Chit fund Decentralized Application: Architecture Overview

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ICS 690-01 Blockchain Technology

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1. Abstract:

Chit fund has always been around the people who have less access to banking infrastructure or credit system. It's usually common around the underdeveloped areas where banking and financial services are challenged to implement and there are restrictions from the government. In this modern age, there are chit funds which use web 2 infrastructure which is accessible by people on the web or through their mobile phone, on an app. There is a centralized approach to this method where the entity who develops the application has much of the control over it. This paper presents a blockchain based decentralized chit fund application. It uncovers an architectural approach in setting up a chit fund application and compares the current web 2 infrastructure with the web3 infrastructure with the utilization of Blockchain technology.

2. Introduction

A chit fund is a rotating savings and credit association system which can be organized by a financial institution or among friends, relative or neighbors. It has the concept of microfinance organization. [1] Chit-fund is a transaction where a person enters into agreement with specified number of persons that everyone shall subscribe to certain sum of money by periodical installments over a period of time as defined by the agreement. [4] It has been adopted in many underdeveloped/ developing parts of the world from Asia to Africa.

3. Working principle

A chit fund consists of an organizer who brings the group together and administers the activities. They are compensated for their contribution. Similarly, there are group member or participants who are involved in the chit fund process. There is a start and end date for a fund and a certain number of participants can contribute to the chat fun. This system can act as a borrowing scheme as participants can access large sum of money or a saving system as participants contribute amount in the future and receives share of surplus.

Example:

Chit funds consist of 10 members, each contributing $100 for 10 months. In first month, the fund has $1000 and a member "A" with least auction bid wins the round. "A" can't bid anymore but has to contribute to the fund and it goes on for 10 rounds. "A" will get dividends if other members bid heavier discounts in the fund. Members who don't borrow will also get a dividend.

4. Architecture Overview: Web 2

The architecture of a Web 3 application (Decentralized Application) is completely different from a Web 2 application. In a typical Web 2 application, let's take an example of a blog post, which needs to store data such as users, posts, comments and such in a database. Then there is a

backend which communicates with the database and passes the information to the front end. Finally, the front end is used to interact with the user. [2] In this architecture, most of the code is hosted in a centralized server.

Chit fund in a web 2 scenario would consist of an application which would require for users to register and also organizer to organize the participants in the front end. The back end would then handle the logic in running a chit fund. There would be a database which would handle the funds and store them safely. This would be under a centralized architecture which can be mapped out as follows:

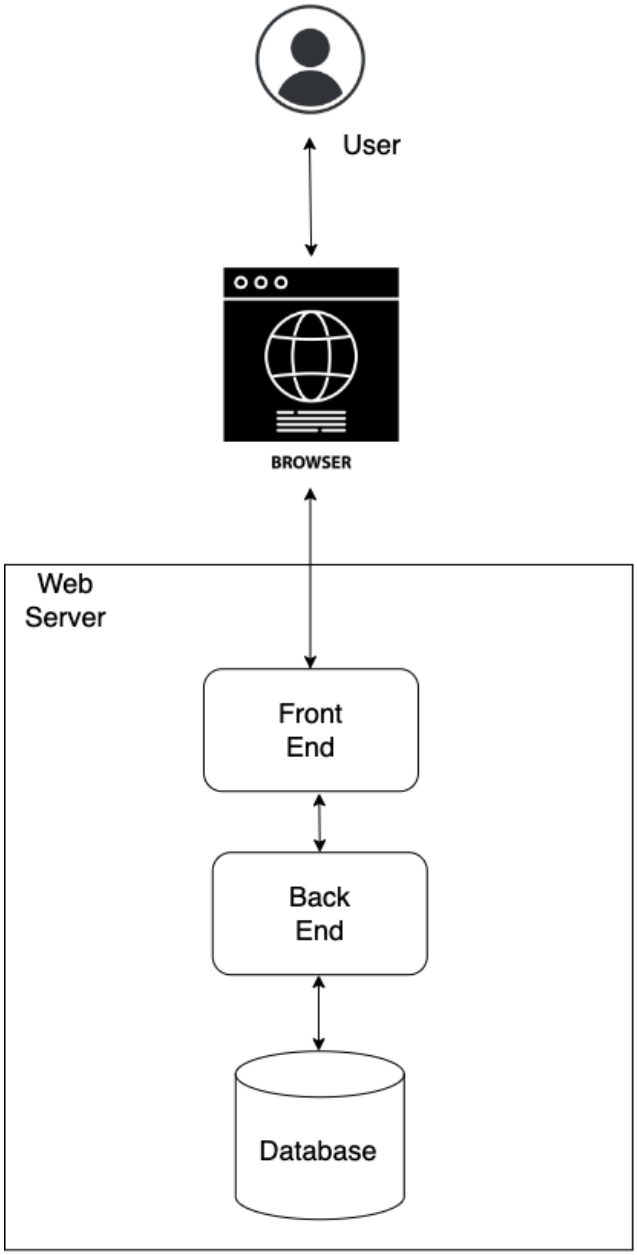

Fig: 1 Web 2 Architecture

5. Integrating Blockchain in Chit fund

Blockchain offers some features and architectural design which has some advantages. The distributed nature of blockchain helps in the transparency of the system and reduce the manual verification and authorization. [4] Following are the advantages of using a blockchain:

a. Transparency: Every peer to peer (P2P) network has the same copy of ledger there by consisting of history of transaction which would be hard to tamper with.
b. Decentralization System: If single node fails, there are history in other nodes which makes the system much more efficient in terms of failure and third-party intervention.
c. Consensus: All the peers in the network has a say in making agreements and contracts. There are DAO (Decentralized Autonomous Organization) and other bodies where people can join to have their say in the agreement.
d. Irreversible and Immutable: It contains record of every transaction. This prevents from tampering of any data and manipulation.
e. Smart Contract(real-time): It has the capability of real time settlement of recorded transaction and eases governance by implementing digital agreements.[4]

6. Current Architecture: Chit fund Web3

A web 3 application has no centralized database that stores an application state. The chit fund application is built on top of blockchain on a decentralized state machine maintained by anonymous nodes. In this decentralized network, no single entity controls the state machine. [2] The front end is similar to the Web2 application and the back end is deployed in a decentralized Ethereum state machine rather than a database. This means each person has a copy of it. Following has the current architecture and each part is explained below:

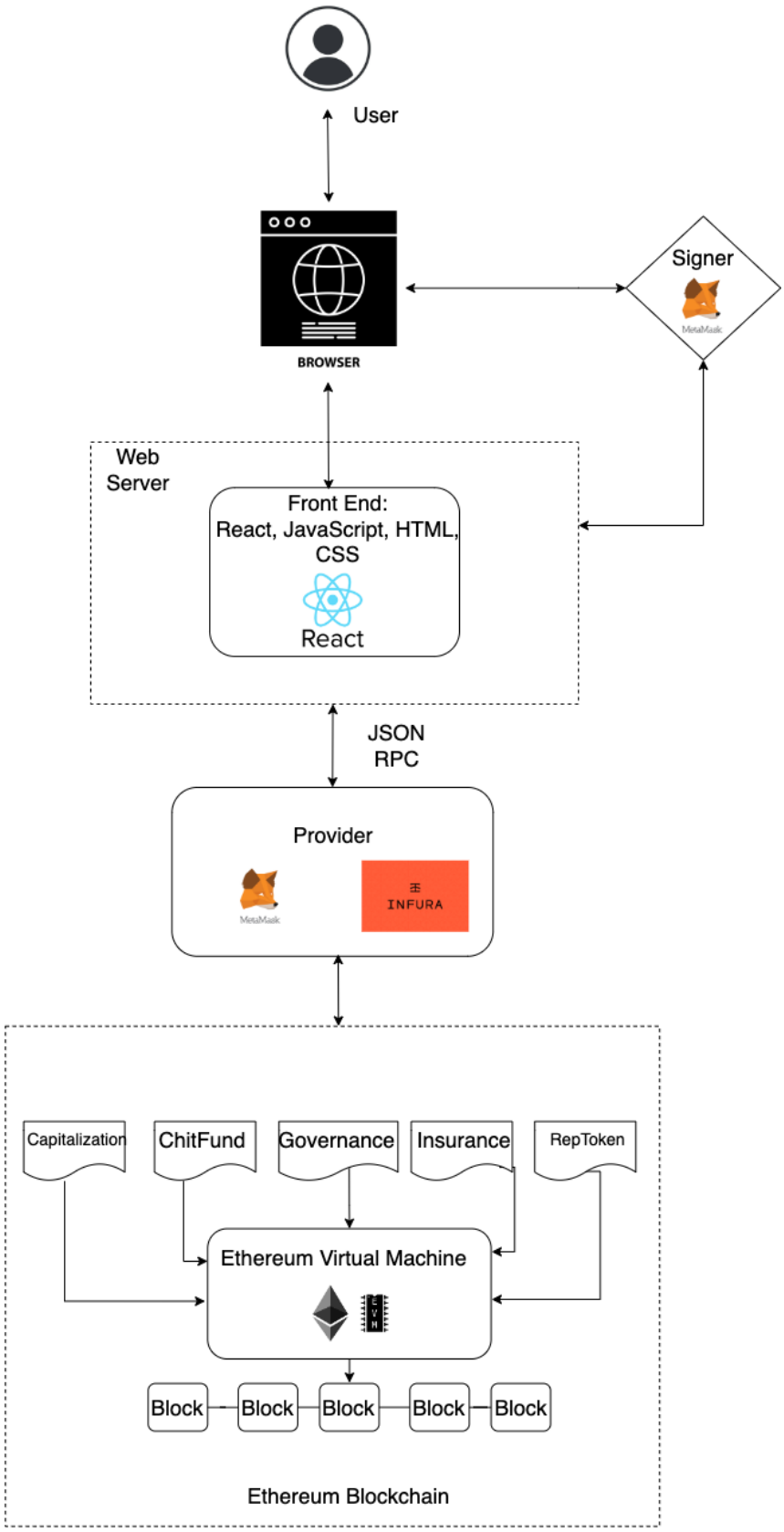

Figure 2: Web3 chit fund application

1. Front End

Front End consist of the UI code logic. It consists of a place to join the fund, contribute to the fund, enter amount and view the Chit fund, investors and number of installments.

a. The front end is written in React code.
b. It communicates with Meta-mask to store the crypto wallet.
c. The user is first signed in using the Meta-mask authentication and the account is connected to the chit fund.
d. Reads JSON RPC file to communicate with blockchain

2. JSON RPC

JSON RPC is a remote procedure call protocol encoded in JSON. It allows for data sent to the server which does not require a response and for multiple calls to be sent to server which can be answered asynchronously. [5]

a. The smart contracts written in solidity is compiled to JSON files using truffle. Truffle is a development environment, testing framework and asset pipeline for blockchain which works using Ethereum Virtual Machine.
b. Once we compile using truffle, the JSON files are generated.
c. React uses these files to make a connection with the smart contract.
d. Infura is used to implement a JSON-RPC specification to ensure a uniform set of methods.
e. To write to a state and submit the transaction to the blockchain, it needs a private key to sign. Metamask is used for this signing process.

3. Smart Contracts:

There are different smart contracts written for Chit fund. These smart contracts are written in Solidity programing language and they run on the Ethereum blockchain. They define the logic behind the state changes in a blockchain.

a. Capitalization

- User contributes eth to fund
- eth is added to pool: user (underwriters) is awarded newly minted reputation tokens which they can use to underwrite users
- process continues until the fund is fully funded
- Once pool becomes fully funded, underwriters are allowed to begin underwriting users wishing to participate in a chit fund

b. Chit-fund

- The main chit fund smart contract to operate the chit fund
- Participants can join the fund, contribute to the fund and see the number of participants and amount in the fund.

c. Rep-Token

- Smart Contract for generating reputation tokens.
- Acts like a voucher which a person can get by being endorsed

d. Insurance

- Chit fund participant is insured by an underwriter before first cycle
- This smart contract will have money/token that will come out before contract starts
- Participant misses payment, they are locked out of the fund.
- Payment made by participant triggers amount to be returned to their underwriter.
- Certain amount is payed to the DAO itself for running the fund.

e. Governance

- DAO smart contract that oversees the functionality
- Measures community sentiment about issues affecting the chit fund DAO ecosystem.
- Determine consensus that something needs to be done in response to a perceived issue.
- Token holders vote on changes to system parameters, bug patches, protocol technical enhancements, governance process, system operations.

4. Ethereum Virtual Machine (EVM):

Ethereum Virtual Machine is used to execute the logic defined in the smart contract and process the state change on a globally accessible state machine. The smart contract needs to be compiled down to the byte code for EVM to understand.

5. Infura

Infura provide the tools and infrastructure that allow developers to easily take the Blockchain application from testing to scale deployment with simple reliable access to Ethereum and IPFS. [6]

a. Chit fund uses Infura to deploy the smart contract in Rinkeby test network (Ethereum test network)
b. Credentials for metamask and infura endpoints are stored in .env file which don't get uploaded to the git
c. Once truffle commands are used to compile the smart contract, the JSON RPC files are generated and the smart contracts are deployed in the Rinkeby test network (Ethereum test network)

6. Communication between Front end and smart contract

The front end needs to communicate to the smart contract to invoke functions. Every node in Ethereum keeps copy of states including code and data associated with each smart contract. When the front end wants to interact with the data and code on a blockchain, it needs to interact with one of these nodes. This is because any node can broadcast a request for a transaction to be executed on the EVM. A miner will then execute the transaction and propagate the resulting state change to the rest of the network. [2]

Provider:

a. Chit fund uses Infura as a third-party service. The front end interacts with the node in the blockchain. It implements JSON-RPC specification. This ensures that there's a uniform set of methods when frontend applications want to interact with the blockchain. If you need a primer on JSON-RPC, it's a stateless, lightweight remote procedure call (RPC) protocol that defines several data structures and the rules for their processing.
b. Metamask also stores the private key where front end needs to sign a transaction, so it also acts like a provider. It is used to write to the state of Block chain.

7. Future Implementation:

1. IPFS:

IPFS is a distributed file system for storing and accessing data in a peer-to-peer network. It makes it easy to retrieve the data. IPFS also has an incentive layer known as "Filecoin." This layer incentivizes nodes around the world to store and retrieve this data. It can be used with Infura which provides an IPFS node.

The front-end application can also be hosted in IPFS since the current version is hosted in a centralized location. This helps to make the application fully decentralized.

2. The Graph:

The Graph is an off chain indexing solution for query data on Ethereum blockchain. It allows to define smart contract to an index, which event and function call to listen to, transform incoming event to entities for front end to consume. Indexing helps to query data with low latency. [2]

3. Polygon:

Polygon can be used as transaction execution in off-chain network which stores only transaction data on-chain. This helps to scale the blockchain as we don't have to execute every single transaction on-chain. It makes transactions faster and cheaper and still maintains communication with Ethereum Blockchain. [2]

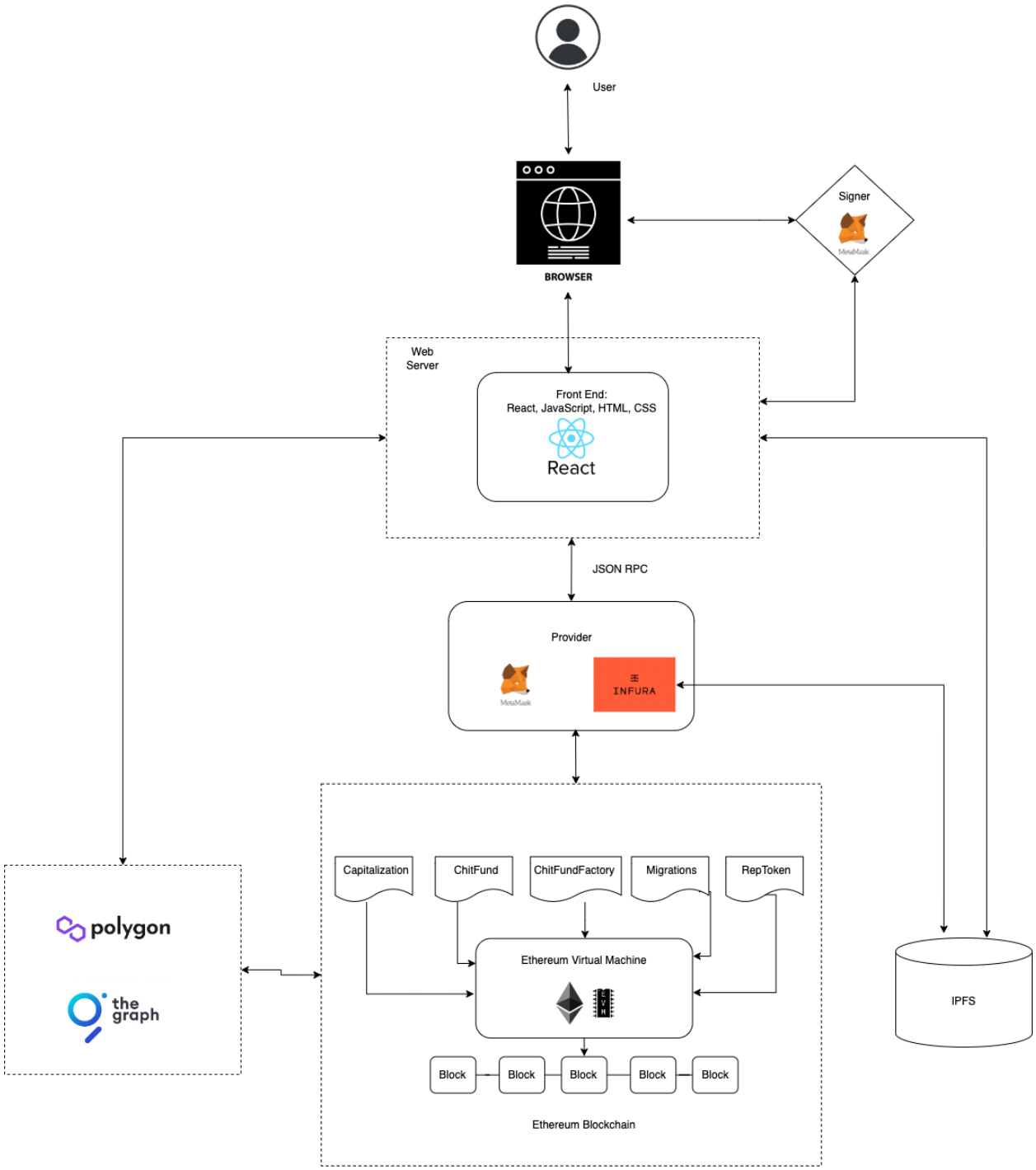

Figure 3: Future Implementation

8. Conclusion

The Chit fund DApp architecture is comprised of different tools and languages. With the existing and upcoming technology, this can truly work as a decentralized application on a blockchain. As more technology is available, the architecture is bound to change according to the needs.

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