

VEHICLE REGISTRATION OPERATION FOR REGIONAL TRANSPORT OFFICE (RTO) USING BLOCKCHAIN TECHNOLOGY

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Abstract: - Nowadays where everything is digitalized, we need to keep that digital data secured and authenticated too. With growing technology the fraudulent activities are also growing. Even in the field of operations (supply chain management) of any goods; everything is done through digital means. To curb cyber frauds & digital frauds there are many technologies. One such technology called 'Blockchain' and it is currently booming in world because of its various features. We will see further in this paper that how blockchain technology is used in vehicle registration process and how it maintain its data and activities in a more secured, reliable and efficient mode. There are various entities related to the motor vehicles such as manufacturer (producers), dealer (middle man), buyer (consumers), registration authority (RTO), insurance company. According to the norms, all the entities should integrate for the successful registration of the vehicles. However, current system might have to face errors due to input of wrong or incomplete information and also some other repercussion such as data manipulation which might be a threat to the system. In India, the vehicle registration process is maintained by Regional Transport Office (RTO). RTO also maintains entire record of road tax, license, emission certificate, no objection certificate. The current system faces the problem of fraud detection i.e. if a fraud is occurred, then it is difficult to trace back as different entities such as manufacturer, dealer, RTO and insurance company works on their own terms. By getting blockchain technology into the current system helps us to get a more reliable solution for future as blockchain technology being a distributed (decentralized) ledger technology and also being more promising in data security and privacy helps for carving a more reliable and efficient system. By the means of the proposed paper, it is an approach to solve problems underlying in the vehicle registration system and also bind all the different agencies related to vehicles under one portal and get them connected through blockchain technology. Binding them under one portal will make the existing system more reliable as all of them would be in the chain and with blockchain; every transaction record along with the timestamp would be available in the system

Keywords: -Blockchain, vehicle registration, manufacturer (producer), dealer (middle man), RTO, buyer (consumer), BCT (Blockchain Technology)

I INTRODUCTION

Nowadays, automobile industry have seen a huge growth in terms of its sales due to the increase in demand and supply. In India, 45% of the families at least have one vehicle of their own. According to the government guidelines, the RTO (Regional Transport Office) is the assigned authority which looks after the vehicle registration process. With the proper documentation, the RTO authority registers the vehicle. Along with time, the sales graph of vehicles have shown positive results with high numbers all across the nation. . Registering more number of vehicles with the conventional process wouldn't help to serve the purpose of maintaining the real time database.

The conventional process have often been with the path of obstacles as it always needs to deal with moving from desk to desk to get the registration work accomplished as different entities such as manufacturer, dealers, insurance company, RTO

works independently. As dealer gives the invoice of the sold vehicle, which is further given to insurance company to get insurance of the car and along with the insurance letter given by the company is being required by the RTO to register the car. This process might be prone to error by submitting false information at any stage or else someone may try to manipulate the data for their own personal interest. RTO maintains the centralized database for registering the vehicle and often have to deal with computational loads. Talking in the time of technology advancements, computational load can be easily tackled with decentralized system which is offered by blockchain technology.

In conventional method of registration; despite of authorization and authentication at every phase of vehicle i.e. manufacturer, dealer and buyer many times it is found hard to trace where the fraud occurred. Bringing all the different entities under one system linked through blockchain technology can help to build a more secured and reliable system. For every transaction made

right from where the vehicle is manufactured to whom it is registered, each and every transaction gets recorded in the block and merits of blockchain technology is that data is immutable and also can be secured with hash function. That's where the point of using blockchain makes it more imminent as in the proposed system, now every log/transaction helps us to get knowledge that who did the transaction and at what time.

1.1. Objective

Considering the potential of blockchain technology, the main objective of this work is to implement a vehicle registration infrastructure based on blockchain. A vehicle registration system based on blockchain can decentralize this kind of registries and as a consequence improve data availability and resilience to faults. As a set of entities, ranging from leasing companies to government offices, rely on the car registration system, a decentralized system based on blockchain can improve its performance and safety when compared with a centralized solution. Given the decentralization inherent to blockchain it is crucial to understand the role of an entity such as the national registry. As it will be discussed throughout this document, a blockchain application for car registration can still take in consideration the authority of the national registry entity. With this requirement, a blockchain based car registration system can benefit from decentralization but still maintain a centralized authority to partially manage and control the system. This technology can also represent an effort to improve government efficiency and transparency. Therefore we propose an implementation of blockchain technology for all types of vehicle registration using smart contracts and analyze its impact on vehicle registration business processes.

II LITERATURE REVIEW

Blockchain has been a topic of discussion during the last few years. It has been in market due to its property of never getting the block destroyed and keeping the entire data from the starting of the system till the end. Many application sector is now working on blockchain; to overcome difficulties faced in the current existing system of their fields. Some of the application can be crypto currency, health sector, E-commerce, Banking and many others.

[01]Cho Cho Htet and May Htet, aimed to develop a secure system for trading system. There is a requirement of more secure environment against the attack, like a 51% attacks. He suggested to use a reliable e-commerce business model with product grading system to get the price of the product based on its quality. He developed a platform where the vehicle owner, buyer, and other agencies like repair services must register themselves. Their record was stored in a public blockchain network. To know the history of a car, buyer can send request to owner and owner sends back the block containing the vehicle information. All of this is recorded as a transaction in blockchain. When the car gets

sold the data in the block of specific vehicle is updated and stored back in the new block and added to the chain. The randomly chosen miner were used to mine the block for the developed blockchain. The miner were chosen based on the coins they mined. By using the blockchain it becomes harder for the attackers to attack the system as it gets distributed over different nodes. [02]Michael and Steven Sprague, provided an idea how implementing hardware security can enhance the security and privacy for the end user and blockchain. First of all the block diagram of any internal structure of computer nodes should be developed. This flow of data should be maintained. The device for authentication should be placed at front so that any user need to be verified before using the system. They said that to rise the security and privacy of the user in blockchain, they need to be verified as a valid buyer or seller on the site. Later they allowed to have a transaction and this transactions are stored safely in the blockchain network. This way by adding the layer of security above the blockchain transaction we are able to provide high security to very important data and our privacy.

2.1 Existing System - (Current Vehicle Registration System)

Undoubtedly, blockchain is a trending technology and have been in used in the automobile industry. The existing system uses blockchain for third party application such as trading system, insurance company or for creating digital identity. Though system is reliable but some crimes related to vehicles such as Duplicate Registration Certificate, Approval of No Objection Certificate on false document by RTO, manipulating invoice for tax benefits are still a pertaining problems in the field of vehicles as no current system deals with all entities such as manufacturer, dealer, buyer, RTO together under one portal that too connected with blockchain technology. Analyzing the current car registration system, a user can interact with the car registration system by going to a national registry ope and requiring information regarding a vehicle or requiring to change a vehicle's registry. Then a national registry employee consults the car registration system and provides the information to the user or updates the vehicle's registry. Information changes, for registered vehicles, mostly require the owner or an authorized party to fill in a form. On the other hand, a vehicle owner can have a narrower but more direct access to the vehicle registration system by using an online platform, although most of the information updates still require approval from a registry employee. In both methods described, most of the operations available require some sort of payment to be executed.

III PROPOSED SYSTEM: (VEHICLE REGISTRATION PROCESS ON A BLOCKCHAIN BASED SYSTEM)

Given the properties of a blockchain based vehicle registration system, the business processes presented in the previous sections can be modified to benefit from blockchain properties. A blockchain based car registration system should work following the principle that information updates over

vehicle's data are correct unless this information is latter proven to be wrong. Thus we propose a blockchain based vehicle registration system on which change requests over vehicle information can be firstly registered to the system, as soon as the request is issued by the respective participant and the request's payment is confirmed. This approach takes advantage of blockchain technology and its immutability to simplify business processes.

By the means of proposed solution, it is an approach to make vehicle registration system more secure and reliable. The solution tends to solve problems such as generation of false document and manipulating the data related to vehicle in the system by the authorized person for their personal interest. By bringing all the agencies under one portal that is connected through blockchain technology, any changes made by one authorized person would reflect all over the system and it would be easy for us to retrieve the information about who did it and when.

3.1 Functioning of Blockchain (3.1 a)

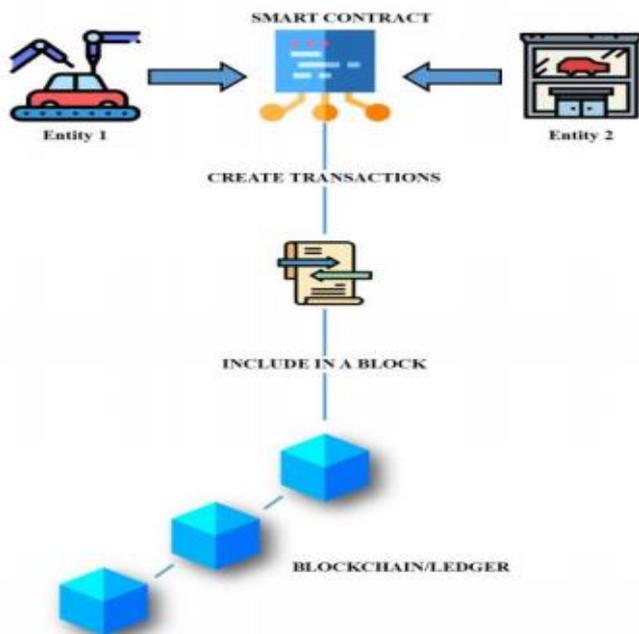


Figure 1. Functioning of blockchain

The above figure depicts how different entities are connected through blockchain and its transaction gets recorded into blockchain. The vehicle registration system is divided into different modules. Such as

- 1) Manufacturer Module
- 2) Dealer Module
- 3) Buyer Module
- 4) RTO Module

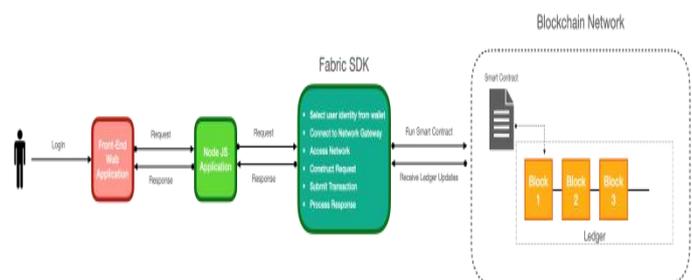
Manufacturer Module: Manufacturer requests for the valid chassis numbers to the RTO. Using this chassis numbers manufacturer can add new Vehicle manufactured in their

industry. Manufacturer can create an assignment to be allotted to the Dealers for which the vehicles are registered to the specific manufacturer. Assignment is allotted to dealer and the transaction history is saved in blocks using blockchain. Blockchain will persist the immutable log of transaction which neither can be deleted nor modified. All transactions made by the particular manufacturer will be viewed in the dashboard. Dealer Module: Dealer could be capable of accept/reject the shipping task allocated through producer. By accepting the shipping task, supplier could be capable of promote cars. The dealer can promote the car to the confirmed purchaser that's then registered to the device. All the Transaction made through supplier together with Delivery Accept/Reject or Vehicle Sell could be logged in the Blockchain. Now with the assist of proposed device no enterprise can deny the reality regardless the cars had been allocated to it or not. Hereby, growing extra consider and collaboration among producer and supplier.

Buyer Module: First, the demonstrated customer may be capping a position to shop for the car. Buyer could be allotted with specific registered Id for the following purpose. The aim of accommodating all the organizations together is so that the buyer gets everything sorted and under one roof. The vehicle (car) may be offered to the customer and transaction may be recorded within the blockchain. After shopping for the car, customer can go for its registration to the respective RTO belonging to the customer's vicinity and might attain the registration number and his/her UID for the Vehicle.

IV IMPLEMENTATION

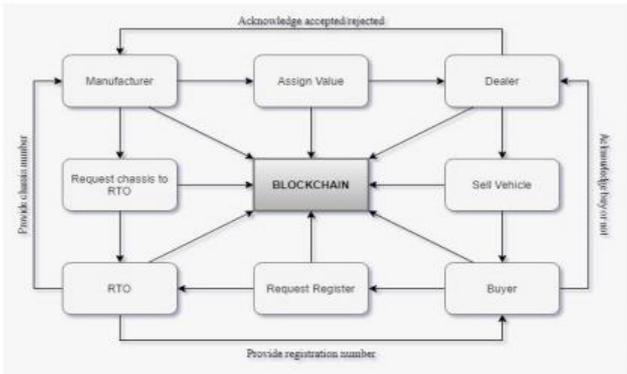
4.1. Hyperledger Fabric Role:



In this section from the above diagram we can see that each system's components is explaining their contribution for the an Hyperledger Fabric infrastructure. Then we present how a client is able to interact with the Hyperledger Fabric's blockchain and describe each step required to execute a transaction, from the moment the transaction is issued to the final steps taken to add the transaction's updates to the blockchain.

RTO Module: RTO will register the vehicle after verifying vehicle details as well as buyer, dealer and manufacturer details. All the details will be available to the RTO as all

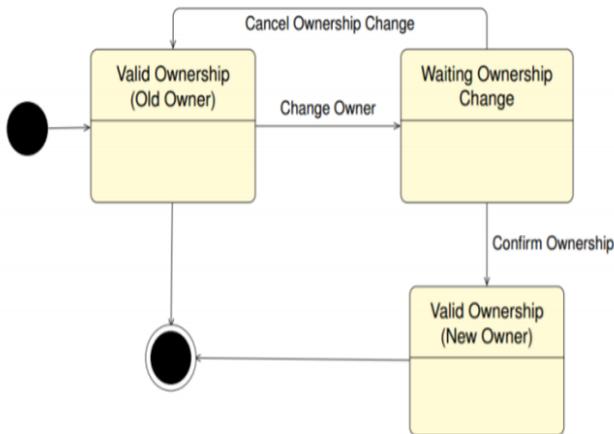
entities are available under the same roof and making vehicle registration process more flexible rather than moving place to place. RTO will provide the registration no to the vehicle. This Transaction will be recorded in the blockchain. This would ultimately give identity to vehicle and all its details can be retrieved just by one system. Further, it can also be extended to insurance company module where insurance company gets the vehicle registered with it for the future claims related to vehicles.



The above picture depicts the connection of blockchain to every entity i.e. manufacturer, dealer, buyer, RTO. Security layer has been added between every connected entity as acknowledgement is being sent back to the entity who started the transaction.

4.2 Change ownership transaction flow:

A Blockchain Use Case for Car Registration

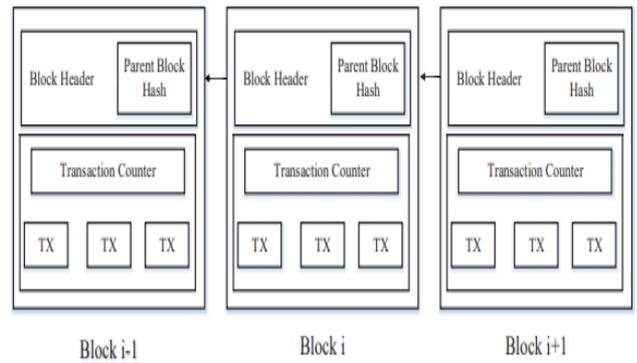


In case of second hand purchase this will be the work flow

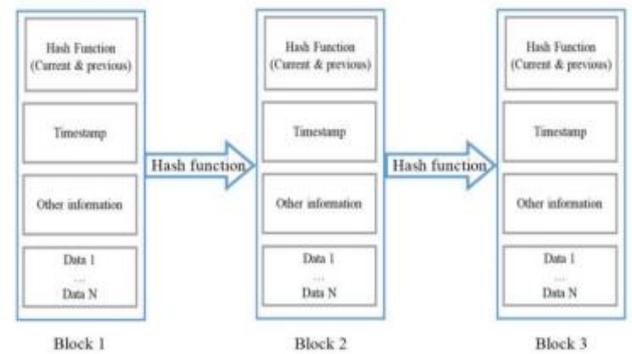
4.3 USAGE OF BLOCKCHAIN:

The blockchain is a chain of blocks which contain specific information (database), but in a secure and genuine way that is grouped together in a network (peer-to-peer). In other words, blockchain is a combination of computers linked to each other instead of a central server, meaning that the whole network in decentralized way.

4.3.1. Architecture of Blockchain:



4.3.2. Blockchain Process:



Everyone in the network are allowed to access the blocks. Blocked are used for storing the transactions in the system. For each transaction the new block gets created and is connected with the previous one. The hash value for each block is been created and is stored in the previous one for the traversal in the chain. For each transaction to be complete both parties, seller and buyer, need to provide permissions and hence the digital signature gets implanted on the contract and it is added to the block. This provides dual way authorization for each transaction to be complete without any kind of third party in between.

V RESULT ANALYSIS

To assess the performance of the blockchain based car registration system proposed we had at our disposal a single Virtual Machine (VM) with 8vCPU, 4 GB of RAM and 1 TB of HDD space, running Ubuntu (20.04.x LTS). Regarding the software setup, tests were performed on top of Docker v20.10.6 -ce. Each peer, certified authority node and orderer was running on the base image of Hyperledger Fabric x86 64 v2.1.0. As state database, instances of Hyperledger Fabric CouchDB image version x86 64 v3.1.1 were used. In order to measure system’s performance, Hyperledger Caliper 2 software was used. Given Hyperledger Caliper is still in development phase, a version based on commit c37860b0423 was adapted for the vehicle registration system to be tested. Hyperledger Caliper allows to measure the performance of multiple blockchain implementations, one of them is

Hyperledger Fabric, given a set of use cases. This tool can produce reports containing various performance indicators, such as transactions per second, transaction latency and resource utilization. Considering Hyperledger Fabric nodes setup, we configured the system with a total of 9 containers with a total of 3 Hyperledger Fabric peers. The system was configured using raft consensus mechanism. Each Hyperledger peer was tied to a different organization, so 3 organizations were configured in total, requiring a certified authority running on a separate container for each organization. Organization's peers used in the experimental setup were configured as endorsement peers. Thus an additional 3 + containers (Chaincode Peer) is used to execute the transaction's required chaincode.

5.1. Methodology:

A set of functions were selected to sample the system's overall performance, based on the principal transaction flows described in Section 4(Implementation), 4.1, 4.2. . Thus, we evaluated the performance of Register Vehicle, Change Vehicle State and Change Ownership. Each function was tested with a varying number of fixed throughput issued, for each block size configuration. Firstly, a set of 100 transactions where issued against the vehicle registration system with a fixed send rate of 50 transactions per second (TPS). Then, a set of 200 transactions where issued with a fixed send rate of 100 TPS. Finally, a set of 400 transactions where issued with a fixed send rate of 200 TPS against the system. As each set of transactions was sent, the throughput was calculated dividing the number of transactions successfully executed by the time taken to execute such transactions. As each component of the Hyperledger Fabric system is running on a single Virtual Machine, we took advantage of Hyperledger Caliper functionalities by tracking the RAM and CPU usage of each Docker container. As a remark it is expected for the CPU usage percentage to surpass 100% usage as docker statistics aggregate CPU usage as the sum of each core's percentage of use. Regarding block size and maximum time for block formation, following experiments were conducted. Each function's throughput and latency information was measured against a block size of 1MB, with 250ms timeout.

Send Rate	1 MB Rate		
	50 tps	100 tps	200 tps
Register Vehicle	13.74	25.68	timeout
Change Ownership	12.28	21.04	40.37
Change Vehicle State	10.79	20.29	35.38

Table 5.1 (a) – Latency (seconds) taken by the block to execute.

Name	Memory(max)	Memory(avg)	CPU(max)	CPU(avg)
dev-peer0.org2.example.co...0.0.1	124.7MB	116.8MB	90.68%	25.30%
dev-peer0.org1.example.co...0.0.1	128.9MB	120.9MB	82.95%	25.42%
peer0.org2.example.com	77.5MB	65.9MB	96.47%	38.99%
peer0.org1.example.com	74.1MB	62.9MB	91.21%	40.05%
orderer.example.com	23.2MB	19.1MB	22.63%	3.91%
couchdb.org2.example.com	134.4MB	124.7MB	195.93%	82.82%
ca.org1.example.com	7.2MB	7.2MB	0.00%	0.00%
ca.org2.example.com	7.0MB	7.0MB	0.01%	0.00%
couchdb.org1.example.com	144.9MB	127.0MB	211.25%	83.66%

Table 5.1(b) - Register Guarantee function with 100.0 tps send rate (1MB block size)

Considering Table 5.1 (a), we notice that across all tested block sizes, the latency suffers a major increase when comparing a 100 TPS send rate with the 200 TPS send rate. The overall latency is roughly doubled when the send rate is around 200 TPS, with no major increase in throughput. Analyzing the system statistics for 1 MB block size during a 100 TPS send rate test, as in Table 3, it is clear the ordering peer (orderer.example.com) is not requiring above average CPU or memory usage. Furthermore, the ordering peer presents low memory and CPU usage during the test. Regarding all components used in the test, CouchDB instances reveal to be the most resource hungry containers. On the other hand, the use of Hyperledger Composer framework might have a significant impact on Hyperledger Fabric overall performance. It is possible that the use of native Hyperledger Fabric chaincode to develop the vehicle registration system's smart contracts may lead to performance improvements. Considering the complexity of a vehicle registration system in India, as the proposed system, it is plausible the quantity of information stored in the blockchain and the complexity of available operations might provide a reason for such latency and throughput results. Thus, the implementation of access control rules embedded in the smart contract, as opposed to using solely the Hyperledger Fabric's access control mechanisms, improved the latency of such transaction's execution. However, it is still noticeable that the access control mechanisms used in proposed blockchain based vehicle registration system contribute to lower performance regarding throughput and latency

VI CONCLUSION

Blockchain technology and its application will be more efficient as the feature provided by BCT are privacy, security, traceability, provenance and these are worth absolutely worth using. Thus it will be helpful to serve as the base of making the current system more reliable. Vehicles are a widely used asset across the world with a high associated value. Adopting technology such as Blockchain to increase transparency of vehicle ownership will make the entire process more trustworthy. Further, this will alleviate manufacturers, customers, authorities and all other involved parties of time-consuming, manual, and repetitive tasks. A data model was build considering the operations identified for a vehicle registration system as well as the participants of the system. The set of

available operations for this registration system for RTO was then described according to their effects of its registry. Regarding vehicle registry's operations we presented two-step transaction flows as Change Ownership transaction flow, allowing to take advantage of a blockchain based automobile registration system. Those operations enabled for registry employees to lower their intervention in those transaction flow. Finally we conducted a set of performance tests over a simple configuration of the Hyperledger Fabric system and conducted an analysis over the collected data. As of the test results we analyzed the throughput and latency results over a set of system's functions varying the block size of the system.

VII. FUTURE WORK

As the vehicle registration system was designed, it encompasses most of the operations over vehicle registries. However, the system focuses only on all types of vehicle registry data. A broader system could be built based on the proposed blockchain based RTO system, including information regarding vehicle characteristics and legal inspection registries. Considering such a system, blockchain technology could be used to unify the car registry system with the vehicle registry maintained by the Regional Transport Office. Furthermore the unified system could be designed as a unique system for entire nation.

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