



# Integrate Ethereum and IPFS

With Javascript (2020)



Andrea Lisi, [andrealisi.12lj@gmail.com](mailto:andrealisi.12lj@gmail.com)



# Decentralized data storage

Smart contracts cannot store big portions of data

- Each transaction costs a fee to the user
- The transaction size cannot exceed the gas limit of a block
  - 8M units of gas

The application is not anymore decentralized if it relies of centralized data centers



# IPFS



IPFS (InterPlanetary File System) is a P2P network for the storage of the data in a decentralized way

- Each stored content is hashed and that hash is used to fetch it
  - Content-based addressing Vs Location-based addressing
- If at least a peer with a content C is online, every peer in the network is able to fetch it
  - Otherwise that content is not available

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# Part 5

# Connect IPFS

Put together smart contracts and IPFS





# Walkthrough

1. Init a Truffle project
  - a. Create a smart contract and compile it
2. Install all the NodeJs requirements
  - a. Truffle-contract
  - b. Web3
  - c. Ipfs-http-client
3. Combine smart contracts and IPFS



# Example contract

```
pragma solidity 0.6.6;

contract IPFSContract {

    string public cid = "None";

    function setCid(string memory _cid) public {
        cid = _cid;
    }
}
```



## Init a Truffle project

Initialize a Truffle project, code the contract and compile it so that its ABI and bytecode is in the *build/* folder



# Install NodeJs requirements

We are going to install:

- [truffle-contract](#)
- [web3](#)
- [ipfs-http-client](#)

```
$ npm init
$ npm install --save @truffle/contract
$ npm install --save web3
$ npm install --save ipfs-http-client
```





# Install NodeJs requirements

The file package.json should have these dependencies

```
"dependencies": {  
  "@truffle/contract": "^4.2.1",  
  "ipfs-http-client": "^44.0.0",  
  "web3": "^1.2.6"  
}
```



# Coding

Create a file *interaction.js* (or any other name). This file is going to:

1. Import all the libraries
2. Instantiate the smart contract
  - a. If the smart contract has already been deployed, fetch it
3. Connect to an IPFS node
  - a. We are going to use a public gateway provided by Infura
4. Code the logic
  - a. Post a text file onto IPFS, store the CID in the contract
  - b. Use the stored CID to retrieve the file and print it



# Coding, 1 - libraries

```
// Smart contracts
const contract = require("@truffle/contract");
const Web3 = require("web3");
const contract_data = require("../build/contracts/IPFSContract.json");

// IPFS
const ipfsClient = require("ipfs-http-client");
const {globSource} = ipfsClient;

const localhost = "http://127.0.0.1:8545";
const web3 = new Web3(localhost);
const provider = new Web3.providers.HttpProvider(localhost);
```



## Coding, 2 - create smart contract

```
// Libraries
// ...

const IPFSContract = contract(contract_data);
IPFSContract.setProvider(provider);

async function main() {
  // Do everything
  // Terminate process
  process.exit();
}
main();
```



## Coding, 2 - create smart contract

```
const IPFSContract = contract(contract_data);
IPFSContract.setProvider(provider);

async function main() {
  const accounts = await web3.eth.getAccounts();
  const alice = accounts[0];
  // Create the contract
  const instance = await IPFSContract.new({from: alice});
  console.log("Cid: " + await instance.cid());
}
main();
```



## Coding, 2 - get a smart contract

```
const IPFSContract = contract(contract_data);
IPFSContract.setProvider(provider);

async function main() {
  const accounts = await web3.eth.getAccounts();
  const alice = accounts[0];
  // Get last deployed instance
  const instance = await IPFSContract.deployed();
  // Get the instance at the address contract_address
  const instance = await IPFSContract.at(contract_address);
}
main();
```



## Coding, 3 - connect to IPFS

```
async function main() {
  // Create instance smart contract ...
  // ...

  // Connect IPFS
  // Connect to local node
  const ipfs = ipfsClient("localhost", "5001", {protocol: 'http'});

  // Connect to Infura with public gateway
  const ipfs = ipfsClient({host: "ipfs.infura.io", port: "5001", protocol: 'https'});
}
main();
```



## Coding, 4.a - Store file on IPFS

```
async function main() {
  // ...
  // Read filename from command line
  const args = process.argv.slice(2);
  const file_name = args[0];
  let file_ipfs_data;
  for await (const f of ipfs.add(globSource(file_name))) {
    file_ipfs_data = f;
    console.log(file_ipfs_data);
  }
}
main();
```





## Coding, 4.a - Store CID on ETH

```
async function main() {  
  // ...  
  // Store the CID in the smart contract  
  const tx = await instance.setCid(file_ipfs_data.cid.toString(), {from: alice});  
}  
main();
```



## Coding, 4.b - Get the CID from ETH

```
async function main() {  
  // ...  
  // Get the CID from the smart contract  
  const cid = await instance.cid();  
  console.log("Cid: " + cid);  
  
}  
main();
```



## Coding, 4.b - Get the file from IPFS

```
async function main() {
  // ...
  // Retrieve the file
  const bytes = [];
  for await (const chunk of ipfs.cat(cid)) {
    bytes.push(chunk);
  }
  console.log(Buffer.concat(bytes).toString());
  // Terminate process
  process.exit();
}
main();
```



# Result

Execute with

- `$ node interaction.js file_name`

```
alic@aalic:~/Documents/PHD/SupportP2P2020/eth-ipfs$ node contract.js ipsum.txt
Cid: None
Cid: QmZ5o9Xjjhea4yYbGfTcUr6wAsq42CawMVK75AZz73RBqM

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```



# Resources

IPFS: <https://docs.ipfs.io/>

Tutorial: <https://www.youtube.com/watch?v=pTZVoqBUjvI>

- Warning: the version of ipfs-http-client in that tutorial is older

for await ... of in Javascript:

<https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Statements/for-await...of>