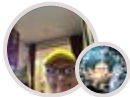Medium   🔍 Search

Understanding ERC-721: The Non-Fungible Token Standard

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Introduction

What makes each of us unique? Our fingerprints, our DNA, our experiences. Just like us, certain digital assets are unique and irreplaceable. Enter Non-Fungible Tokens (NFTs). These tokens, represented by the ERC-721 standard, provide a way to distinguish and represent each digital item uniquely. Whether it's collectible items, access keys, or virtual real estate, NFTs are changing the game in the digital world.

What is ERC-721?

ERC-721, or Ethereum Request for Comments 721, is a standard for creating and managing NFTs within Ethereum smart contracts. Proposed in January 2018 by William Entriken, Dieter Shirley, Jacob Evans, and Nastassia Sachs, ERC-721 introduced a set of methods and events that define how non-fungible tokens behave on the Ethereum blockchain.

Key Features of ERC-721

ERC-721 provides several essential functionalities:

1. Transferability: Tokens can be transferred from one account to another, enabling the ownership of digital assets to change hands securely.

2. Ownership Tracking: The standard allows for tracking the current owner of a

specific token, providing transparency and security in ownership.

3. Total Supply: It facilitates the tracking of the total supply of tokens available on the network, ensuring scarcity and authenticity.

4. Approval Mechanism: ERC-721 includes methods for approving the transfer of tokens by third-party accounts, adding flexibility to ownership management.

ERC-721 Methods and Events

The ERC-721 standard defines a set of methods and events that must be implemented by smart contracts to be classified as ERC-721 compliant. These include:

Methods:

- `balanceOf` : Returns the balance of tokens owned by a specific address.

- `ownerOf` : Returns the owner of a specific token.

- `transferFrom` : Transfers tokens from one address to another.

- `approve` : Approves another address to transfer the given token.

- `setApprovalForAll` : Approves or revokes the ability of another address to transfer all tokens on behalf of the owner.

Events:

- `Transfer` : Triggered when tokens are transferred from one address to another.

- `Approval` : Triggered when approval is granted for a specific token to be transferred.

- `ApprovalForAll` : Triggered when approval is granted or revoked for all tokens on behalf of the owner.

Sample Code ERC0721 Contract

Example Code: Interacting with ERC-721 Contracts

Let's see how easy it is to interact with an ERC-721 token contract using Web3.py, a Python library for interacting with Ethereum:

```solidity
// SPDX-License-Identifier: MIT
pragma solidity ^0.8.0;

import "@openzeppelin/contracts/token/ERC721/ERC721.sol";
import "@openzeppelin/contracts/utils/Counters.sol";

contract MyNFT is ERC721 {
    using Counters for Counters.Counter;
    Counters.Counter private _tokenIds;

    constructor() ERC721("MyNFT", "MNFT") {}

    function mintNFT(address recipient, string memory tokenURI) external return
        _tokenIds.increment();
        uint256 newItemId = _tokenIds.current();
        _mint(recipient, newItemId);
        _setTokenURI(newItemId, tokenURI);
        return newItemId;
    }
}
```

- `contract MyNFT is ERC721 { ... }`: This declares the `MyNFT` contract, which inherits from the `ERC721` contract.

- `return newItemId;`: This line returns the ID of the newly minted token to the caller.

- `function mintNFT(address recipient, string memory tokenURI) external returns (uint256) { ... }`: This function allows anyone to mint a new NFT. It takes the recipient's address and the token's URI as input parameters and returns the ID of the newly minted token.

Deploy the contract on the Ethereum mainnet:

Before deploying to the mainnet, ensure you have the necessary funds in your

Ethereum account to cover the deployment costs.

To deploy using Hardhat, you would typically create a deployment script. Create a new file in the `scripts` directory, for example, `deployMyNFT.js`, and add the deployment script:

Write a JavaScript script to interact with the contract (`deployAndMint.js`)

```javascript
const { ethers } = require("hardhat");

async function main() {
  const MyNFT = await ethers.getContractFactory("MyNFT");
  const myNFT = await MyNFT.deploy();
  await myNFT.deployed();

  console.log("MyNFT deployed to:", myNFT.address);

  const recipient = "0xYourRecipientAddress";
  const tokenURI = "https://example.com/tokenmetadata";

  const newItemId = await myNFT.mintNFT(recipient, tokenURI);
  console.log("New NFT minted with ID:", newItemId.toString());
}

main()
  .then(() => process.exit(0))
  .catch((error) => {
    console.error(error);
    process.exit(1);
  });
```

```
npx hardhat run scripts/deployAndMint.js --network <NETWORK_NAME>
```

Replace `<NETWORK_NAME>` with the name of the network you want to deploy to (e.g., `rinkeby`, `ropsten`, `localhost` for a local development network).

To deploy on mainnet:

```
npx hardhat run scripts/deployMyNFT.js --network mainnet
```

This script will deploy the `MyNFT` contract to the specified network and mint a new NFT, assigning it to the specified recipient address and setting the token URI.

1. Verify the contract on Etherscan (optional):

2. After deployment, you may want to verify the contract on Etherscan for transparency and accessibility. You can use the Hardhat Etherscan plugin for this purpose.

```
npx hardhat verify --network mainnet <DEPLOYED_CONTRACT_ADDRESS>
```

Conclusion

ERC-721 revolutionizes the way unique digital assets are represented and managed on the Ethereum blockchain. By providing a standard for non-fungible tokens, it enables a wide range of use cases, from digital art and collectibles to virtual real estate and gaming assets. With ERC-721, the possibilities are endless, and the digital world becomes even more diverse and exciting.

(Nft)   (Web3)   (Ethereum)   (Blockchain)

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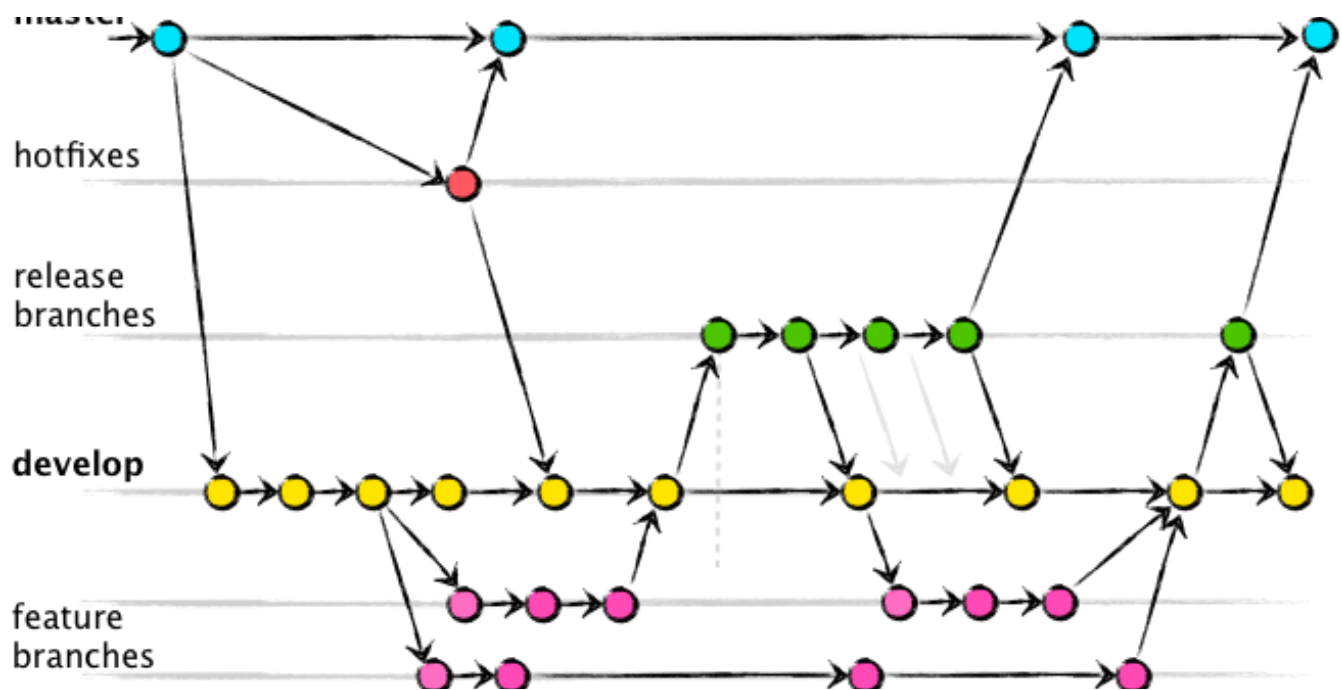
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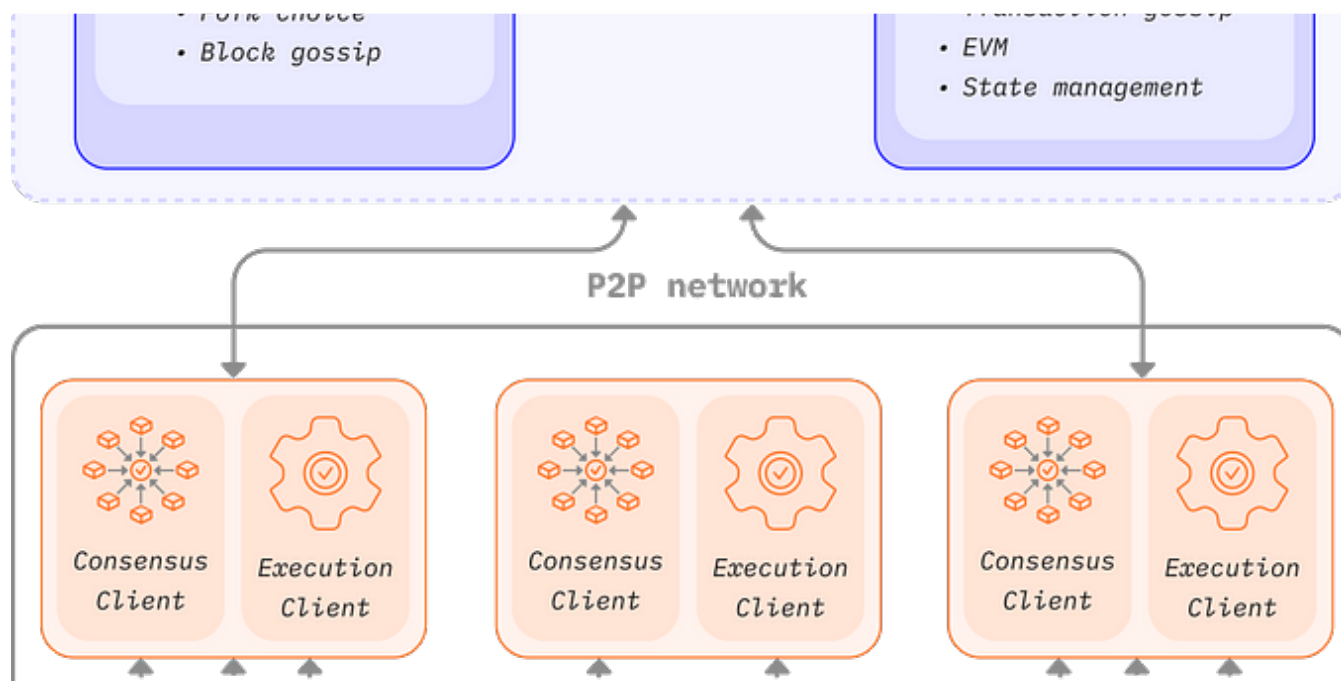
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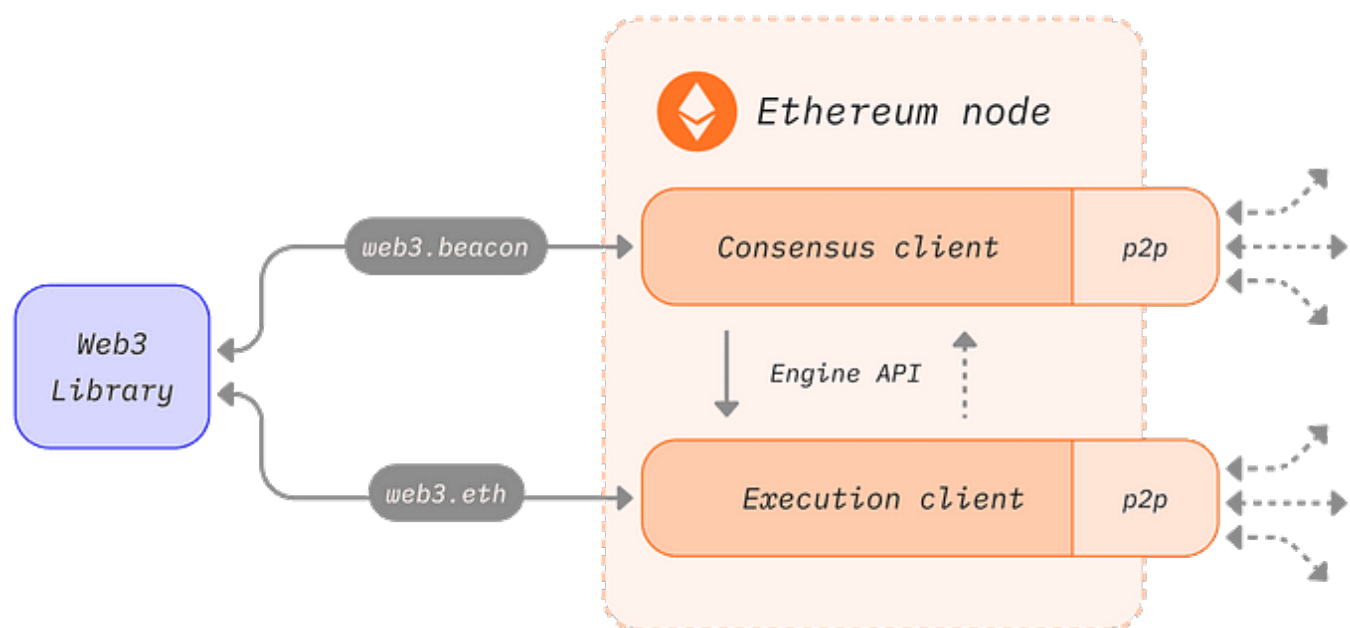
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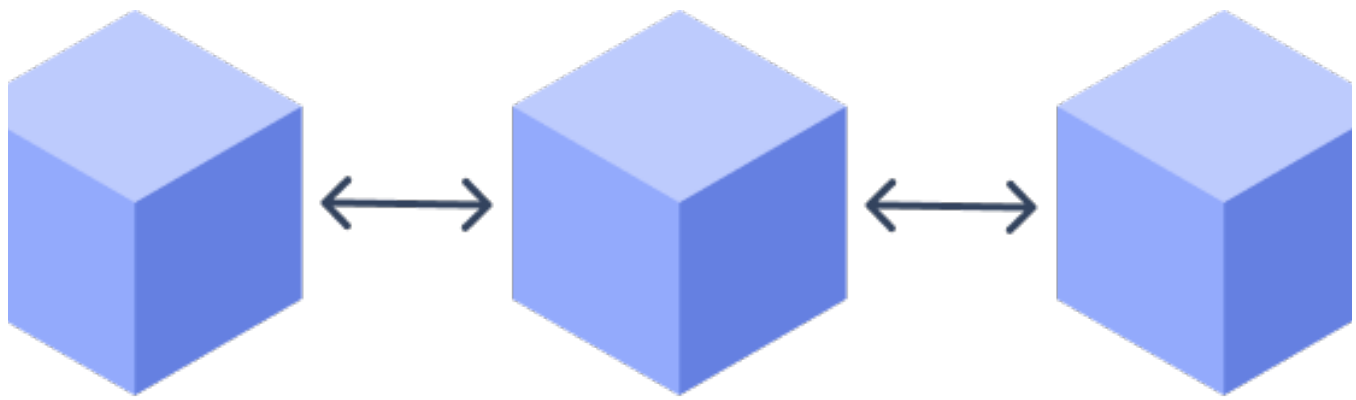
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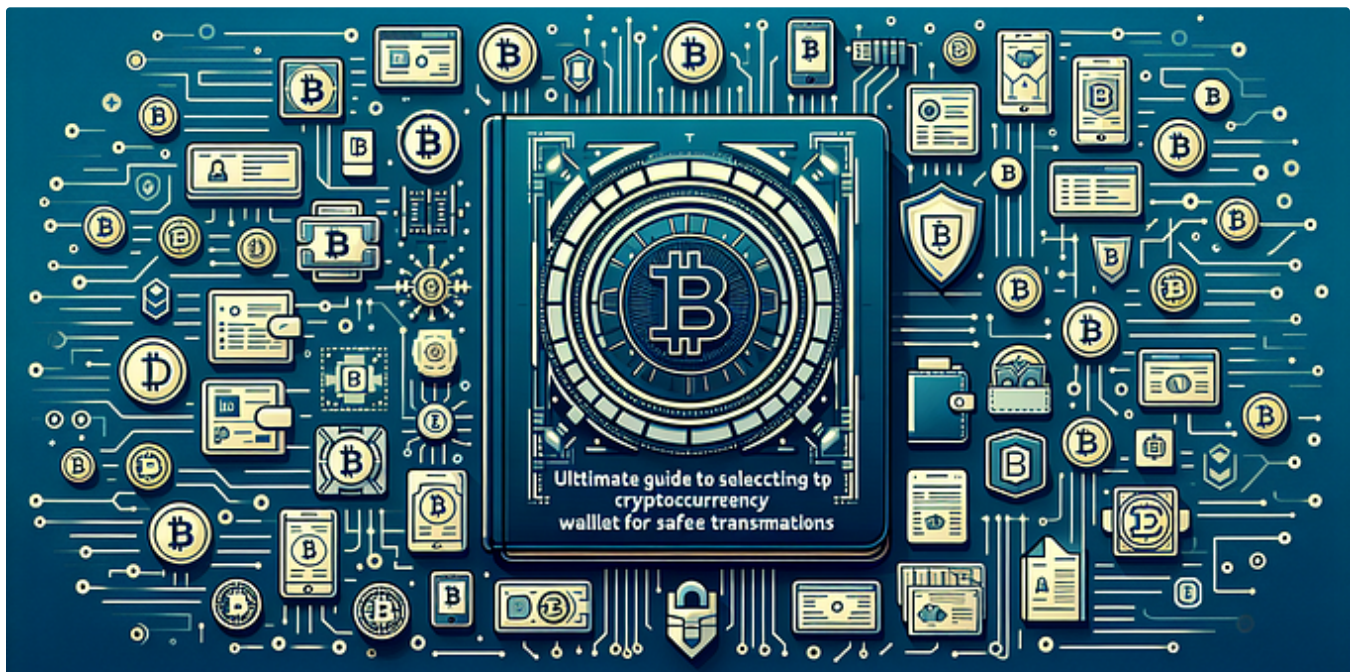
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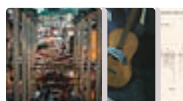✦   Oct 6

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✦   Oct 26   👋 6.2K   💬 89   🔖⁺

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