



Application of blockchain in Usage Based Insurance

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ABSTRACT

Usage Based Insurance (UBI) consists of schemes such as Pay As You Drive (PAYD) and Pay How You Drive (PHYD). In this paper, we detail the application of Blockchain in Usage Based Insurance schemes - PAYD and PHYD. Using Blockchain, we propose an effective mechanism to store transaction data and also the condition of the vehicles. We also detail measuring these parameters to calculate premium amounts, create new insurance schemes and also a new market for used vehicle sale.

Keywords— Insurance, PAYD, PHYD, MHYD, Blockchain, Smart contract, Public Key, Private Key

1. INTRODUCTION

Vehicle insurance has been a huge sector of income for the government and contributes significantly to the GDP. It is said to be a \$9 billion market and expected to grow to around \$20 billion by 2025. According to a survey by the Government of India, there are around 210 million vehicles as of 2015 out of which over 60% are uninsured. It is a big market opportunity which has been overlooked so far.

Usage Based Insurance (UBI) is an important innovation in the field of automotive insurance. It comprises of two schemes - Pay As You Drive (PAYD) and Pay How You Drive (PHYD). The advancement in telematics is an enabler for UBI whereby the condition of the car can be monitored in real time using sensors embedded in the vehicle. UBI aligns the insurance premiums/schemes with the driving behaviours. Patterns are generated which can be used by the drivers to assess their driving habits. Thus, UBI also gives rise to options such as Manage How You Drive (MHYD). These schemes are detailed later.

In this paper, we propose the application of Blockchain in building an efficient, secure and transparent Usage Based Insurance scheme. We also introduce a concept for used vehicle sale and peer to peer insurance using the proposed framework.

2. CONCEPTS OF BLOCKCHAIN

Blockchain is an emerging technology in the field of computer science having various applications. It is an open, distributed

ledger that records transactions between two parties efficiently, securely and in a verifiable way. It is a continuous growing list of records called blocks which are linked and secured using cryptography.

2.1 Structure of Blockchain

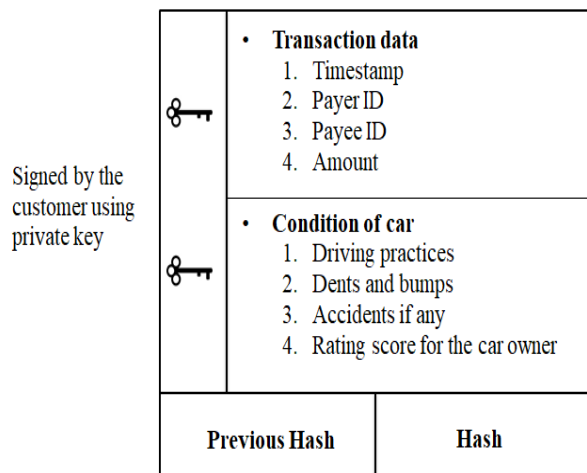


Fig. 1: Structure of each block

Each block in the chain has information about the condition of the car and transaction data. These pieces of information need not belong to the same car owner. These blocks are constructed from the pool of transaction data and car condition data; hence the information stored in each block could be related to any of the vehicles.

In order to distinguish data belonging to separate vehicles, it is encrypted with the private key of the car owner. Given that the car owner alone has access to his private key, we can easily verify that that data belongs to the specific person.

2.2 Smart contract

Smart Contract is an agreement between two parties enforced and recorded by the blockchain. It is executed after reading through all the blocks in the chain. Since the blocks are infallible, the accuracy of the transaction can be guaranteed. The working is shown in the figure 2.

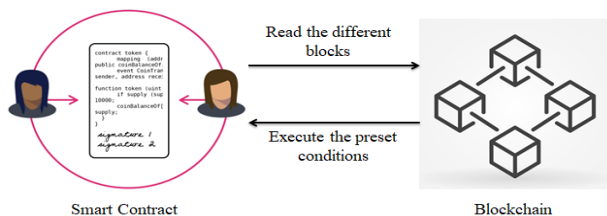


Fig. 2: Concept of smart contract

2.3 Insurance license

Each insurance company needs a license from IRDAI to operate. Issuing of this license along with the terms and conditions by the IRDAI to the insurance companies is recorded and stored in the blockchain as a transaction. This denotes that the insurance company can sell vehicle insurance in India and it is made visible to all customers. The IRDAI enters into a smart contract with the insurance companies for automatic revoking of license or re-licensing after the term.

The customers buy vehicle insurance from Insurance companies. The various terms and conditions of the insurance like insurance premium, damage coverage, claim policy, etc are stored and recorded as a transaction in the blockchain. The customers enter into a smart contract with the insurance companies for automatic payment of insurance premium by the customer and automatic claim settlement by the insurance company.

2.4 Payment of insurance premiums

Since the customers have entered into a smart contract with the insuring companies, the insurance premium amount is automatically paid every year (or a different time frame) as all contracts in the blockchain are automatically enforced. The number of insurance defaulters comes down drastically. A smart contract also reduces the verification time in case of claims and fastens the process of claim settlements. Its application is shown in the figure 3.

The use of blockchain automates underwriting and claim handling. Since the insurance policies, contract terms and claims are recorded in the blockchain, a smart contract can automatically select the application that should be accepted and the applicable terms including pricing, pay a premium or settle claims on the occurrence of the condition set out in the contract and identify frauds. Hence, if the damage to the vehicle can be sensed through telematics and recorded in the blockchain, a smart insurance claim can be made through the smart contract. It reduces the time and effort of the customer to make the claim. Since the data recorded is authentic, the insurance claim has zero verification time.

The settlement of claims is also recorded as a transaction in the blockchain. This information is used in calculating the insurance premium in the future.

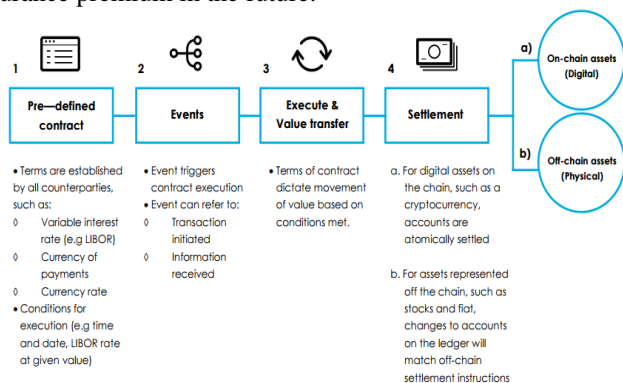


Fig. 3: Smart contracts for vehicle insurance

2.5 Smart insurance document

Each insurance policy has a unique insurance number associated with it. This unique insurance number along with the digital signature of the insuring company for the insurance policy is used to generate a QR code. The QR code is unique for each insurance policy and is also authentic as it contains the insuring company's signature. Hence, the insurance papers which are traditionally carried are replaced by a simple QR code.

2.6 Vehicular data as a part of the blockchain

Using the advancements in the field of IoT and telematics, vehicular data can be recorded in real time. The vehicular data collected is encrypted using the common secret key agreed in the insurance policy and stored in the blockchain on a regular basis. The insurance company decrypts the customer's vehicular data and analyses it to form driving patterns. This is used in PHYD (explained later) to estimate the insurance premium.

By storing the vehicular data in the blockchain, no one can tamper with the vehicular data in order to alter the insurance premium. Hence, the calculation of premiums is accurate and reliable. Also, storing of vehicular data in the blockchain can enforce the settlement of claims through a smart contract.

The driving patterns and the various parameters sensed can be made available to the corresponding customer through a mobile application. To promote safe and accident-free driving, incentives can be provided by the insurance companies to good drivers. This is called MHYD, which is detailed later.

2.7 Benefits

This technology has a large number of advantages and can fill the loopholes in the current insurance system. Advantages of using this technology are the following:

- No single point of failure
- A decentralized system, hence ensuring transparency with no single entity controlling the blockchain
- No fraudulent insurance companies in the system
- Elimination of insurance premium defaulters due to the use of smart contracts
- Automation of insurance premium payments by vehicle owners
- Smart claims automatically trigger the repair process and have zero verification time
- Insurance papers are replaced by a QR code
- Efficient implementation of UBI

3. USAGE-BASED INSURANCE

Pay As You Drive (PAYD) is a popular form of Usage Based Insurance where the insurance premium is set based on the number of kilometres travelled in the vehicle during the insured period. It provides a low insurance premium to customers who drive less. The insurance period can be customized based on the requirements of the customer.

Pay How You Drive (PHYD) is a form of Usage Based Insurance that is rapidly being adopted in the industry because of its benefits. Instead of basing insurance premiums on a vehicle's make and model, the age of the driver, occupation of the driver etc., PHYD assesses premiums based on how the vehicle is driven. This form of assessment is more appropriate because the drive pattern is a key indicator of how likely the user is to file for a claim. For example, a rash driver is more likely to meet with an accident and hence more likely to file for a claim.

3.1 Technology involved

We have already proposed the use of Blockchain to store vehicular data. Using multiple sensors like Milometer, Accelerometers, Angular rate sensors, Vibration measurement device, GPS, Torque sensors, Engine and E-motor sensor, Brake and Clutch sensor, etc various vehicular data can be collected from each vehicle. Hence, it is possible to monitor the vehicle in real time. The data collected is stored in the blockchain and is used by the insurance companies to build models which are then used to estimate the premium to be paid by the user.

3.2 Parameters

The insurance cover and premium for a specific vehicle is presently calculated using mainly the following parameters:

- **IDV:** This is the cover amount of the vehicle. The cover is decided on the basis of the value of the vehicle with depreciation adjusted.
- **Age:** As a person matures, he becomes more responsible and with less tendency to drive rashly. Accordingly, the premium discount is provided.
- **Occupation:** Discount on the premium is offered to people belonging to certain professions. The professions include medical doctors, chartered accountants etc.
- **Claim History:** If the driver makes no claim during the policy years, he/she can get a discount called a no claim bonus.

In addition to these parameters, we propose the following in the PHYD scheme:

- **Average speed and Acceleration:** The speed and acceleration of the vehicle have a say in deciding the premium amount. A vehicle driven at high speeds which accelerates a lot is more likely to damage the vehicle.
- **Braking and Cornering:** If the driver usually brakes hard and turns at high speeds, it wears out the vehicle and may eventually lead to him/her damaging the vehicle.
- **Distance travelled:** This is a common parameter in estimating premiums. A vehicle which travels longer distances is more likely to suffer damage.
- **Time of the day and day of the week:** The vehicle is more likely to be damaged at night and during the weekends.
- **Weather conditions:** If the vehicle is driven in rain, snow or other harsh weather conditions, the driver is more likely to end up damaging it.
- **Type of Manoeuvre:** Dangerous moves such as fast overtakes, overtaking on a curve, exceeding speed limits etc. all increase the probability of damage to the vehicle.
- **Good practices:** Use of indicators, horns etc. are good driving practices and their effective use means that the car is less likely to suffer damage.
- **Region:** The region (district/city/town) where the vehicle is majorly used- urban areas, rural areas or on the highways, is considered. Vehicles primarily used in rural areas are less likely to file for claims.
- **Service date:** The duration from the last service date of the vehicle is also taken into consideration. A recently serviced vehicle is in a better condition than one which was serviced long ago. Also, a vehicle which has been serviced many times in a short duration, may be driven by a rash driver and so he/she is more likely to file for a claim.

All the above parameters are examined in the data that is collected from the vehicle in real time. Driver specific drive patterns are built indicating whether the user is a safe or rash driver. Each parameter has an associated percentage indicating

its importance or relevance in the calculation of the premium amount. The Insured Declared Value (IDV) is the base premium value. The appropriate additions or deductions to the IDV are made based on the drive patterns to calculate the final premium amount.

Regression models may be used to extrapolate the drive patterns and estimate how the user may drive in future. This can be used to offer long term insurance covers good and safe drivers.

Customers can access the data sensed, regression models and driving patterns through a mobile application. This is to provide feedback to the user on his/her driving patterns. This gives rise to Manage How You Drive (MHYD). In addition, to promoting safe driving habits, the app can also be used to provide user-specific suggestions and advice. The driver can improve his/her driving by following the suggestions provided.

3.3 Incentives for the customer

The following incentives can be provided to the customers:

- **Cashback:** Providing cash incentives to the policyholder upon reaching certain predetermined goals or targets
- **Premium discount:** Policyholders will get a certain percentage off their agreed premium rate upon reaching certain predetermined goals or targets
- **Value-added services:** Offering merchant discounts, vehicle maintenance alerts, and other additional services alongside the policy holder's PHYD product

The aforementioned goals or targets may be anything as agreed by the driver and the company at the time of issuing the cover. For example, if the customer consistently follows good practices and uses the vehicle only in pleasant weather conditions, he/she may get cash back or 10% off on their premium amount.

The architecture of the PHYD insurance scheme is shown in the figure 4.

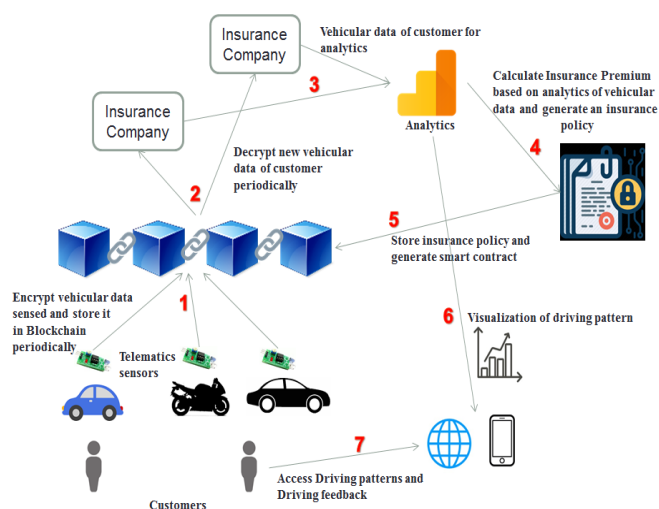


Fig. 4: PHYD architecture

3.4 Benefits

PHYD's benefits are mainly of three categories:

3.4.1 Benefits to the customer:

- Ability to reduce his/her premium by driving safely
- Transparency in the calculation of premiums due to the use of Blockchain
- Access to many rewards and value-added services depending on the drive patterns
- Low accident response time by the companies

3.4.2 Benefits to the insurance company:

- Fight fraudulent claims
- Enhancement of pricing accuracy
- Identify, retain and attract profitable customer accounts
- Reduction of claim costs
- Enable lower premiums for the customer thereby attracting more of them

3.4.3 Benefits to society:

- Reduce accident frequency, severity
- Reduce traffic, congestion and ensure good driving practices

3.5 Used car market

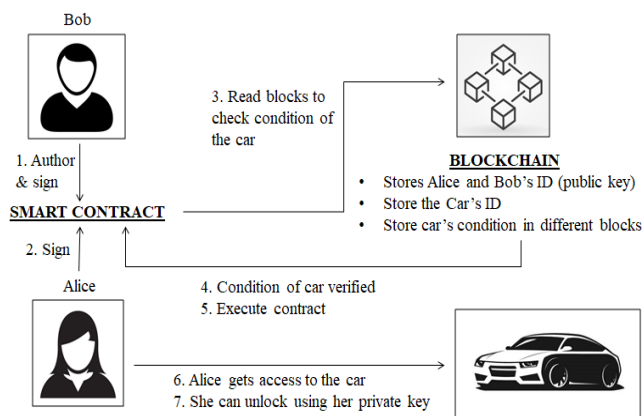


Fig. 5: Smart contract in used-vehicle market

Including vehicular data in the blockchain also gives rise to the option of a reliable used-vehicle market. Customers wishing to sell their used vehicles can publicly share their vehicle condition information which is sensed and analysed by the insurance companies to other customers. Customers willing to buy used vehicles can use the vehicle information to make their choices and negotiate the price. The vehicle condition shared is authentic as it is stored in the blockchain and has been continuously tracked by the insurance company. The buying and selling of used vehicles can also be done through smart contracts thus making it authentic, secure and reliable. There is no need of a third party dealer as the buyer and seller can

directly communicate as there are in the blockchain. This is illustrated in the earlier figure 5.

3.6 Peer to Peer insurance

Peer to Peer Insurance is an insurance model where a group of friends, colleagues or family members pool money together to ensure their vehicles. Insurance premiums are lower than traditional insurance and the leftover amount in the insurance pool is returned to the participants after the insurance term. Blockchain is used to create and enforce a peer to peer insurance contract. Insurance premium pool can be created and settlement of claims can be made through smart contracts. Hence, a reliable and secure peer to peer insurance system can be formed. The advantage of using blockchain is that this scheme can be securely and reliably enforced even between strangers.

4. REFERENCES

- [1] Nakamoto, Satoshi. "Bitcoin: A peer-to-peer electronic cash system." (2008).
- [2] Kantor S, Stárek T. Design of algorithms for payment telematics systems evaluating driver's driving style. Transactions on Transport Sciences. 2014 Jan 1; 7(1):9.
- [3] Husnjak S, Peraković D, Fehrenbacher I, Mumdziev M. Telematics system in usage-based motor insurance. Procedia Engineering. 2015 Jan 1; 100:816-25.
- [4] Bordoff, J. and P. Noel. Pay-As-You-Drive Auto Insurance: A Simple Way to Reduce Driving-Related Harms and Increase Equity, Discussion Paper 2008 July. Washington, D.C.: The Brookings Institution.
- [5] Allen Greenberg. Designing Pay-Per-Mile Auto Insurance Regulatory Incentives, Transportation Research D, Volume 14, Issue 2009 August 6, pp. 437-445.
- [6] Todd Litman. Pay-As-You-Drive Pricing and Insurance Regulatory Objectives. Journal of Insurance Regulation, 2005, Vol. 23, No. 3.
- [7] Jacobus Zantema, Dirk Van Amelsfort, Michiel Bliemer and Piet Bovy. Pay-As-You-Drive: Case Study Into Safety and Accessibility Effects of PAYD Strategies. 2008, Transportation Research Board Annual Meeting.