Theory of Blockchain

Session 10:

Ethereum – Part 2

Module 1 – Sample Applications + NFTs

What Smart Contract can do?

- Ethereum has a Turing-complete language.
  - It can implement complex functions

- We can assume the Ethereum network is a decentralized platform for app development.

- We give examples of a few applications that can be implemented on Ethereum.

ERC-20 Tokens

- Ethereum Request for Comment 20 (*ERC*-20) is the implemented standard for fungible *tokens* created using the Ethereum blockchain.
- A fungible token is interchangeable with another token, but non-fungible tokens (NFTs) are not interchangeable.

(101blockchains.com)

ERC-20 Tokens

Token exchange implementation:

- We can recreate Bitcoin with just four lines of smart contract code.
- Financial fungible tokens only need a database with one operation.
  - Ensure Alice has enough money + that she initiated the transaction
  - Subtract Z from Alice, give Z to Bob

```
def send(to, value):
    if self.storage[msg.sender] >= value:
        self.storage[msg.sender] = self.storage[msg.sender] - value
        self.storage[to] = self.storage[to] + value
```

Non-Fungible Tokens – ERC-721 & ERC-1155

- NFTs are tokens that are different each. They are unique in characteristic. Technically, anyone can create NFTs, but whether or not they gain high values is up to other factors.

- They can represent a physical asset (e.g. a paining, music piece or house).

- You can guess that the unique features of the asset are included in the token/blockchain.

Decentralized Property Lease and Land Title

- At the moment, property lease and title are governed by central authorities (governments).
  - Paper deeds are forgeable
  - Government employees might be bribed.

- With NFTs we can turn the table around and bring transparency and immutability to the picture.

- The problem is mapping from the real world to the virtual one is not always perfect. Things/assets can change.

Other Applications

Public Data Registry

One can use smart contracts to create a public database. For example a decentralized Domain Name System (DNS).

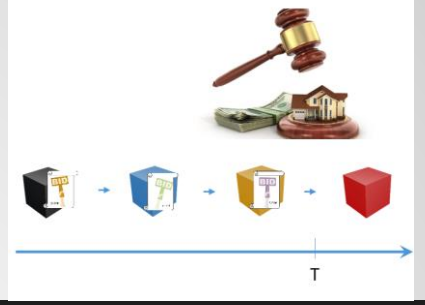
DNS:

translates URL to IP address (www.example.com → 12.192.123.5)

Decentralization is good for DDoS protection, but the blockchain overhead is high, and it's immutable.

```
def register(name, value):
    if !self.storage[name]:
        self.storage[name] = value
```

Auction



- Auction was mentioned as an example of smart contract applications.
- Transactions to the contract (offers/bids) can be verified by everybody and everything is transparent.
- The core code is only a few lines (the code on the right does not show the withdrawal function).

```
    function bid() payable {
        // Revert the call in case the bidding
        // period is over.
        require(now ⩽ auctionClose);

        // If the bid is not greater,
        // the money is sent back.
        require(msg.value > topBid);

        if (topBidder ≠ 0) {
          // It is always preferable to let the recipients
          // withdraw their money themselves.
          returnsPending[topBidder] += topBid;
      }
      topBidder = msg.sender;
      topBid = msg.value;
      topBidIncreased(msg.sender, msg.value);
    }
```

Supply Chain

A decentralized database with contract features can help in tracking supply chain in a transparent and immutable manner.

- Suppliers and merchants can put their contracts on the Ethereum network so that it is transparent and known to everyone.
- Buyers can see where the components of their devices/services have come from.

Smart Grid – Smart Energy Management

In the future power grid, energy is generated and consumed in a distributed manger. A household might produce extra electricity and sell it to a neighbor.

- Smart contracts can handle micro-energy trades in a p2p manner.
- Even complex energy hand-overs or relays can be implemented by smart contracts.

What Comes Next …

- We learned about fungible and non-fungible tokens.
- We saw a few applications of smart contracts on decentralized platforms like Ethereum.
- Next, we introduce the changes and upgrades made to Ethereum after the merge.

See you in the next module …