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MARINE HULL INSURANCE USING PRIVATE BLOCKCHAIN, FILECOIN PROTOCOL AND SMART CONTRACTS

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Abstract: Marine transportation is the oldest means of transportation, which is the most useful when the goods to be shipped are in bulk. Travelling through sea means there is high chance of mishappening even when safety regulations are in place, which could result in damage or loss of the ship or the shipments. Thus, Marine insurance is advisable as it covers the hull**,** cargo, freight and marine liabilities. Any losses or damages sustained during a marine journey must be settled as early as possible through Insurance. The process of declaring and claiming Insurance involves a lot of documentation, which is collected and stored in paper format, and third-party participation. In modern times, there has been a shift towards Digitization in every sector, which means everything is stored in a digital format. One of the key developments in Digitization has been the use of Blockchain technologies which support distributed ledgers, smart contracts, smart properties, storage, etc. Applications, in which there is involvement of money or assets, are reliant on blockchain because of the security, by encryption of data, and performance provided by it. In this paper, we have discussed the challenges and key issues associated with the declaration and claiming of Marine Hull Insurance through the existing system. To resolve these issues, we combine three of the latest technologies in Blockchain, namingly, Private Blockchain, Filecoin Protocol and Smart Contracts. Our proposed system is based on a digital platform, where all documents can be commonly accessed and third-party involvements are removed, resulting in simpler, faster and easier declaration and claiming of marine hull insurances that removes the complications in the present general procedure.

Keywords: Marine Hull Insurance, Private Blockchain, Filecoin, Smart Contracts

I. INTRODUCTION

Travelling by water is one of the main modes of transportation, especially when there is a need of a colossal transport of goods. Destinations are conventionally far from the port of origin and it takes a number of days to reach them. These exhaustive journeys require the ships to not only go through weather changes every day, but also to encounter the unpredictability of the ocean and potential confrontations with pirates or cross-border attacks. Even with proper safety regulations in place, there is no guarantee of a 100% invulnerable transportation. In fact, the statistics suggest that, in 2016 alone, there were 768 reportable incidents related to ship accidents and failures [1]. This means that a high risk is involved when we transport goods in bulk, which could result in severe losses for the ship owners and other transporters.

Marine Insurance, one of the oldest forms of insurance, is a safeguard for these shipping corporations and transporters as it covers most of the financial losses that the transportation may amass between the point of origin to the destination. These losses encompass the damage to the hull - the main body of the ship or vessel, the terminals or to the cargo carrying the goods.

Although the Marine Insurance acts as a savior for all the involved parties, it requires a lot of documentation and paperwork to get a marine insurance and to file a claim for the

insurance. These intricacies of collecting documents lead to a waste in time, on an average 10-15 days. This can be simplified if all the required documents can be accessed commonly by all the agencies that insure the ship. A cloud network can be used to tackle this problem, however, since clouds are centralized and do not offer much security, it's not the preferable option. There is a need for something more secure, accurate, time saving and simple such as Filecoin.

The focus of this paper is mainly on the losses and damages incurred by the hull and how hull insurance can be simplified. We try to achieve security, accuracy and simplicity and save time by proposing the use of latest technologies based on blockchains, such as, Filecoin and Smart Contracts. Filecoin is a protocol based on sharing unused hard disk spaces of anonymous nodes on the internet for minimal fees. It can be used to store and share the documents that are to be accessed by all parties involved.

Secondly, smart contracts, which may be used as a part of Filecoin or otherwise, could replace legal hand written contracts. Smart contracts guarantee accuracy, as one cannot fiddle with the agreements, and since the transactions will be carried out automatically without any third party interfering, the cost of hiring a broker is also waived away.

Since privacy and security are the keys here, we can perform the above implementations with the help of a private blockchain, in which as network administrators, the insured can control the access given to the other parties, such as legal adjusters, insurance companies, etc to the data insured shares and the smart contracts insured operates on.

II. BACKGROUND

A. Marine Insurance

Marine Insurance can be labeled as the mother of all insurances. When there is any damage or loss related to the ship or the goods, a marine insurance should immediately be filed for claim with the insurer. The insurer will then take necessary actions to find out whether reasonable care was taken and safety regulations were adhered to during the journey of the ship or not to approve that it is a genuine attempt to file a claim.

Ocean Marine Insurance is further classified into:

- **Hull Insurance**
- **Cargo Insurance**
- **Freight Insurance**
- **Protection and Indemnity Insurance** [2][3]

Under Marine Hull Insurance, cover is provided for the following cases:

- Any damage sustained by the body of the ship or the vessel
- Any damage to the machinery present inside the ship
- Theft of the vessel
- Damage to the third party from the vessel

Documents and certificates issued on declaration of the Insurance are:

i) Cover Note: The document which provisionally grants cover before the issue of a regular policy.

ii) Marine Policy: This document is an evidence of the contract and contains the details, like, name of the insured, etc.

iii) Open Policy: It is issued for a notable amount to cover all the shipments or sending during a particular period of time within its scope.

iv) Open Cover: It is useful for large export and import firms-making frequent shipments to obtain an Open Cover once instead of obtaining insurance cover separately for each shipment [4].

Some procedures and formalities that must be followed to claim a marine insurance are:

1. Notice to Insurer:

After the loss or damage of the hull, notifying the insurance company is the first step that should be taken by the insured. Either the insured or insured's agent have to issue an immediate notice to the insurance company regarding the mishappenings.

2. Appointment of the Surveyor:

On receiving the notice from the insured, a surveyor is appointed by the insurance company. This surveyor is responsible for identifying the causes and extents of the losses. The surveyor checks the following:

- Whether reasonable care was taken, i.e., the safety regulations were followed or not
- Whether the route followed by the ship was changed.
- The magnitude of the damages.
- How the claim could be minimized.

After checking all this, the surveyor has to prepare a Survey Report which will report to the insurance company about the happenings. The company will act on the basis of this Survey Report.

3. Landing Remarks:

After landing, the insured has to obtain landing remarks from the Port Authorities. The Port Authorities will report how the ship arrived, whether the damages or losses were pertained before the arrival or after it.

4. Submission of Claim:

To finalize the claim, the insured has to produce the following documents:

a) Policy: The original policy or certificate of insurance has to be submitted to the Insurance Company. This document establishes the claimant's title and also serves as an evidence of the subject matter being actually insured.

b) Ship and Insurance Survey Report: Survey report is absolutely necessary as it contains the details of the causes that lead to the damages and the extents of the loss.

c) Debit Note/Claim Bill: The claimant has to send a debit note demonstrating the amount claimed by him with respect to the loss or damage.

d) Copy of Protest: If the loss or damage has been caused by the uncertainty of the sea, the master of the vessel has to make a protest after arriving at the destination before a Notary Public.

e) Any other documents required by the company[5].

5. Finalization of the Claim:

After verifying the documents, if the insurance company is completely satisfied with the claim, they pay the amount of claim to the insured or the authorized person as per the insurance policy.

Marine Insurance does not cover the losses in some cases, such as:

- Negligence leading to loss or damage
- Riots, Strikes, Civil commotion leading to loss or damage
- Contamination by radioactive rays
- Destruction by a weapon of war - Atomic bomb, etc[6]

B. Private Blockchains

Blockchain technology is a decentralized network allows data to be distributed across several nodes, which can be consulted shared and secured with the help of a consensus algorithm followed by that blockchain[7][8]. The most commonly used blockchains are the public blockchains, also called the permissionless blockchains. In such blockchains, anyone can join the network, look at the details of a transaction, send messages and validate and authenticate transactions. In a public blockchain, no one is in control and the nodes are pseudonymous. Hence, no one is accountable in this network. Now, if something goes wrong, say a data breach, no single node can be held responsible for the failure. This raises various legal questions and challenges. It is not optimum for storing data as data is sensitive information and giving sensitive information to a network based on trustless transactions is not a smart decision. To overcome these shortcomings, permissioned blockchains called private blockchains exist on the network. In a private blockchain, the control of the blockchain lies with the administrator of the blockchain. Thus, he is the data controller and is accountable for all that materializes in the blockchain. All privileges such as entry to the blockchain, permission to send messages, permission to view data, permission to validate and authenticate transactions are all subject to approval by the administrator. Private blockchains can be used by business organizations which require sharing of data but with limited access only[9].

C. Smart Contract

Initially, blockchains were used only to keep a ledger of transactions distributed across all the nodes in the network, which made it the underlying structure for Bitcoin. Lately, the applications of blockchain have expanded to accommodate contracts on the chain. These contracts, better known as smart contracts, are containers of code and data, which get manipulated on the basis of the conditions or promises written in the code.

Smart contracts are the exact replicas of normal contracts, but on blockchains. They are to be signed by two or more individuals and represent an agreement for an exchange of services between the entities. The major difference between smart contracts and normal contracts is that smart contracts are immutable [10]. They cannot be falsified. Another difference is that they are executed automatically and do not require any third party to validate the exchange of services.

Smart Contracts are executable codes which work on the premises of If-then-that principle [11]. They contain a well-defined set of instructions and conditions, on the basis of which necessary action is taken.

For example, let's take the example of a person A who wants to rent a car from B. Both of these digitally sign a smart contract. B will grant the digital key of the car to A when a payment is received from A. In normal circumstances, a

person may take the money and refuse to grant the key of the car.

However, in the case of a smart contract, both the entities give it's assets to the smart contract. On receiving both the key and token amount from B and A respectively, the smart contract triggers a response which grants the key to A and token amount to B's wallet. As soon as the time period specified in the smart contract ends, digital key will be given back to B and A would have to deposit more amount in order to have access to the digital key again.

Smart Contracts are a fairer mechanism that provides a smoother exchange of services between the entities.

D. Filecoin

Filecoin is a decentralized storage network in which a peer to peer exchange takes place through tokens, also called Filecoin. Clients are provided storage space by miners once an amount of Filecoin is deposited by the client. Filecoin is based on an InterPlanetary File System (IPFS) which is used to decentralize data, implement smart contracts and to build and run distributed applications.

The three entities that exist in Filecoin Protocol are:

- **Clients -** Pay some tokens to store and retrieve data in the distributed storage network, with the help of Put and Get requests.

- **Storage Miners** - Provide space for data storage in return of some token money. They serve the put requests received by the clients. To become a Storage Miner, one must deposit a collateral amount which is proportional to its storage space.

- **Retrieval Miners -** They serve the Get requests from the clients and retrieve the data from the storage. They earn tokens by serving data.

Mining power of a miner depends on the storage space available with him. Miners receive their payments when they provide proof that the the services requested by the clients were correctly addressed and audited by the network. Filecoin uses ***Proof-of-Replication***, Proof-of-Storage algorithm which allows a host(H) or storage miner to convince a client(C) that some data (D) has been replicated to its own uniquely dedicated physical storage. Clients can select replication parameters according to their preference. The other algorithm is ***Proof-of-Spacetime***, where a client can check if a host is storing his outsourced data for some range of time[12][13].

On successful storage of data, a key is provided to the client. This key can be used to retrieve the data thereafter.

III. PROPOSED SYSTEM

A Marine Insurance provides a sense of security when we think about preventing or minimizing the losses, especially when the potential losses could extend up to millions of dollars. Since, there's a lot of money as well as responsibility at stake, all documents must be verified before an insurance certificate can be granted. The insurance company has to check the documents to see if they are in compliance with the protocols of the company.

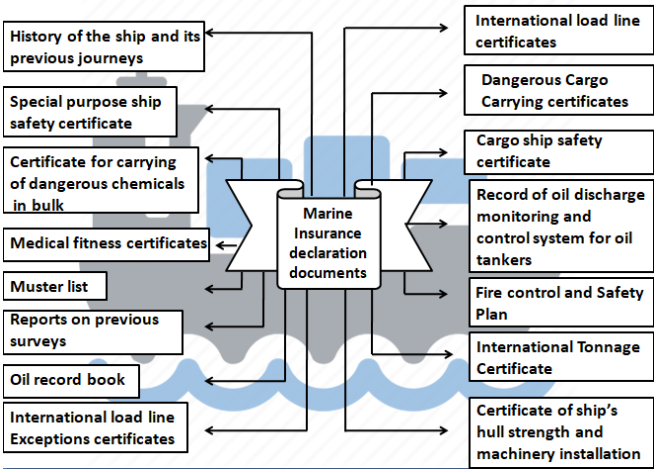

Fig.1 List of documents for declaration

After the above documents have been examined and verified, the insurance company decides if it should grant the insurance certificate and the premium amount is decided.

To record, maintain, collect and present these documents to the insurance company takes up a lot of crucial time. In emergency cases, where the shipment has to leave the port as early as possible, this latency in the processing of documents causes needless delay. Also, in cases where the ownership of the ship changes hands, the insurer's must be informed and the policies must be rendered accordingly. Manual collection and transfer of documents delays the journey of the ship in such a case.

The contracts or certificates provided by the insurance company are obtained and claimed after a series of intermediaries, like brokers, pull a few strings. These brokers charge a certain fees for their services and communication between the insured and the insurer often goes through them. They become pivotal in the claiming of an insurance. Multiple Insurances mean multiple brokers. The more the involvement of brokers, the more the fees they will be charging and more the delay in communication.

We're also familiar with the required documents and the followed procedure filing a claim, which is even more hectic. A proper inspection is carried out to confirm that damages or losses were not due to willful negligence and were indeed a result of an unforeseen event. Furthermore, it may also be the case that the ship was lost or sunk along with the crew and its paperwork. Without the invaluable documents, it is difficult to claim insurance.

In some cases of loss or damages, surveys are not mandatory. If a ship is still on cruise and has had a loss or damage which doesn't require to be surveyed, it must wait till it reaches the

port in order to submit the notice for insurance and then present the necessary paperwork. Even though the loss was apparent and claiming insurance was only subject to document verification, there was still an unnecessary delay involved.

More often than not, multiple insurance companies are involved in one ships insurance, all these insurance companies will have to be separately provided with all the mandatory documents. The intricacies involved in carrying out these hectic tasks stigmatize the aid and security provided to us by Marine Insurance. Instead, we should devise ways using which, Marine Hull Insurance can be granted and claimed more conveniently.

With our proposed system, these delays could be dealt with by cutting short the time required to collect the documents and transferring it to the insurance company. Our system makes use of a distributed storage network, in which these material documents will be stored digitally on the nodes in the network. These documents are stored on the free disk space of the nodes, called miners, and can be upgraded by the intended insured party, as and when the need arises. This is possible because the Filecoin protocol allows the user to store data on someone else's free disk space for a minimal fee, which is much more reasonable than the fees charged by the cloud services. With the help of Filecoin, the user's files and documents will be saved on a decentralized network, unlike the centralized storage provided by cloud services. This data can be replicated as per the demands of the user. Since, it is possible to have multiple copies of your documents stored, Filecoin provides for more security and availability.

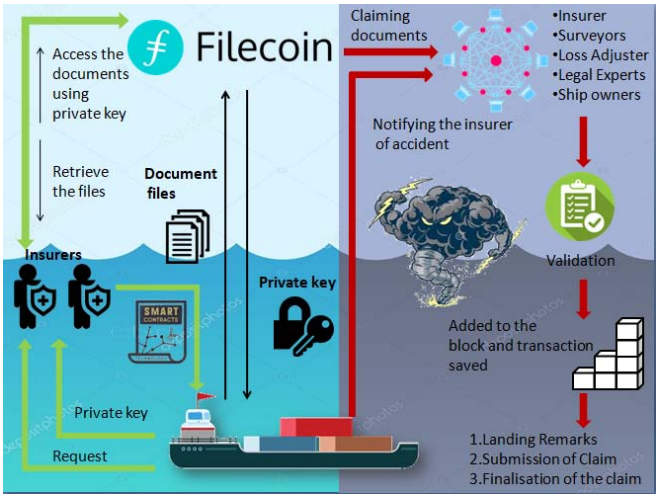

Fig2. Proposed System

The Filecoin protocol uses Proof-of-SpaceTime, using which the client/user can check that his outsourced data is stored for a particular storage time or not. The motivation for these miners to store our data and to stay online for any further interaction with the user is that they only get paid the token (Filecoin) if they are able to present the Proof-of-Replication and Proof-of-SpaceTime. If they fail to provide users their services, they will be penalized by the FileCoin protocol, resulting in a deduction in their token amount.

Once the data is stored, a key is generated and provided to the user to access the data for future use. This key can be shared with the other parties such as the insurer to verify the documents at any point of time from anywhere.

We suggest the use of smart contracts, which is a technology of the future, to replace Insurance contracts or certificates. Once a Smart Contract has been agreed upon and coded, it's immutable. Smart contracts do not require any third parties to act as intermediaries; it simply looks at the specified conditions and triggers a response. It removes the redundant role of the brokers and cuts down the expenses and communication time. Using smart contracts, insurance companies could just send a message that all the documents are verified and the money will automatically be transferred to the insured, accelerating the claiming process.

We propose the use of a private blockchain to create a network of the parties involved - Insurers, Insured, Insurance Brokers, Owners of the Ships, Loss Adjusters, Loss Assessors, Consultants, Surveyors, Settling Agents, Recovery Agents, Managing Agents and Reinsurers[14]. In this private blockchain, the Insured will act as the network administrator. All the other parties will act as nodes. The private key that was allotted to the user on successful storage of files on Filecoin will be distributed by the insured, across the network. He will act as the data controller in the network and will grant the access permissions to only the intended nodes. The insurance companies can use this key to retrieve the data from Filecoin and verify the documents. The permissions will permit the nodes to read the documents or data but not to modify it. Since the point of access to the documents is the same for all insurance companies, there is no need to separately provide documents to each company. Therefore, the burden of collecting, storing and transferring documents is reduced.

Smart contracts that will be signed between the insured and the multiple insurers will exist on these private blockchains. The network administrator can control which nodes will be able to view the smart contracts that he has signed with the companies. If a smart contract has been signed with an insurance company, say A, then only the insurance company A will be permitted to view the contract and not other companies. Once the smart contracts are triggered and transaction takes place, a block will be added to the blockchain which serves as a proof for all the involved parties to verify that the particular insurance was duly claimed.

The insured could also share other details on the network, such as the ship's location, the timestamps of the ship's journey, the weather conditions, notice to insurers and other messages deemed important.

This would allow the insured to file a claim even before completing the journey and the insurance company would get a head start to carry out its inspection before the ship reaches the shore. This not only allows the required parties to have a quick access to documents, but also provides safety against the loss of these documents and notifies all the owners that insurance claiming is under way.

IV. CONCLUSION

By switching the process of manual handling of documents to a digitized platform, we have initiated a transformation in Marine Hull Insurance. Our proposed system is an evolutionary model which could restructure the Marine Insurance process. With the help of three technologies - Private Blockchains, Filecoin and Smart Contracts, we have devised practices that can speed up, secure and simplify the process. The content stored on Filecoin provides adequate security as the data is encrypted end-to-end at the client, and the miners do not have access to the decryption key. Private Blockchain and Filecoin deliver instant availability of documents for insurance companies and insurer as they provide a single point of access, which improves the collection and verification time. The Smart contracts have replaced legal contracts and removed the need for third parties such as brokers, who leverage the huge amounts involved in Marine Insurance to earn massive commissions. While our system is some way off from practical implementation, our proposed switch to digitization will instrumentally improve the efficiency of the current procedure of Marine Hull Insurance.

V. FUTURE WORK

Hull Insurance also covers damages incurred by the machinery inside the hull. With the help of Internet of Things, real time information regarding the machinery could easily be shared, for example, any malfunction in the machineries could be detected and communicated across the blockchain before any major losses occur. Other areas of marine insurance, namely, Cargo Insurance, Freight Insurance and Protection and Indemnity Insurance can also adopt a similar system for declaration and claiming. Presently, once a smart contract has been coded and finalized, it cannot be changed, even if there are mistakes in the contract or the policies are changed, which is often the case with Insurance companies. In such situations, smart contracts put the involved parties at a disadvantage. This drawback can be overcome in the future if new rules, which allow amendment of smart contracts, are introduced by blockchain technologies.

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