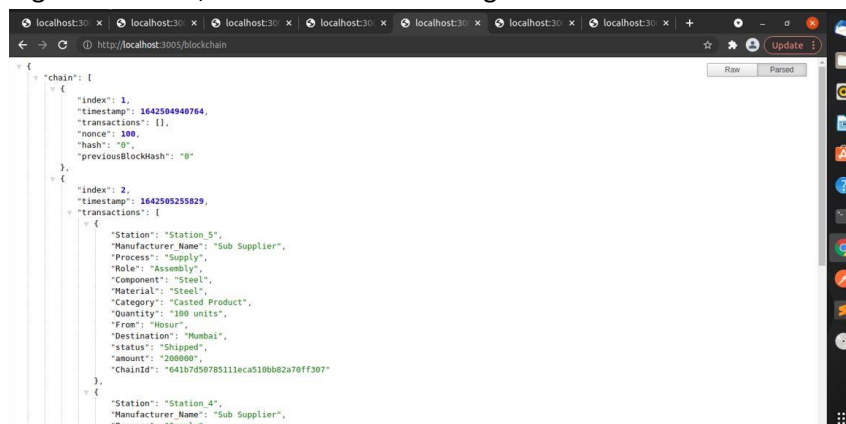
(Above figure shows the multiple nodes at the package json)

- Hosting the nodes in the network using postman
- Connecting multiple nodes together to form a chain
- Adding the current node URL in the package json
- Mine endpoint (choose a block and start mine to create a new block that will create by using proof of work method)
- New endpoint outline, started registering and broadcast the node to entire network
- Each node is stored inside network node array then request promise library for requesting
- Each node is registered and broadcasted successfully, which means the nodes are pushed into the network node array
- Register node bulk which contains the URL of the nodes that are already inside the network by verifying it or else it will add the URL in it
- Register and broadcast node create a decentralized blockchain network by adding new nodes into it



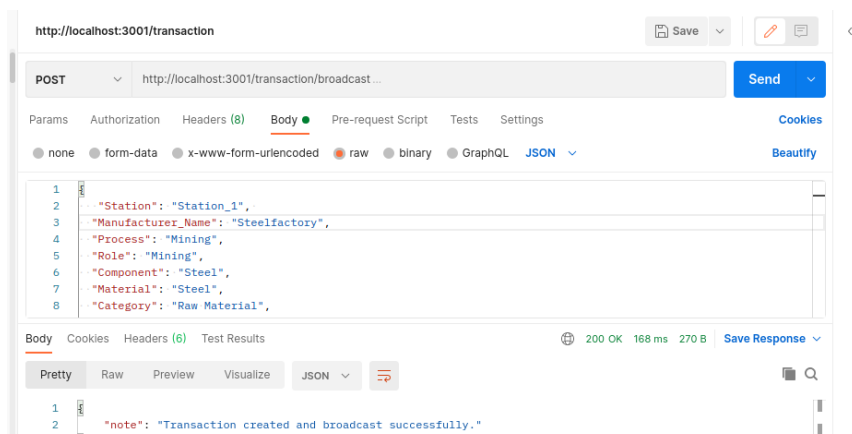
(Above figure shows that the supply chain data are deployed into the network using postman)

- Synchronizing the network, same blockchain throughout the network



(Above figure shows the synchronized supply chain data in the blockchain network)

- Create a new transaction that will allow us to send the data throughout the network
- Create a transaction broadcast for creating a new transaction and broadcast it to the network



(Above figure shows the supply chain data which have been added in the blockchain network)

- Create mine endpoint and receive endpoint this will synchronize the network

```

{
  "note": "New block mined & broadcast successfully",
  "block": {
    "index": 2,
    "timestamp": 164250255829,
    "transactions": [
      {
        "Station": "Station 5",
        "Manufacturer Name": "Sub Supplier",
        "Process": "Supply",
        "Role": "Assembly",
        "Component": "Steel",
        "Material": "Steel",
        "Category": "Casted Product",
        "Quantity": "100 units",
        "From": "Hosur",
        "Destination": "Mumbai",
        "Status": "Shipped",
        "Amount": "200000",
        "ChainId": "641b7d5078511eca510bb82a70ff307"
      },
      {
        "Station": "Station 4",
        "Manufacturer Name": "Sub Supplier",
        "Process": "Supply",
        "Role": "Assembly",
        "Component": "Steel",
        "Material": "Steel",
        "Category": "Casted Product",
        "Quantity": "100 units",
        "From": "Hyderabad",
        "Destination": "Mumbai",
        "Status": "Shipped"
      }
    ]
  }
}

```

(Above figure shows the mined blockchain data in the network using chrome console)

- Verify every block is legitimate if it is not then reject the block
- Consensus algorithm is created to confirm there is no fraudulent information in network by comparing one node to all the other node in the network to confirm the correct data

```

{
  "note": "Current Chain has not been replaced.",
  "chain": {
    "index": 1,
    "timestamp": 1642504439170,
    "transactions": [],
    "nonce": 100,
    "hash": "0",
    "previousBlockHash": "0"
  },
  "index": 2,
  "timestamp": 164250255829,
  "transactions": [
    {
      "Station": "Station 5",
      "Manufacturer Name": "Sub Supplier",
      "Process": "Supply",
      "Role": "Assembly",
      "Component": "Steel",
      "Material": "Steel",
      "Category": "Casted Product",
      "Quantity": "100 units",
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      "Material": "Steel",
      "Category": "Casted Product",
      "Quantity": "100 units",
      "From": "Hyderabad",
      "Destination": "Mumbai",
      "Status": "Shipped"
    }
  ]
}

```

(Above figure shows the implemented consensus algorithm in the network)

- Create longest chain rule (consensus algorithm) which takes single chain and compare all the other chain inside the network if there is another longer chain then it will replace the single chain in the network
- Request the data for consensus algorithm
- Create a user interface for our blockchain

Supply Chain

(Above figure is the User Interface for supply chain)

- Create queries for required data in the supply chain that needs to be fetched

Supply Chain

Block Hash

Chain ID

Station

Manufacturer_Name

Process

Role

Component

Material

Category

Destination

From

Status

Supply Chain

Chennai

Destination

Search

DATA

Station	Manufacturer_Name	Process	Role	Component	Material	Category	Quantity	From	Destination	status	Amount
Station_5	Supplier	Supply	Supplier	Steel	Steel	Casted Product	100	Hosur	Chennai	Shipped	200000
Station_6	Automotive Manufacturer	Assembly	Assembly	Steel	Steel	Casted Product	100 units	Hosur	Chennai	Arrived	-

(Above figures shows how user can interact with the supply chain and its data that needs to be fetched)

CONCLUSION

This report shows how to create blockchain for supply chain. This technology will enhance and fundamentally transform supply chains in many industries. By removing the intermediaries with blockchain based transformations, the transactions will become faster and secure.