Application of Blockchain for Life Insurance Using Hyperledger Composer

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Abstract

In India the insurance processing is mostly done manually. From buying of insurance to claim processing client is dependent on insurance agent. This type of processing leads to wrong entry, fraudulent claim and cost overhead on agent's commission. After buying policy, insurance client has to maintain documents, and make available them at the time of claim firing, this work is very cumbersome. This paper aims to provide blockchain solution for life insurance claim processing, which will provide secure, automatic, low cost and faster claim processing. Prototype for smart contract with overall architecture is illustrated in this paper.

Keywords: Blockchain, Hyperledger, Insurance, Smart Contracts

1. Introduction

Blockchain development for insurance is in its early stage, many researchers are interested in adopting blockchain for insurance process. Using blockchain for insurance will provide secure and automatic claim processing. Most of the time in life insurance family members have not idea about any life insurance purchased by dead person and delay is made for claim processing or collecting all required documents for insurance claim, sometimes beneficiary does not get any benefits of insurance. If blockchain solution is used for insurance process there is no need to maintain documents and make available at the time of claim processing by client, also the documents will be kept secure in blockchain. Insurance process will become automatic by use of smart contract, smart contract is the small program written on top of the blockchain and responsible for transaction processing at particular condition. For implementing blockchain solution for Insurance industry in India, consortium blockchain network has to be used as multiple organizations are involved in this network and only authorized nodes have to give access permissions, and another reason is that, there is ban on cryptocurrencies in India. So, for implementing blockchain for Insurance industry in India Hyperledger Fabric is best solution. In this paper authors aims to

design blockchain solution for life insurance using Hyperledger Composer tool of Hyperledger fabric framework.

2. Literature Review

In India Banking, Insurance and Cards industry are coming together to form a consortium to realize the benefits of Blockchain at an industry level. Insurer are focusing on using blockchain solution to speed up claim processing, also Blockchain is best solution for avoiding errors, which will introduce while manual entry [1]. Integrating Blockchain with IoT devices can be used in area such as supply chain [2], Unmanned Aerial Vehicle [3], also for accessing and managing IoT devices [4][5]. Using existing blockchain frameworks we can develop application which are solve only by binary conditions [6]. Number of papers dealing with implementation details are less in number and in most of the paper researchers are interested to use Ethereum [7]. Blockchain technology has lot of benefits in insurance company but we cannot fully automate insurance processing some evaluations by assessors is must, Blockchain can be adopted for limited use cases where there is no requirement of complex regulatory processing [8]. Nath [9] reported Blockchain technology to share fraud intelligence will make harder to any fraudulent activity by criminals and further suggested to adopt this technology step by step to avoid big bang. In one of the paper combinations of Hyperledger Fabric and Ethereum is used for implementing blockchain for transportation insurance is used for getting advantage of both the private and public blockchain. Hyperledger fabric is used for storing data and Ethereum is used for modeling payments [10]. As Insurance industry suffers from fraud, [11] researchers are going to use AI for fraud detection and permanently save the result in blockchain to minimizes claim refund losses. Mayank [12] proposed blockchain framework for insurance to offer fine-grained access control and carried out experiment by scaling up the network to test the robustness of the system. Finally concluded that the network size is directly proportional to the confirmation time, more the number of nodes, more will be the confirmation time, in short slower will be the network.

3. Background Work

Blockchain is most disruptive technology in today's word, as its decentralized working system makes it free from fault tolerance, its p2p system and consensus mechanism removes unwanted cost of third party in trustless environment. Blockchain's cryptographic feature makes it secure. Smart contract written on top of the blockchain provides atomicity. In short blockchain applications are secure, minimizes cost, works fast and automatically. So, most of the enterprise applications are interested in adopting Blockchain solution.

3.1. Blockchain

The main aim of Blockchain is to avoid double spending problem and provide security. In Blockchain every completed transaction is recorded in an immutable

ledger in a verifiable, secure, transparent and permanent way, with a timestamp and other details [13]. Each blockchain employs a consensus mechanism and the choice of mechanism varies among networks to resolve different states, or "forks" in the network [14] details a variety of consensus mechanisms. In this paper, we propose to add blockchains as a mechanism to design a smart contract application for Life insurance.

3.2. Life Insurance Process

In life insurance also called as life assurance, according to contract between an insurance policy holder and an insurer or assurer, beneficiary gets amount including funeral expenses from insurer after the death of insured person on the basis of premium amount paid by assurer. Beneficiary also gets benefit in other situations like terminal illness or critical illness. The policy holder can pay premium as either one term payment or periodically. Life policies applies terms and conditions to limit the liability of the insurer, death claims relating to suicide, fraud, war, riot, and civil commotion are excluded in contract of policies

3.3. Death aregistry Process in India

In India, it is mandatory under the law to register every death with the concerned State/UT Government within 21 days of its occurrence. If the death has taken place in government hospitals/private hospitals/nursing homes/ medical institutions, such deaths are to be reported by the head of the institutions within 21 days of the death to the concerned registrars. If the death has taken place at home, it is the responsibility of the head of the family/any other family member to report the same within 21 days to the sub-registrars. A death certificate is then issued after proper verification [15].

4. Gap Analysis

Most of the researchers provide novel architecture, model and framework using blockchain but there is lack of technical details about used blockchain elements. There are number of papers present on blockchain framework using Hyperledger composer for health-care, supply chain and banking sector but there is only one paper available related to Insurance sector, which provides only general framework for insurance process and only two participants, as Insurance company and insurance client [12], but by further studies it is found that there will be different participants, endorsement policies, consensus algorithms, ordering peers and different algorithms for smart contracts for different type of insurance policies. The purposed system in this paper aims to design blockchain framework for life insurance having four types of participants as Insurance company, Death registry, Verifier, and insurance client. Development language of purposed work is Hyperledger composers Modeling language which supports JavaScript API.

5. Material And Methods

The designing of purposed framework is done according to Hyperledger composer which is runs on top of Hyperledger Fabric.

5.1. Hyperledger Fabric

Hyperledger Fabric is project lead by IBM, under the Linux Foundation. It provides platform for modular architecture to develop Enterprise Blockchain solution. Hyperledger Fabric which supports for building private (permissioned) business network [16]. Composer Playground is a web-based tool for modeling and testing business network. Playground communicates with the local Fabric runtime directly [17].

5.2. Development environment of Hyperledger

Figure 1 shows the development environment of Hyperledger Composer. The different files such as Network Model, Transaction Logic, Access Control Rules and Query File are packaged and archived in single file called as Business Network Archive file. The BNA file is then be deployed onto a Fabric network. Composer REST Server is a tool which allows us to generate a REST API server based on our business network definition. By use of Yeoman configuration tool it is easy to create Angular front-end against the REST API

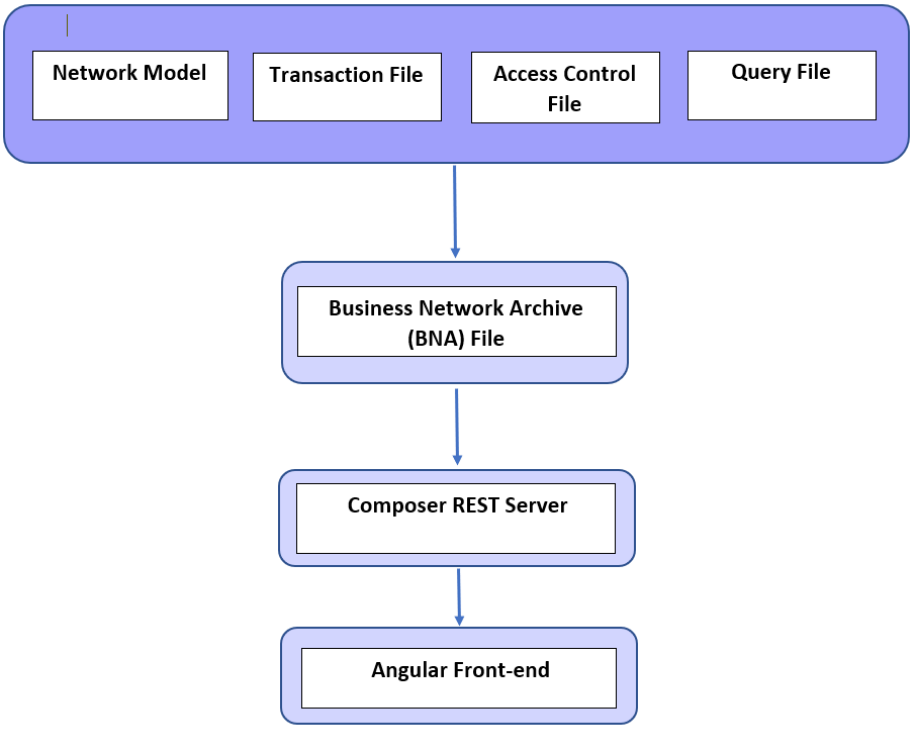


Figure 1: Development environment overview for Hyperledger [13]

6. Purposed Framework

In proposed framework details of design methodology, blockchain participants, assets, transactions, transaction logic, access control rule and query file are discussed. Transaction logic will be implemented in JavaScript considering this, algorithm of transaction logic is written.

6.1. Methodology

For the purposed framework, phases such as Analysis, design and implementation are used. In analysis phase, authors analyze requirements of purposed work and identify participants, asset and transactions. Depending on analysis author design the architecture of purposed system is shown in Figure 2. In this architecture Death Registry workers, Insurance workers, claim verification workers and insurance Customers are user group of the system. Users interact with blockchain network through Nodejs server which uses Fabric SDK, with their respective web Application The detailed design of smart contract is discussed in next section. Authors will implement the design in implementation phase.

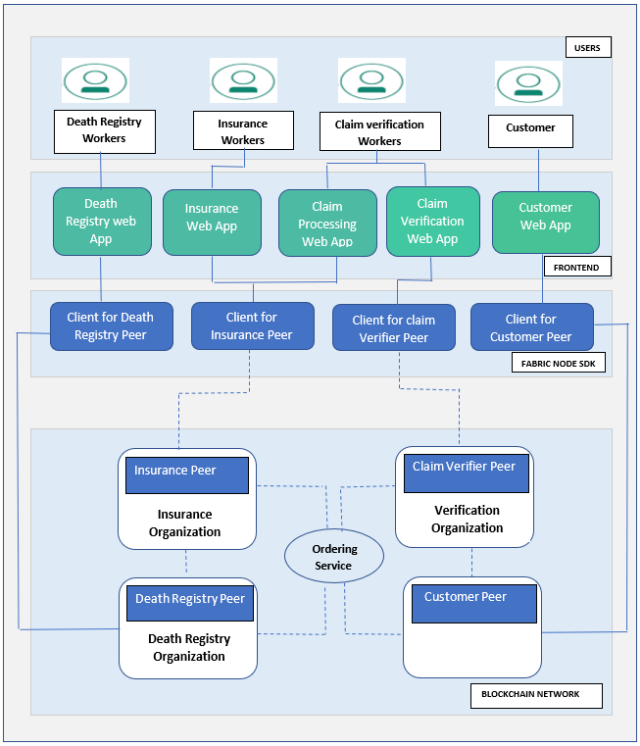


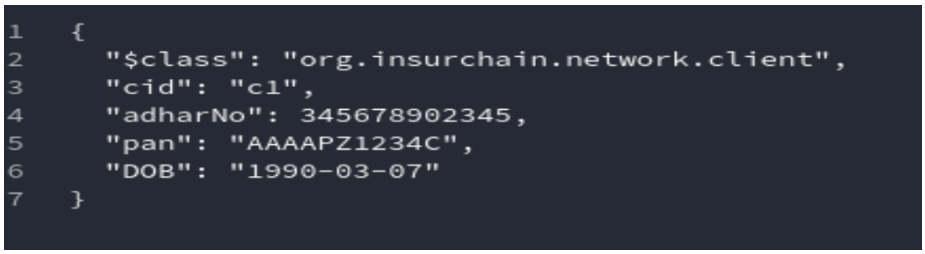
Figure 2: Architecture of purposed Blockchain Framework for Life Insurance

6.2. Design of Proposed work

In our proposed work for network model author design Participants, Asset and transactions as follows.

6.2.1. Participants

Insurer or Insurance Industry, insurance policy holder or customer, death registry and validators are the participants of purposed system. The main transaction occurs between customer and Insurance industry. The endorsement peers are insurance industry, customer and death registry office. We require some nodes as validators for validating the state of blockchain. The testing for creating these participants is shown in Figure 3, Figure 4, Figure 5 and Figure 6



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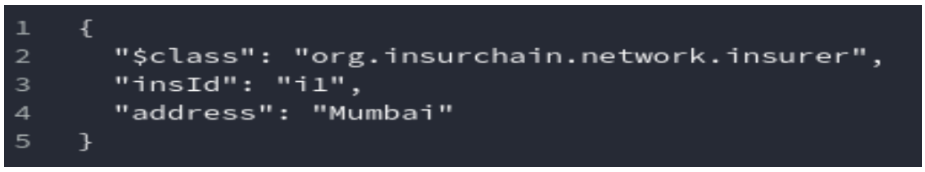
{
  "$class": "org.insurchain.network.client",
  "cid": "c1",
  "adharNo": 345678902345,
  "pan": "AAAAPZ1234C",
  "DOB": "1990-03-07"
}
```


Figure 3: New Customer is added to Blockchain



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{
  "$class": "org.insurchain.network.insurer",
  "insId": "i1",
  "address": "Mumbai"
}
```
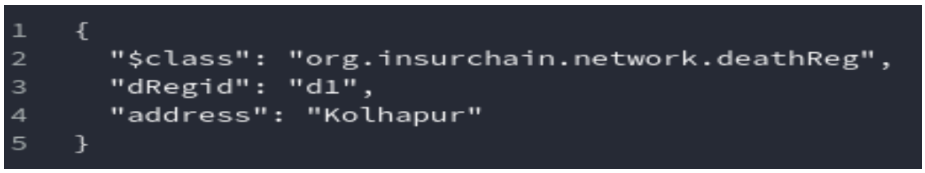
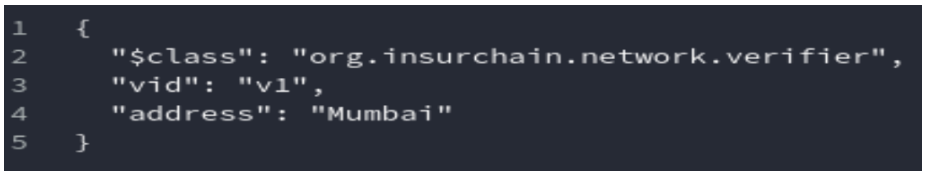


Figure 4: New Insurer is added to Blockchain



```
{
  "$class": "org.insurchain.network.deathReg",
  "dRegid": "d1",
  "address": "Kolhapur"
}
```


Figure 5: New Death Registry participant is added to Blockchain



```
{
  "$class": "org.insurchain.network.verifier",
  "vid": "v1",
  "address": "Mumbai"
}
```


Figure 6: New verifier participant is added to Blockchain

6.2.2. Assets

In our purposed work asset is policy and attributes of assets are policy number, start date, status, premium, beneficiary. Every insurance policy has unique policy number, so this is our prime attribute using this we can make transactions. The Figure 7 demonstrate adding new asset in Blockchain.

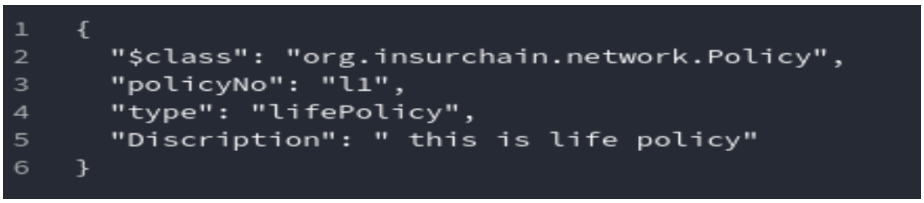


Figure 7: New policy Asset is added to Blockchain

6.2.3. Transactions

From buying policy to refund of policy there will be transactions like client Registration, Buy policy, Claim, Pay Premium, Refund and History these all are listed in Table 1. The most important transaction is automatic claim processing, when an authorized person makes any entry for life status as death. Therefore, design of claim processing is main objective of our proposed work.

Table 1: Transaction with description

Transaction	**Description**
Client Registration	Client have to register for Insurance processing
Buy Insurance	When client purchase Insurance, New information such as policy number, start and end date, Aadhar Number, status is added. Life Status will be "Alive" at the time of buying insurance policy
Pay premium	This transaction will be used for paying premium
Claim processing	When any authorized person in death registry office changes the Life status as "dead" and cause of death then depending upon cause of death automatically claim fire
Policy Expiry	When policy expires automatically it will give notification, and saves the record with status as "Expired"

6.2.4. Transaction Logic

As discussed previously researcher's main objectives is to design smart contract for automatic claim processing. When insurance client purchase insurance policy smart contract registers life status as alive (Algorithm 1) along with client id Cid, insurance company id Iid and Policy number PolicyNo. Figure 8

demonstrate the transaction, for buying the new policy. When any authorized

```
{
  "$class": "org.insurchain.network.BuyPolicy",
  "policy": "resource:org.insurchain.network.Policy#l1",
  "ins": "resource:org.insurchain.network.insurer#i1",
  "clnt": "resource:org.insurchain.network.client#c1",
  "premium": 1000,
  "st": "Alive"
}
```

Figure 8: Transaction for Buying Policy

person in death registry office changes the Life status as "dead" and cause of death then depending upon cause of death automatically claim fires (Algorithm 2). The sequence diagram shown in Figure 9 shows the process of automatic claim processing, as per Algorithm1 and Algorithm 2, there is no need to apply for claim processing manually by beneficiary and wait for benefits.

Algorithm 1 Policy: buyPolicy

Input : Cid, Iid, $PolicyNo$, $Premium$
Output : $status$=alive

1: Cid ←Discover (Client Id from ParticipantRegisty)
2: Iid ←Discover (Insurer Id from ParticipantRegisty)
3: $PolicyNo$ ← Discover (Policy Number from AssetRegisty)
4: $Status$ ←" alive"
5: Add ← AssetRegistry

Algorithm 2 Policy: claimPolicy

Input : Cid, Iid, $PolicyNo$, Did, Vid

1: $Cid \leftarrow Discover(ClientIdfromParticipantRegisty)$
2: $Iid \leftarrow (InsurerIdfromParticipantRegisty)$
3: $PolicyNo \leftarrow Discover(PolicyNumberfromAssetRegisty)$
4: **if** status=Dead **then**
5: Verify death cause
6: **if** cause=valid **then**
7: Refund (Cid, Iid, PolicyNo, amount)
8: **end if**
9: **end if**
10: Update AssetRegisty

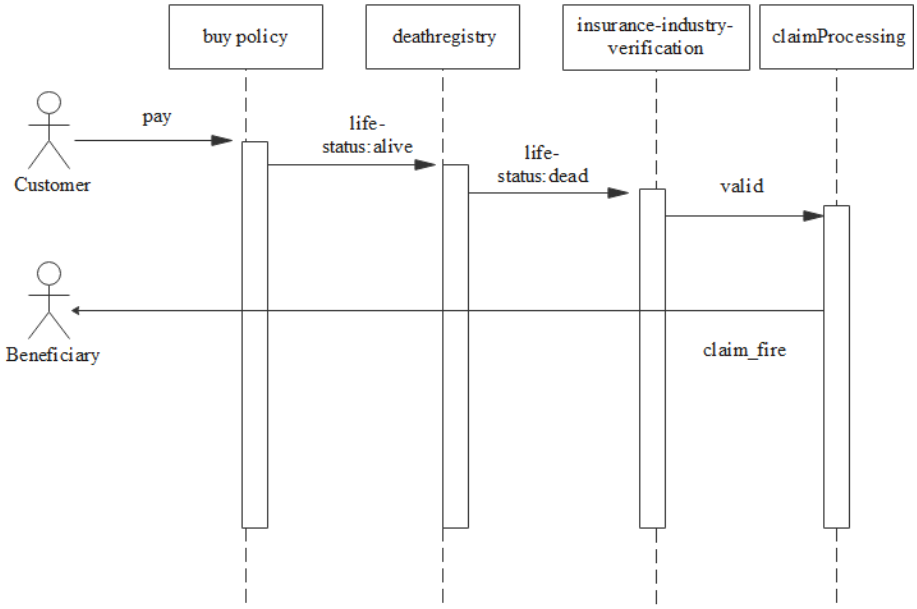


Figure 9: Sequence Diagram of Automatic Claim processing

6.2.5. Access Control Rule

Access control rules defines which participant can view which part of the system. In our purposed design insurance client can only view details of its own policies. In Figure 10 you can view that admin can access data of all clients and Figure 11 shows that client can access its own data only, Figure 12 shows that client does not have authority to create new participant.

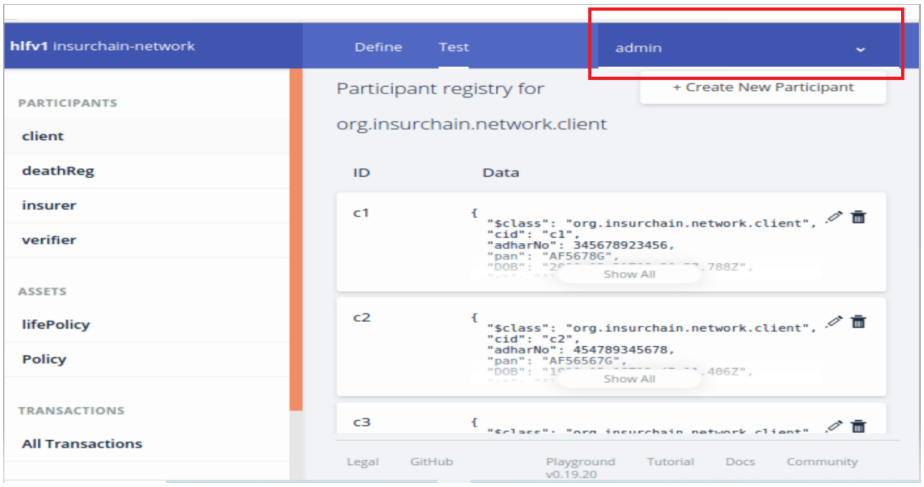


Figure 10: Admin can access all client's data

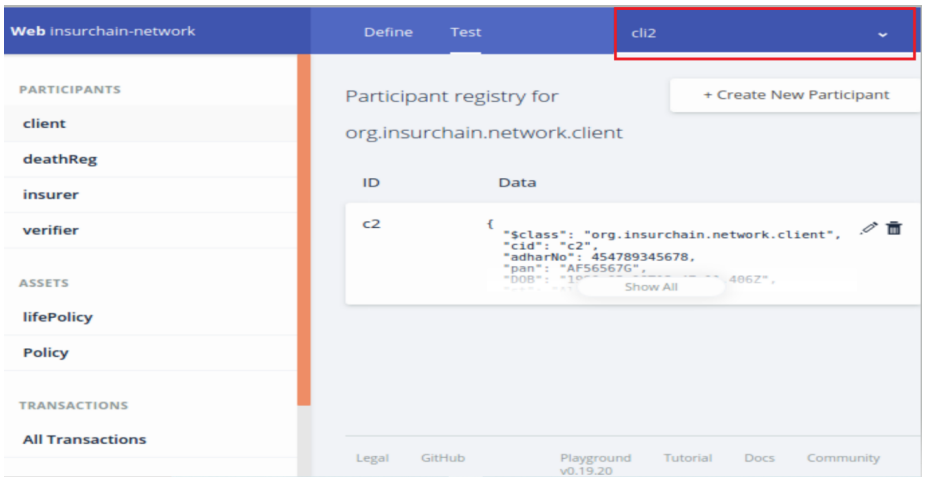


Figure 11: Client can access only its own data

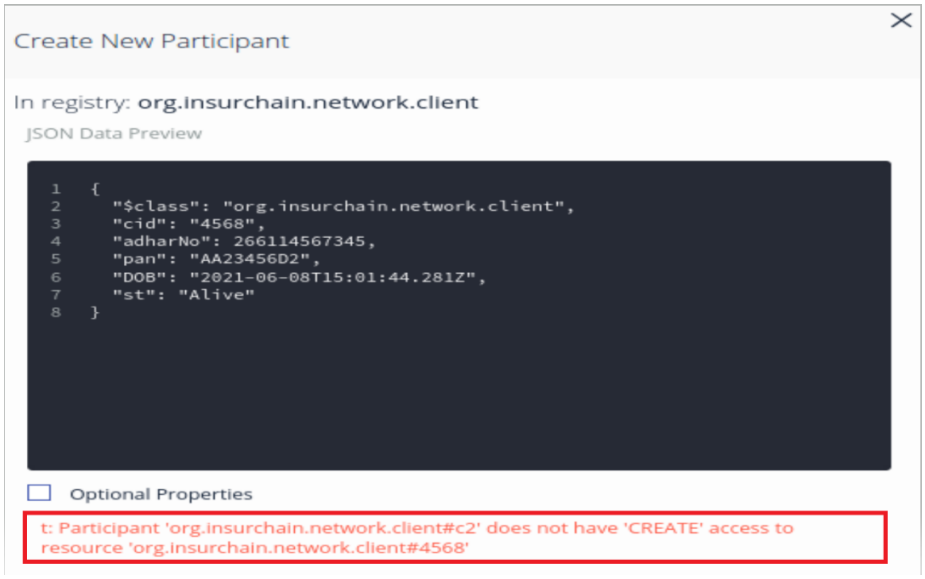


Figure 12: Client does not have authority to create new participant

Likewise in our purposed system authorized person in death registry can only change the life status of policy holder and cannot access other part of system. Person from insurance industry who verifies the death reason, whether the reason for death is valid or not for claim processing. After the confirmation, the person who verifies have authority to make appropriate entries in Verification Form.

6.2.6. Query File

In query file we can write queries like SQL queries. In purposed work, author designs query for admin and policy holder. In our framework, we design query to perform all admin activities, also queries for customer for accessing own activities.

7. Test Result

In this paper simple data is used for demonstration purpose. Authors shows all implementation details of asset, participants and transactions. Here, Hyperledger Composer based implementation is used for testing purpose, and found that the system works well according to ACL. Only authorized person can access or update specific data. Thus, the result shows that Hyperledger fabric is best suited solution for building fine grained permissioned blockchain.

8. Conclusion And Future Scope

This paper proposes a design of blockchain based framework for implementing life insurance process which will provide fine grained solution for automatic claim processing. The purposed framework is based on Hyperledger Fabric. In which, insurance client need not to maintain required documents and provide them at the time of claim process and wait to get benefits. Author are purpose to develop smart contracts based on the proposed design, using raft orderer service with permeant database, user interface with all required networking artifacts in future.

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