
CoviChain: A Blockchain based Distributed Framework for Healthcare Cyber-Physical Systems

S. L. T. Vangipuram¹ , S. P. Mohanty² and E. Kougianos³
University of North Texas, Denton, TX 76203, USA.^{1,2,3}

Email: lakshmisukruthatirumalavangipuram@my.unt.edu¹ , saraju.mohanty@unt.edu² and ,
elias.kougianos@unt.edu³

Talk Outline

Introduction

Data Storage in H-CPS

Problems and Motivation

Edge and Distributed storage

Blockchain

Proposed CoviChain

Implementation

Validation

Experimental Results

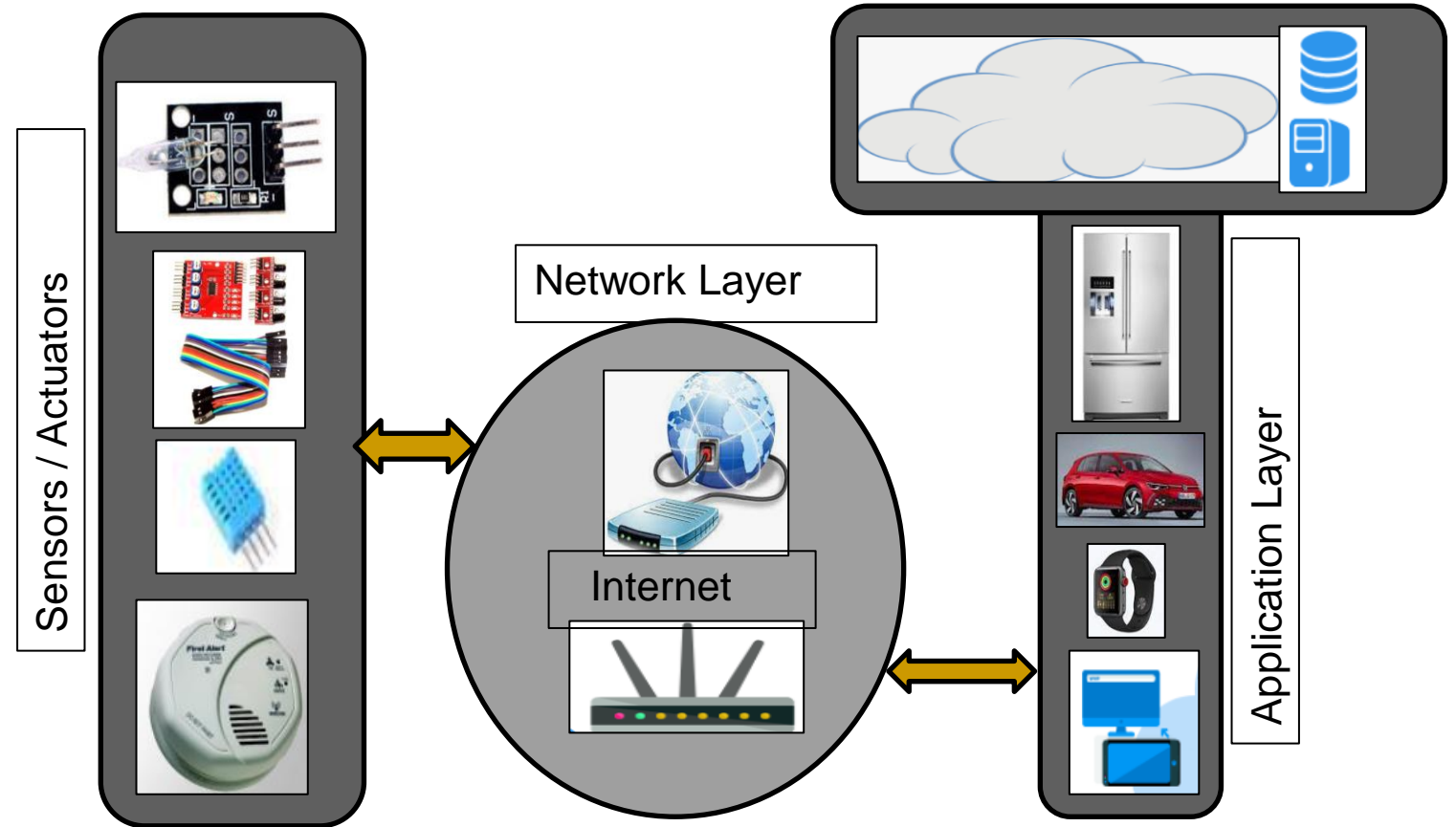
Conclusion

Introduction

IoT-Internet of Things

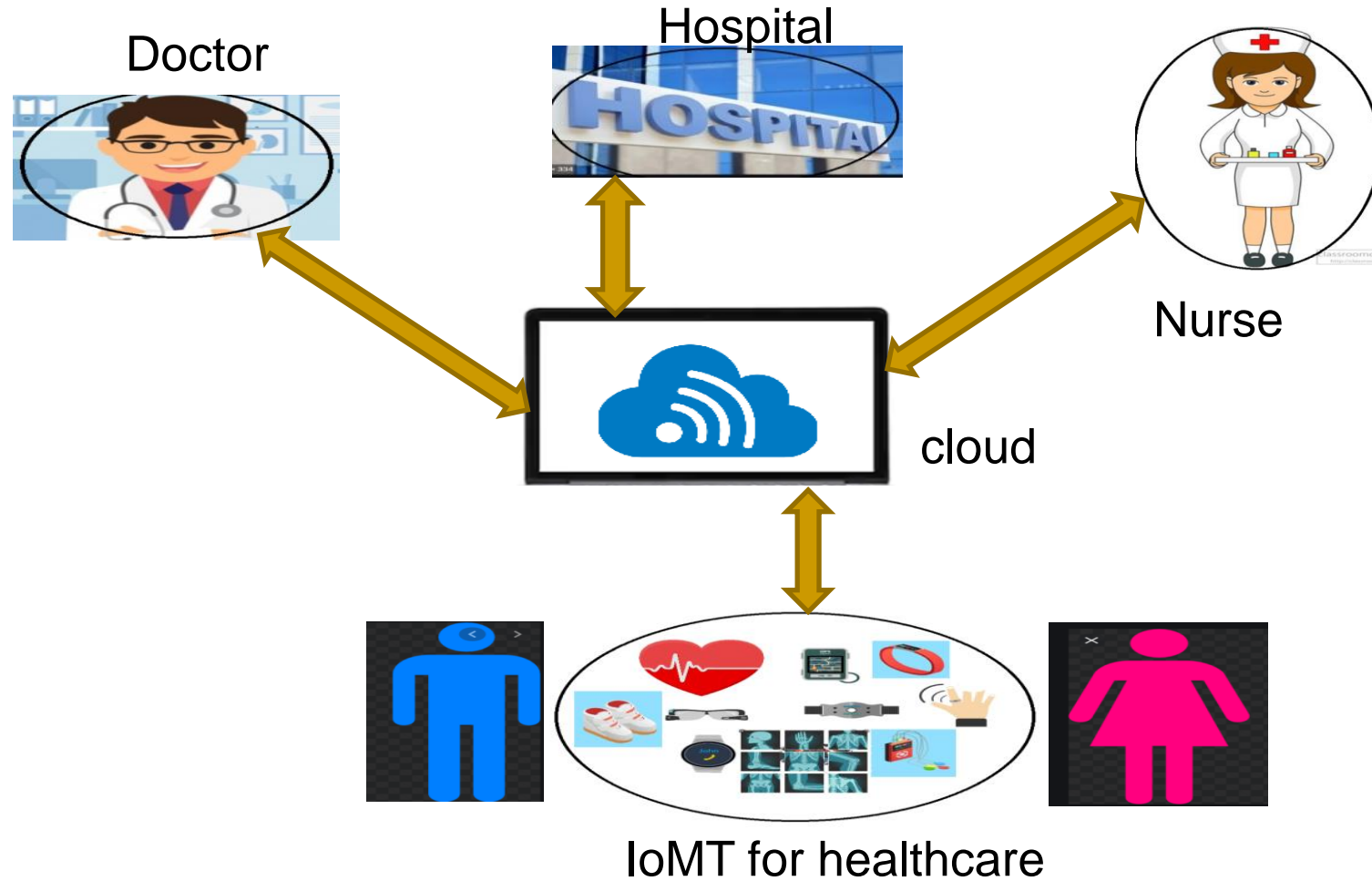
■ Application Fields

- ❑ Smart City
- ❑ Smart Medical(IoMT).
- ❑ Smart Farming(IoAT)
- ❑ Smart Industrial (IIoT)
- ❑ Smart Energy(IoE)
- ❑ Smart Supply chain and Retail.
- ❑ Smart Home.



Introduction

IoMT-Internet of Medical Things



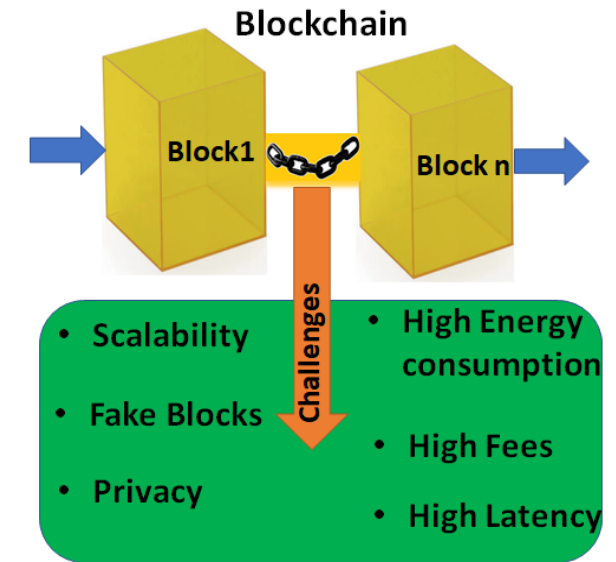
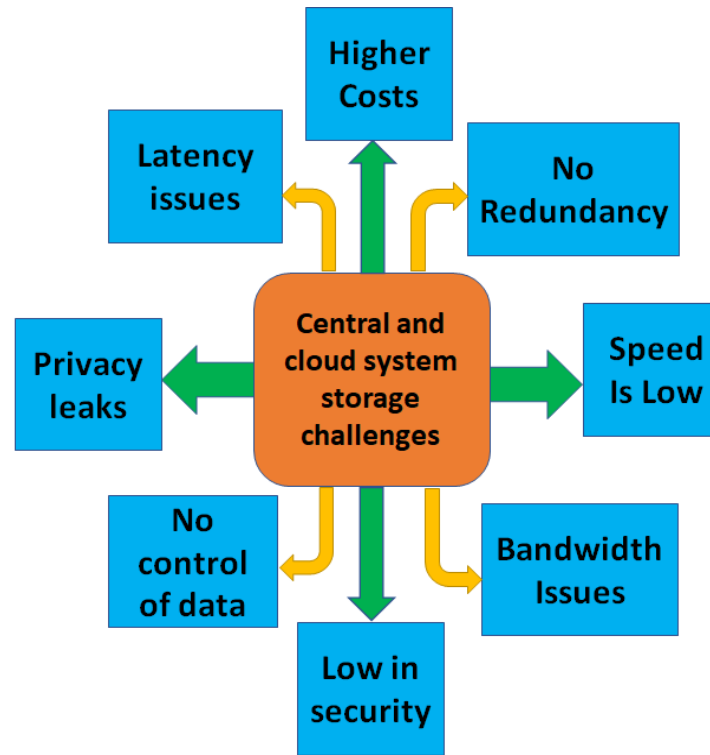
Data Storage in H-CPS[1]

Application	Protocol	Edge	Data Storage	Security	Computation
Aarogyasetu	iBeacon	No	Centralized	High PB	High at CS
Trace Together	BlueTrace	No	Partially Centralized	Possible PB	High at CS
MedRec	SC	No	Off-Chain Centralized	Single Hashing	High at CS
CoviChain	IPFS+SC	Yes	Off-Chain Decentralized	Dual Hashing	Less at CS

C-Centralized, PC-Partially Centralized, PB-Privacy Breach, CS-Client Side, D-Decentralized

Problems & Motivation

- ❑ Mining Time is 13 Seconds for 1MB Data.
- ❑ The price of Ethereum Stands at \$ 1811.41.
- ❑ To Store 1 KB Data, it takes 0.032Eth and for 1MB=32.768.



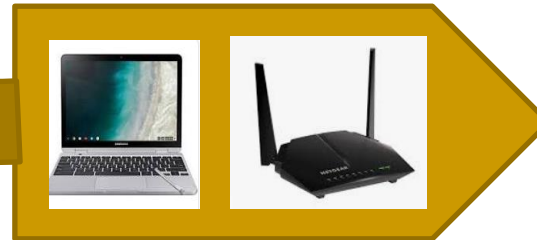
Data Size	Mining Time [Sec]	Ethereum Required	Cost
10 MB	130 Seconds= 2 min 10 Seconds	327.68 Eth	\$ 593,562.8

Edge/Fog?



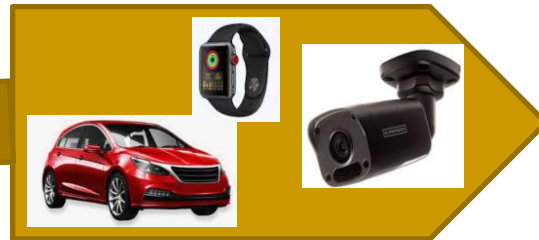
The Cloud:

- Larger Data processing
- Storage of large information from organization or business



The Edge:

- Data processing
- Local processing of the data
- Near to IoT

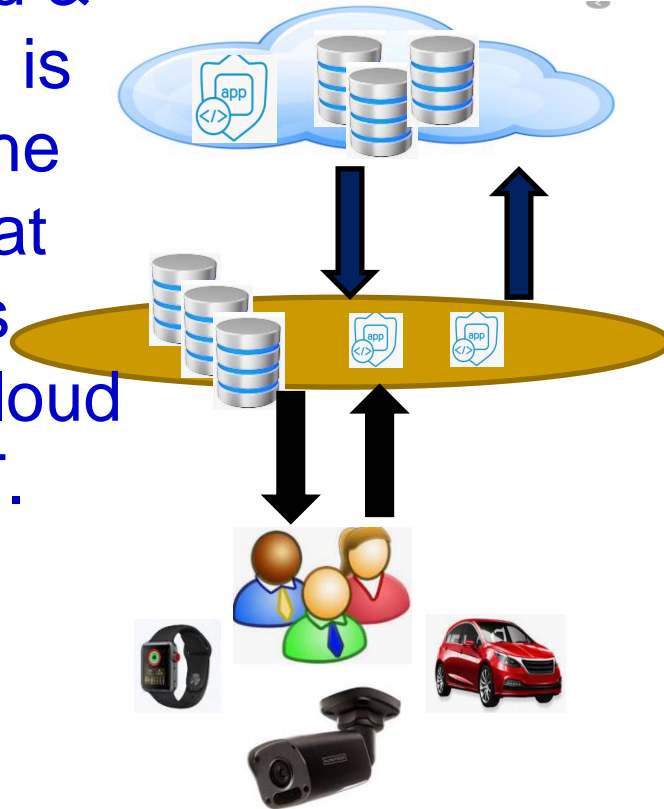


Internet of Things:

- Smart Wearable
- Smart vehicle
- Smart Home

Why Edge/Fog?

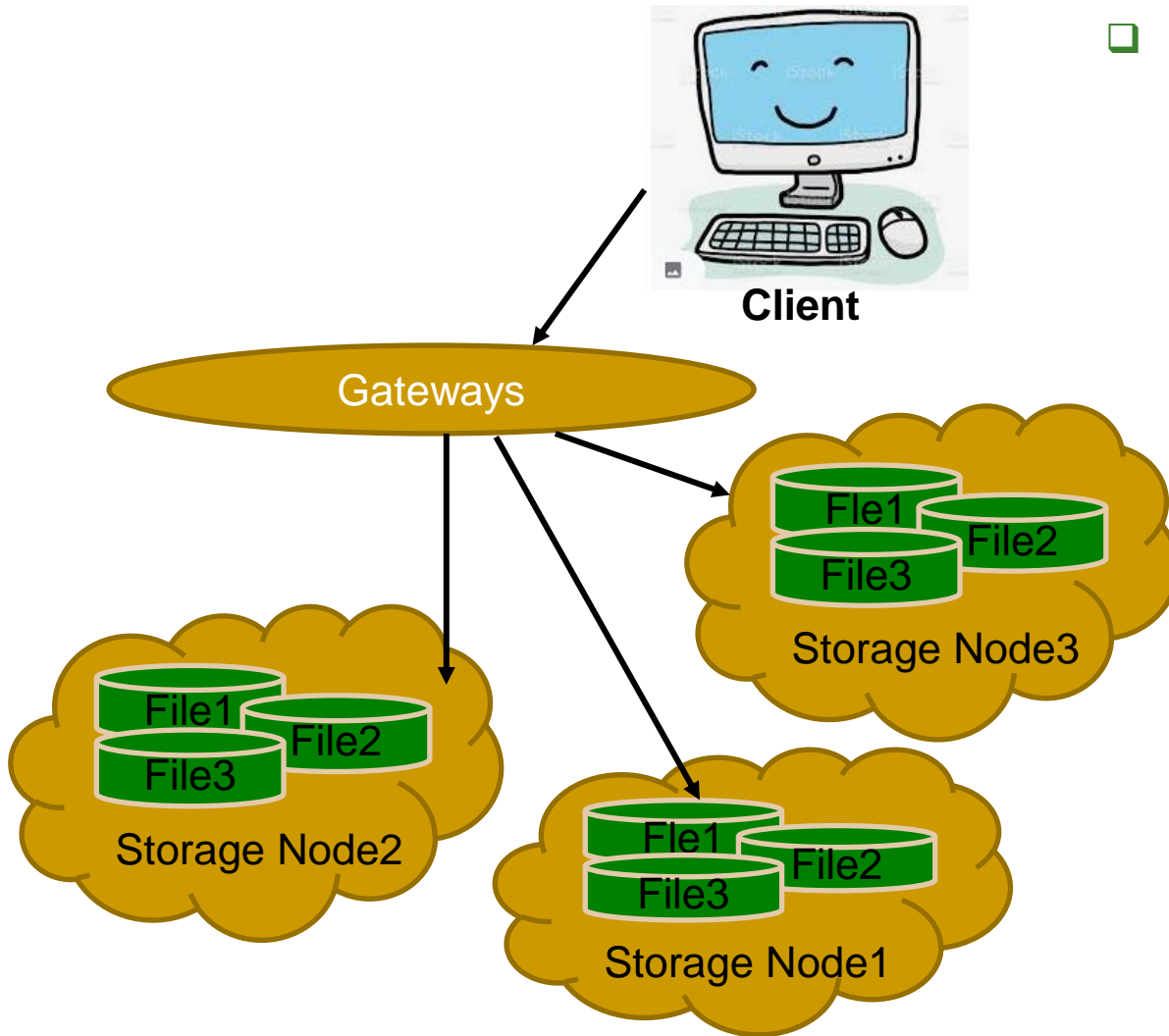
Data to be processed & analyzed is sent to the Edge that resides between cloud and IoT.



Data to be processed & analyzed is sent directly to Cloud.

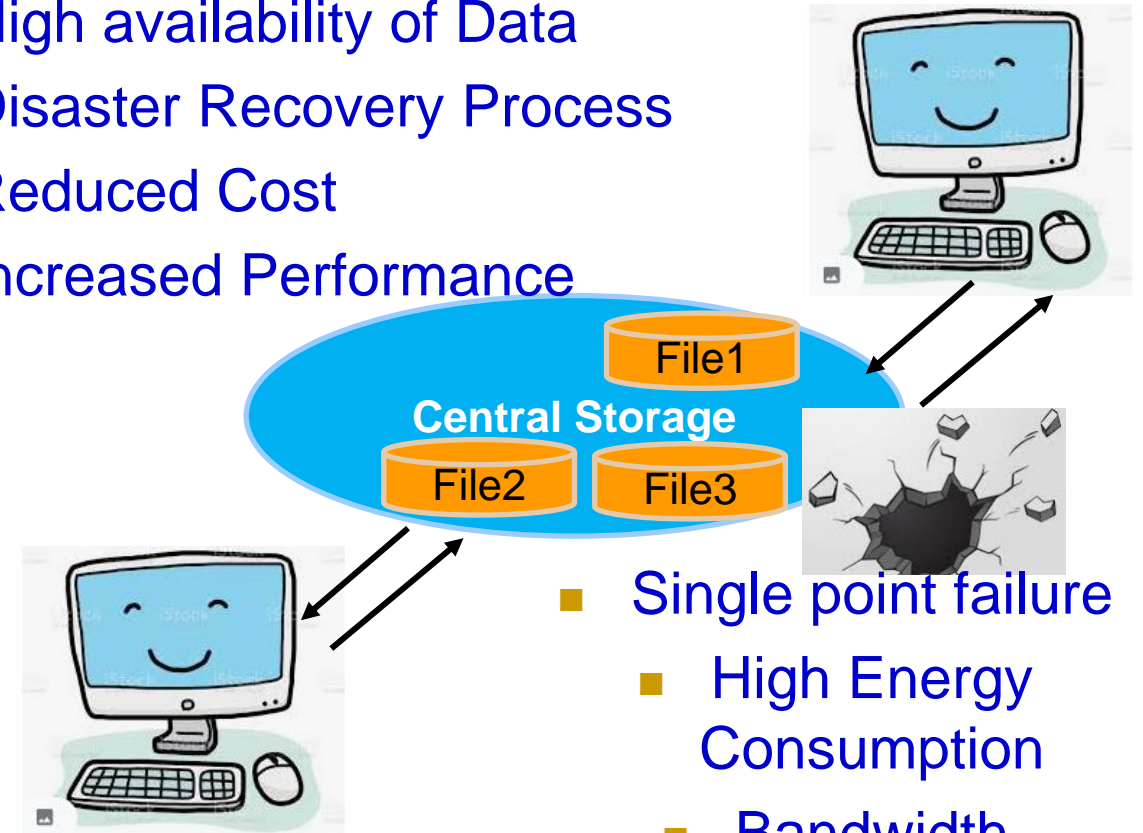


Distributed Storage



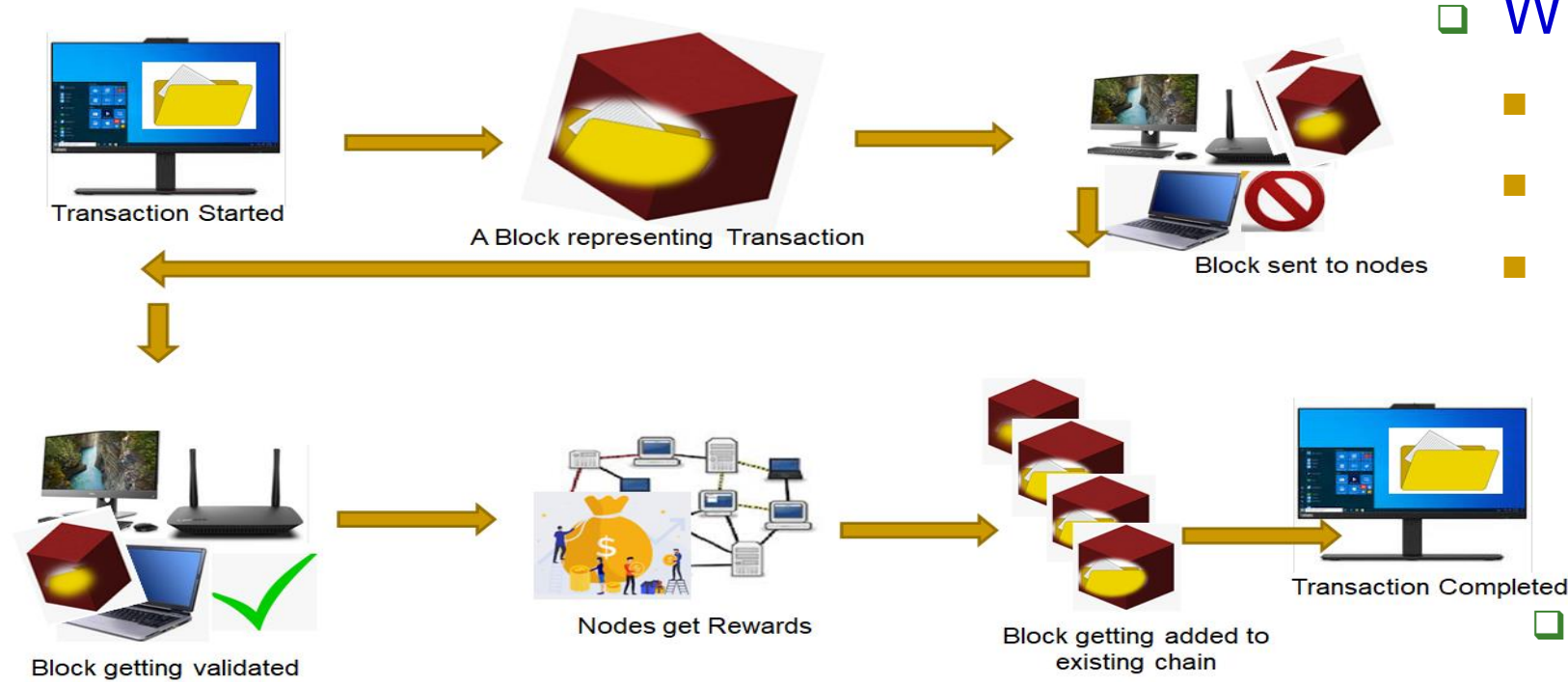
□ Why?

- High availability of Data
- Disaster Recovery Process
- Reduced Cost
- Increased Performance



- Single point failure
- High Energy Consumption
- Bandwidth Bottlenecks

Blockchain

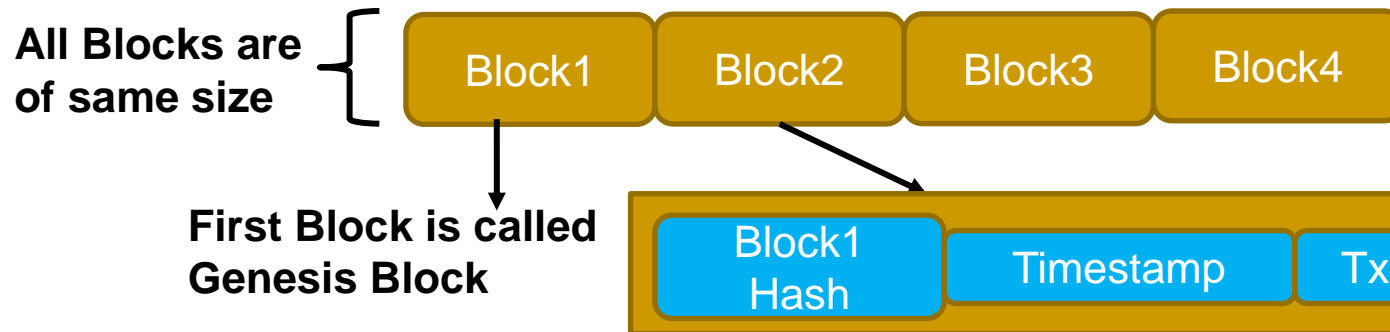


What?

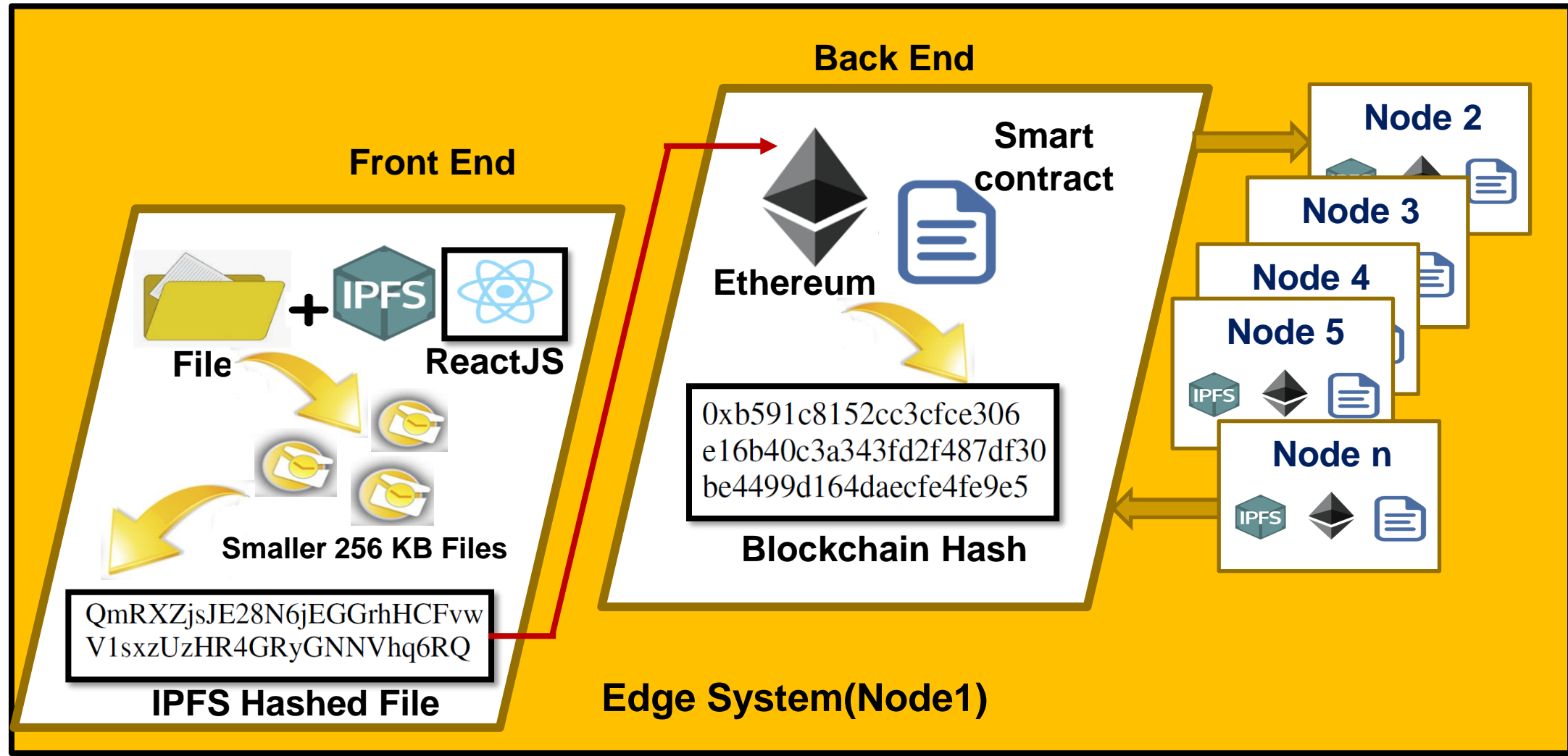
- Data stored as ledger records.
- Records Combined form Blocks.
- Blocks are secured by Hashes

Why?

- Decentralized
- No Administrator
- Data cannot be modified
- Embedded Timestamp

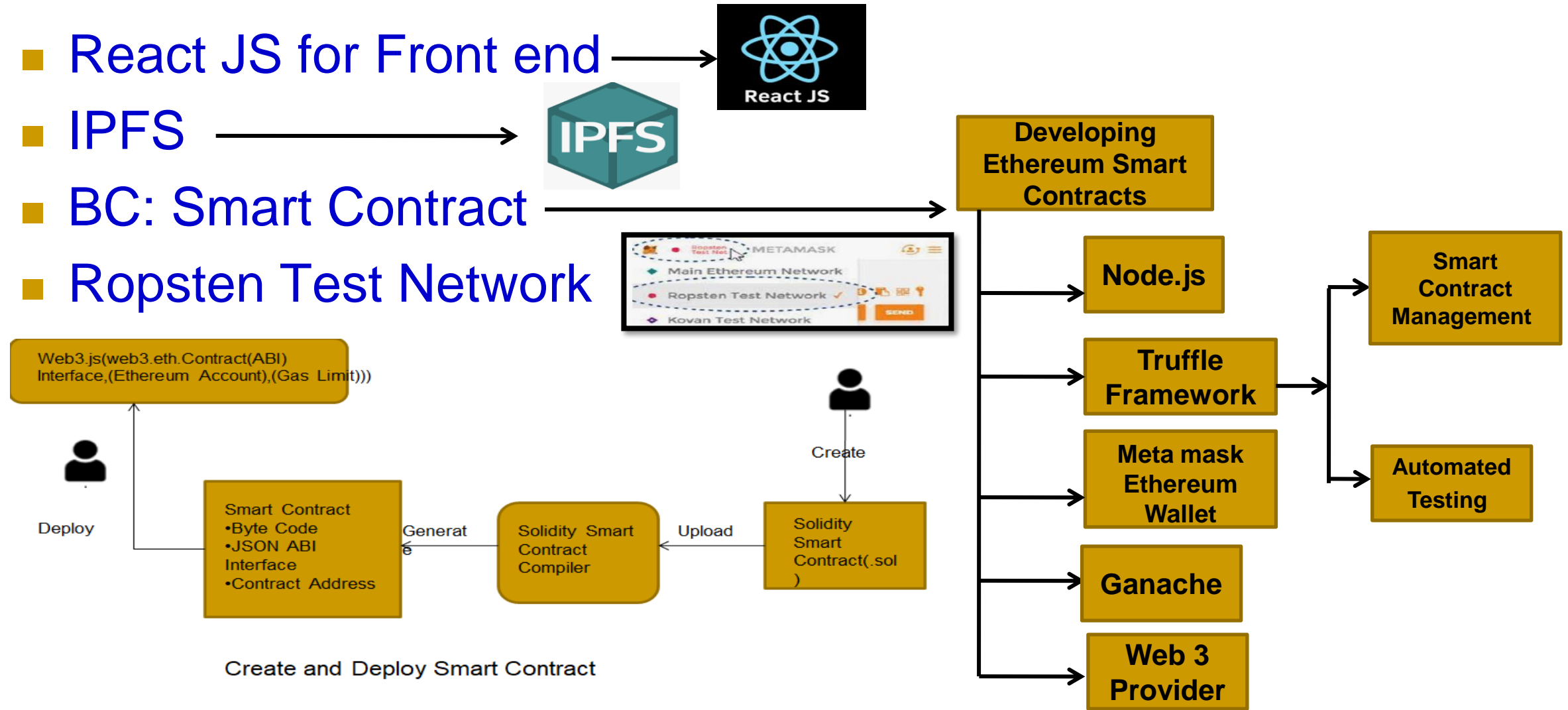


Proposed CoviChain



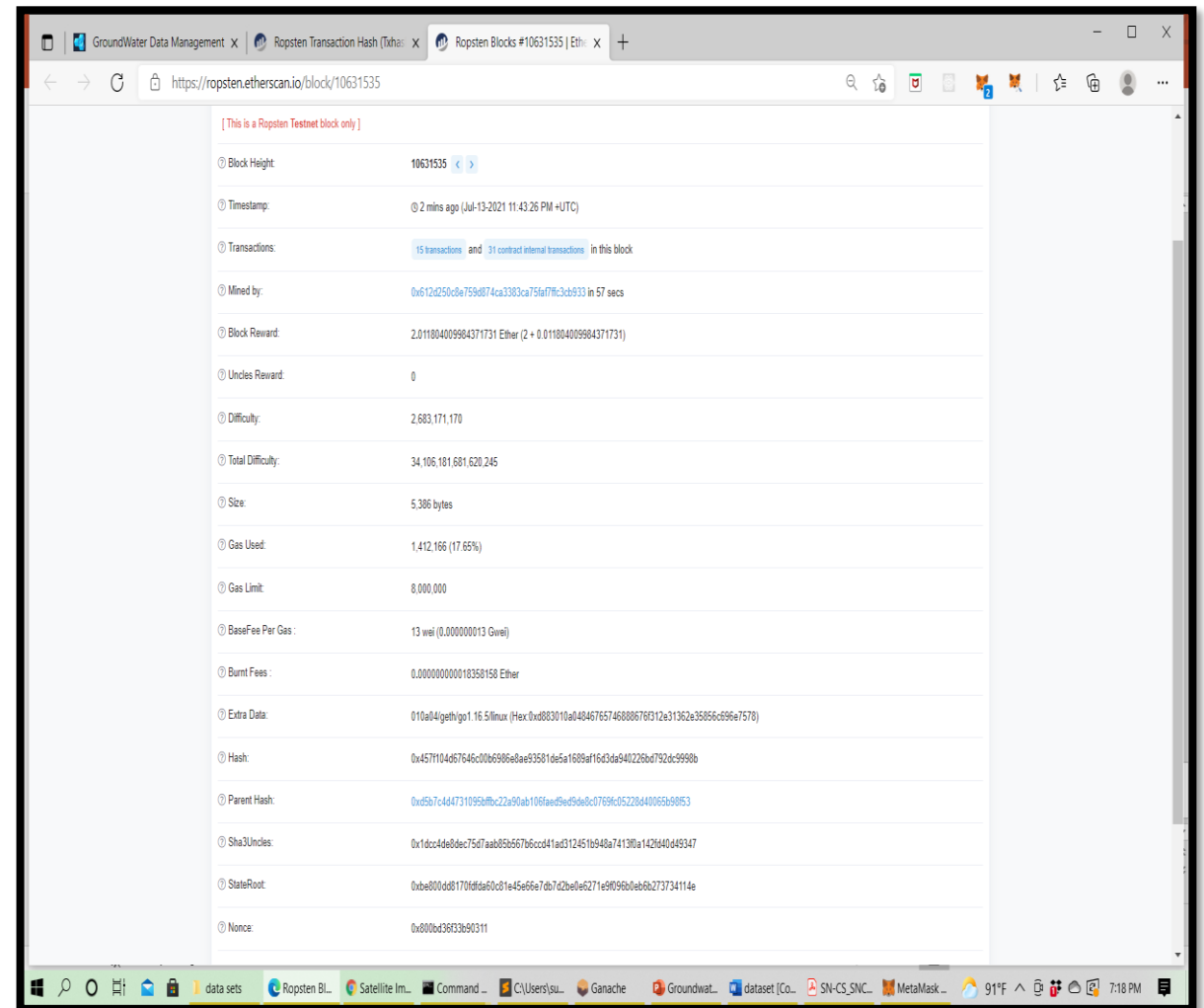
Technologies used for Implementation

- React JS for Front end
- IPFS
- BC: Smart Contract
- Ropsten Test Network



Validating

- Uploaded IPFS Hashed Link to Blockchain explorer Ropsten Test Network.
- Recorded all Transaction details with timestamp and Blockchain transaction Hash



CoviChain Results with Double Hashing with Reduced Cost and Time [1]

File	File Size	IPFS-Hash	Blockchain Hash
.txt	97 KB	QmRTyUIHJthg fhSDjh8gfs6fstR RFdcdfjc8RYT Dh7safgj9hsd	0xb591c8152 cc3cfce306e16b4 0c3a343fd2f487 df30be4499d16 4daecfe4fe9e5
.CSV	4.41 MB	QmYUDWJCT UAqJL97kfJ7JZ J9Mjm8FTHLvw NwJJmPS8bKev	0x6aefa11dd5 2d5782ea0c64 8ad66b590efb42 f402451c7b9307 947a4ac308992

File	File Size	Time (ms)	Gas Fees	Cost(\$)
.txt	97 KB	39	0.00460792eth	8.34
.CSV	4.41 MB	77	0.00489103eth	8.85

Conclusion

- The paper successfully implements blockchain with IPFS distributed Storage for substantial Data.
- The data upload and mining time on to blockchain is significantly decreased.
- The proposed application is a precise and cost-effective solution and useful for sensitive Healthcare Data

