Design and Implementation of a Token-NFT-Liquidity Smart Contract Suite

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1. Introduction

We aim to present a suite of smart contracts designed to manage NFT auctions using a custom token called SapiCoin.

We used Solidity language for developing this suite of smart contracts.

A Token can be viewed as a class in other programming languages (e.g. Java), however to avoid binding a smart contract to a specific Token we used an abstraction standardized by the Ethereum Community.

In addition to token transfers and auctions, our system includes a liquidity pool implemented using Uniswap v3, which allows users to trade between Ether and SapiCoin.

2. Tokens

2.1 ERC-20

ERC-20 is the standard that represents a token on EVM compatible blockchains.

There is no central authority responsible for issuing these standards; instead, communities such as **Ethereum Magicians** provide a space to discuss improvements to the Ethereum standard through EIPs (Ethereum Improvement Proposals).

2.1.1 Polymorphism

Achieving this requires polymorphism.

The Ethereum Virtual Machine does not provide instructions for handling abstract classes, but the VM itself is polymorphic.

2. Tokens
— 2.1 ERC-20

2.1 ERC-20

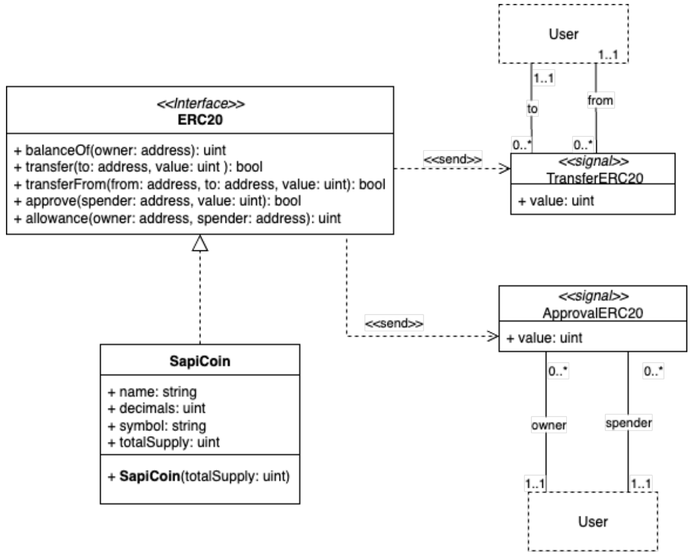
When a method of a smart contract is invoked through a transaction, the memory address of the method is accessed by computing the hash of the function signature. If the invoked method does not exist, a default fallback function is executed (which can be overridden).

```
contract SapiCoin is ERC20 {
  /* Implementation */
}
```

So Solidity exploit this behavior to defines interfaces. So ERC-20 can be viewed as an Interface.

Design of the standard ERC-20

2.1 ERC-20



A Model Driven Architecture approach provides a structured method for designing blockchain smart contracts. Using UML diagrams—such as Class and State Machine diagrams—developers can model both the structure and behavioral logic of smart contracts across multiple abstraction layers, improving clarity, analysis, and maintainability.

2.2 Token ERC-721

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2.2.1 ERC-165

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2. Tokens
— 2.2 Token ERC-721

3. Auction

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3. Auction
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left

middle

right

3. Auction
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top

bottom

3. Auction
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4. Implementation details

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5. Liquidity Pool

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6. Conclusions

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