Auto Chain – Built on Blockchain

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***Abstract* – We are motivated to do this project because currently the historical information of an automobile are typically scattered and might be replicated in multiple location without automatic data synchronization mechanism. In addition to these inefficiencies and potential discrepancies introduced by unsynchronized data replication, the historical data are typically do not have the safeguard or protection level that blockchain technology can provide against data integrity. Blockchain will function as foolproof bookkeeper, such as logging the mileage, maintenance, and repair records. By having the shared records using blockchain technology, all the participants in the automobile life cycle, such as regulator, owner, and insurer will see the same consistent records. We are using the Hyperledger composer to implement this project.**

Keywords – Blockchain, Smart Contract, Auto, Hyperledger composer.

I. Introduction

An automobile will typically going thru different ownerships during its life cycle starting from the manufacturer and eventually ended its life in the scrapping yard.

A. *Traditional Methods*

In the traditional approach, each owner of the automobile will have their own in house ledgers and records keeping methods as illustrated in figure 1. Every time the change of ownership of the automobile happen, multiple relevant participants, e.g. manufacturer, dealer, regulator, lender, and insurer, will record the transaction on their own ledgers. These duplication records efforts to maintain multiple ledgers are inefficient, error prone, slow and expensive. In addition, certain data might only reside in a single location, which make the eco system very vulnerable if that particular data happen to be breached.

B. *Blockchain Business Network*

Figure 2 show the automobile transaction and records keeping using blockchain network technology. The blockchain network allow the participants to share and access the records. Every time transaction occur, the share ledger is updated thru peer-to-peer replication once consensus is reached. The blockchain network is economical and efficient as it eliminate duplication efforts. The published transactions and records are secure, authenticated, verifiable, and immutable. The blockchain decentralized ledgers system offer resistance to cyberattack, fraud, and data compromise; therefore superior data integrity and preservation [1].

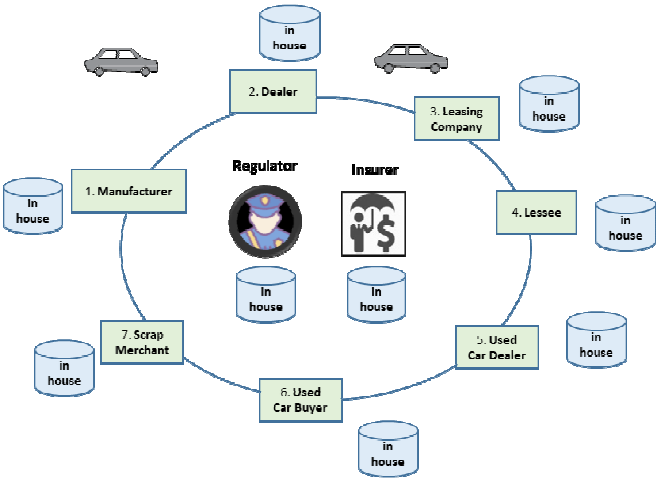

Figure 1. Traditional automobile transaction bookkeeping. Participants duplicate and store them in their in house ledgers.

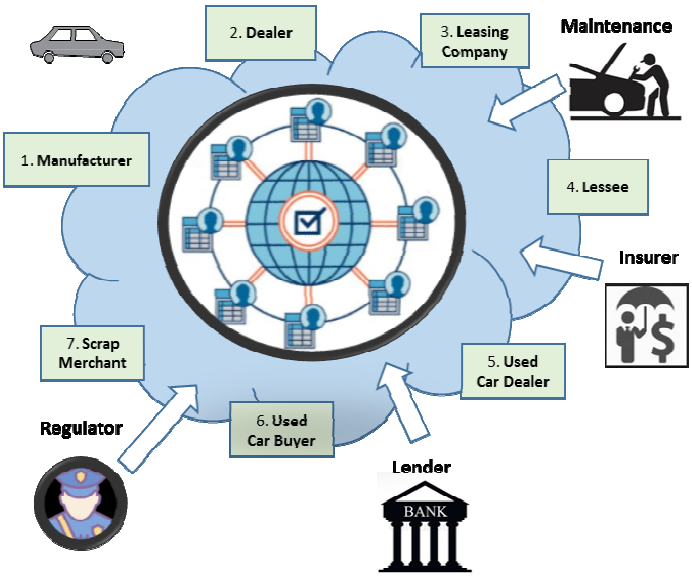

Figure 2. Blockchain Network System. Transactions are shared and available to all the relevant participants.

II. BLOCKCHAIN

Blockchain is fundamentally peer-to-peer distributed ledger that is cryptographically secure, append only, immutable (extremely hard to change), and updateable only via consensus or agreement among peers [2]. A block is a set of timed stamped transactions bundled together connected to previous block hash (hash pointer). This previous block hash links the blocks together and prevents any block modification or block insertion between two existing blocks. By doing this, each subsequent block strengthens the verification of the previous block and hence the entire blockchain integrity. The method makes the blockchain tamper-evident, lending to the key attribute of immutability as shown on figure 3 [3].

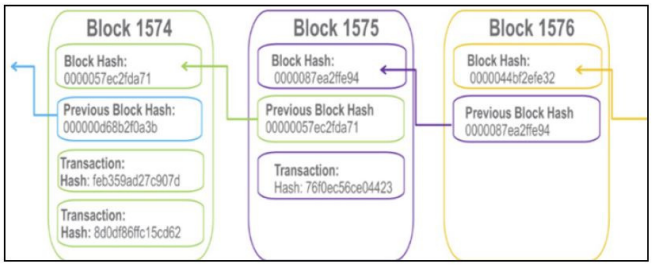

Figure 3. Structure of blockchain hash links connectivity

III. HYPERLEDGER

A. *Hyperledger vs Bitcoins vs Etherium*

Hyperledger, a Linux Foundation project, is an open source community to help advance technology and thought leadership. Table 1 show comparison with Bitcoin and Etherium.

TABLE I
HYPERLEDGER VS BITCOIN VS ETHERIUM

	Hyperledger	**Bitcoin**	**Etherium**
Platform	General Purpose	Payments	General Purpose
Governance	Linux Foundation	Bitcoin Developers	Etherium Developers
Network	Private	Public	Public/Private
Currency	None	BTC	Ether
Mining Reward	N/A	Yes	Yes
Consensus Type	Pluggable: PBFT	Proof of Work	Proof of Stake
Mode of Operation	Permissioned	Permissionless	Permissionless
Data Integrity	High	Extremely High	Extremely High
Availability	High	Extremely High	Extremely High
Confidentiality	High	Poor	Poor
Performance	Good	Terrible	Terrible

B. *Hyperledger Composer Overview*

Hyperledger Composer is an open development toolset and framework to make developing blockchain applications easier. Hyperledger Composer supports the existing Hyperledger Fabric blockchain infrastructure and runtime, which supports pluggable blockchain consensus protocols to ensure that transactions are validated according to policy by the designated business network participants. Figure 4 show overview of the Hyperledger composer organization [4].

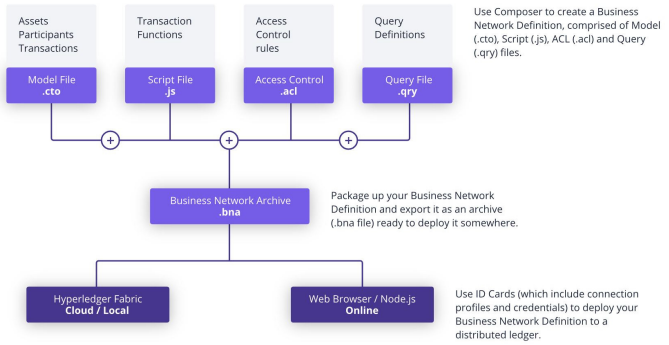

Figure 4. Hyperledger Composer Overview

C. *Hyperledger Composer Solution flow*

Hyperledger Composer quick "full-stack" blockchain solution is shown in figure 5 [5]. It show the business logic that runs on the blockchain, REST APIs that expose the blockchain logic to web or mobile applications, as well as integrating the blockchain with existing enterprise systems of record.

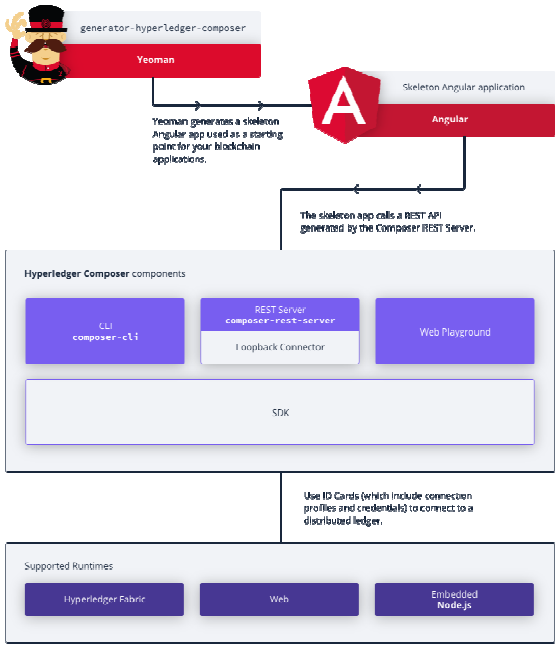

Figure 5 Hyperledger Composer Solution flow

IV. Implementation

The Auto Chain front-end is created using HTML, JaveScript with React library. The back-end is implemented in JaveScript and Node.js. The blockchain transactions records are stored in Hyperledger. The key components of the blockchain are as follow:

1. Asset – these are the car and the car listing.
2. Participants – as shown in fig 2, it include the manufacturer, dealer, leasing company, lessee, lender, regulator, insurer, used car dealer, used car buyer, and scrap merchant.
3. Transaction – Change of ownership, loan contract, insurance term, etc.
4. Access Control Rules – depending on the type of transaction involved, participants might be granted the following operations:
    a. CREATE
    b. READ
    c. UPDATE
    d. DELETE
    e. ALL

V. Conclusion

As has been shown the enterprise permissioned blockchain technology like hyperledger can tremendously help streamline the record keeping of an automobile during its life cycle. It eliminate the inefficiencies of the duplication effort while offering supreme high data integrity and availability to relevant parties. In addition, the open source hyperledger composer support for multiple mainstream software has eased the effort of integrating or adopting the blockchain technology.

VI. Future Enhancements

As the connected and IoT devices proliferate everywhere and the advent of autonomous vehicles are closer and closer, we would like to explore blockchain technology potential in supporting the safe and reliable autonomous vehicles.

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