Token, NFT

and Other Ethereum Standards for Digital Assets

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Concept of Token

A **token** represents a transferable units of value

➡ It is a digital asset implemented as a smart contract on the Ethereum blockchain

A Simple Token

```
3
4   // This is the main building block for smart contracts.
5   contract SimpleToken {
6       // Some string type variables to identify the token.
7       string public name = "My D21 Token";
8       string public symbol = "D21";
9
10      // The fixed amount of tokens, stored in an unsigned integer type variable.
11      uint256 public totalSupply = 1000000;
12
13      // A mapping is a key/value map. Here we store each account's balance.
14      mapping(address => uint256) balances;
15
16      // The Transfer event helps off-chain applications understand
17      // what happens within your contract.
18      event Transfer(address indexed _from, address indexed _to, uint256 _value);
19
20      /**
21       * Contract initialization.
22       */
23      constructor() {
24          // The totalSupply is assigned to the transaction sender, which is the
25          // account that is deploying the contract.
26          balances[msg.sender] = totalSupply;
27      }
```

Simple Token Methods

```
29      /**
30       * A function to transfer tokens.
31       *
32       * The `external` modifier makes a function *only* callable from *outside*
33       * the contract.
34       */
35      function transfer(address to, uint256 amount) external {
36          // Check if the transaction sender has enough tokens.
37          // If `require`'s first argument evaluates to `false`, the
38          // transaction will revert.
39          require(balances[msg.sender] >= amount, "Not enough tokens");
40
41          // Transfer the amount.
42          balances[msg.sender] -= amount;
43          balances[to] += amount;
44
45          // Notify off-chain applications of the transfer.
46          emit Transfer(msg.sender, to, amount);
47      }
48
49      /**
50       * Read only function to retrieve the token balance of a given account.
51       *
52       * The `view` modifier indicates that it doesn't modify the contract's
53       * state, which allows us to call it without executing a transaction.
54       */
55      function balanceOf(address account) external view returns (uint256) {
56          return balances[account];
57      }
```

The need for a Token Standard

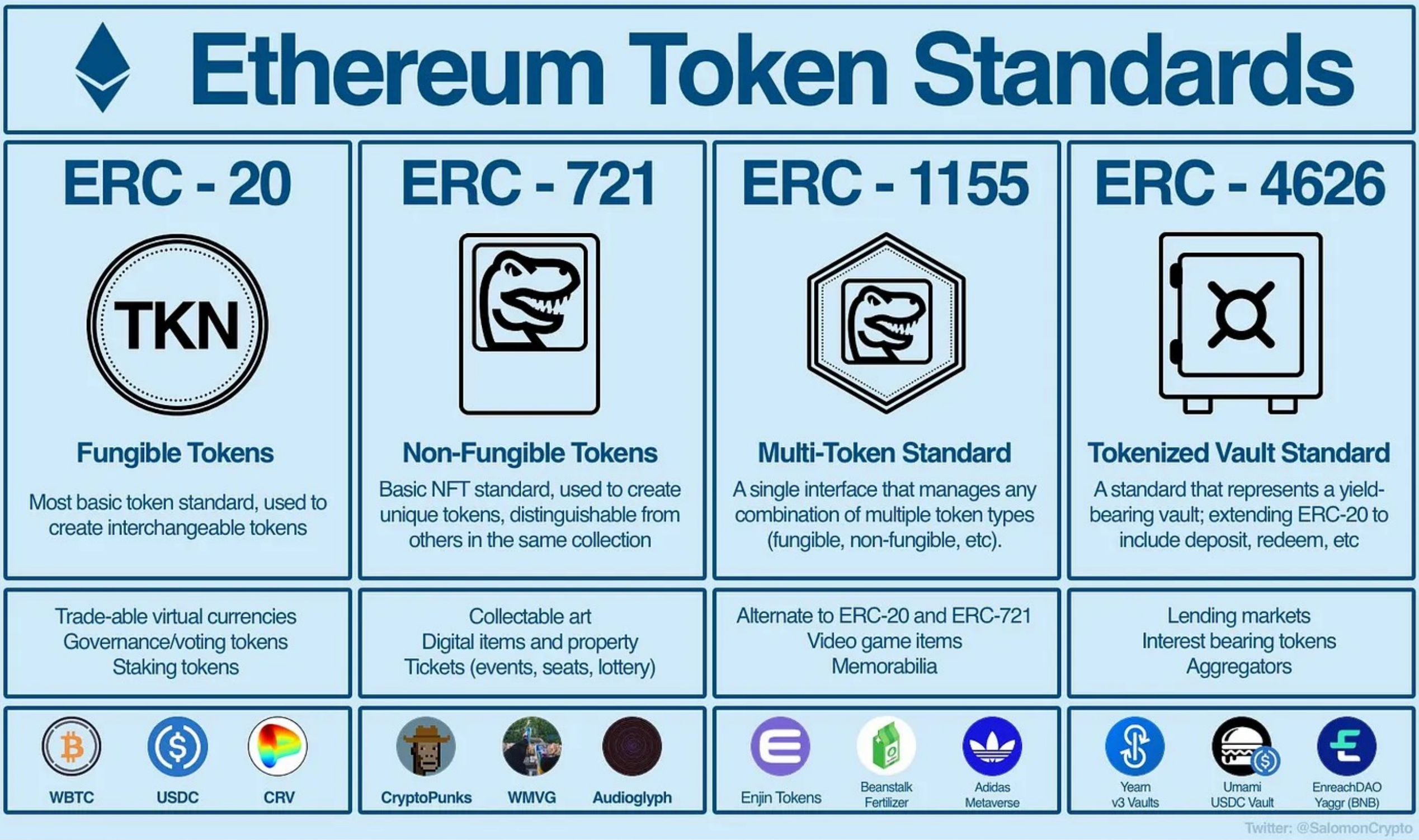
- ◉ Problem : the token interface might change from one contract to another

- ✓ Having a standard token interface create predictable APIs for wallets, dApps, and protocols

Ethereum Standards for Digital Assets

ERC 20	Fungible Token
ERC 721	Non-Fungible Token (NFT)
ERC 1155	Semi-Fungible Token
ERC 4626	Yield-Bearing Vaults

Ethereum Standards for Digital Assets



https://x.com/LogarithmicRex/status/1553982842232717313?s=20&t=h0iyCfb5geZjvIcAn-9TnA

ERC-20 Fungible Tokens

Tokens are fungible meaning they are interchangeable

➡ Represent the ownership of a quantity relative to a total supply

Features:

- Allow token holder owner to transfer to a address
- Or allow the holder to delegate spending to another address via allowances (e.g. useful to build an exchange)

ERC20

```
import "@openzeppelin/contracts/token/ERC20/IERC20.sol";
```

Interface of the ERC-20 standard as defined in the ERC.

Functions

- `totalSupply()`
- `balanceOf(account)`
- `transfer(to, value)`
- `allowance(owner, spender)`
- `approve(spender, value)`
- `transferFrom(from, to, value)`

Events

- `Transfer(from, to, value)`
- `Approval(owner, spender, value)`

ERC20 Applications

Stablecoins (USDC, DAI)

Governance tokens

Utility/Incentive tokens

Wrapped assets (WETH-style patterns)

ERC721 Non-Fungible Token (NFT)

Tokens are non-fungible meaning they are all unique and identified by an id

➡ Represents the ownership of a unique asset within a collection

Features

- Allow a token holder to transfer ownership of the asset
- Or allow the owner to delegate transfer to another address via an approval (e.g. useful to build a marketplace)

ERC 721

```
import "@openzeppelin/contracts/token/ERC721/IERC721.sol";
```

Required interface of an ERC-721 compliant contract.

Functions

- `balanceOf(owner)`
- `ownerOf(tokenId)`
- `safeTransferFrom(from, to, tokenId, data)`
- `safeTransferFrom(from, to, tokenId)`
- `transferFrom(from, to, tokenId)`
- `approve(to, tokenId)`
- `setApprovalForAll(operator, approved)`
- `getApproved(tokenId)`
- `isApprovedForAll(owner, operator)`

Events

- `Transfer(from, to, tokenId)`
- `Approval(owner, approved, tokenId)`
- `ApprovalForAll(owner, operator, approved)`

The OpenSea Metadata Standard