
Permissioned Blockchain based E-Voting System using Hyperledger Fabric

Group 1.1

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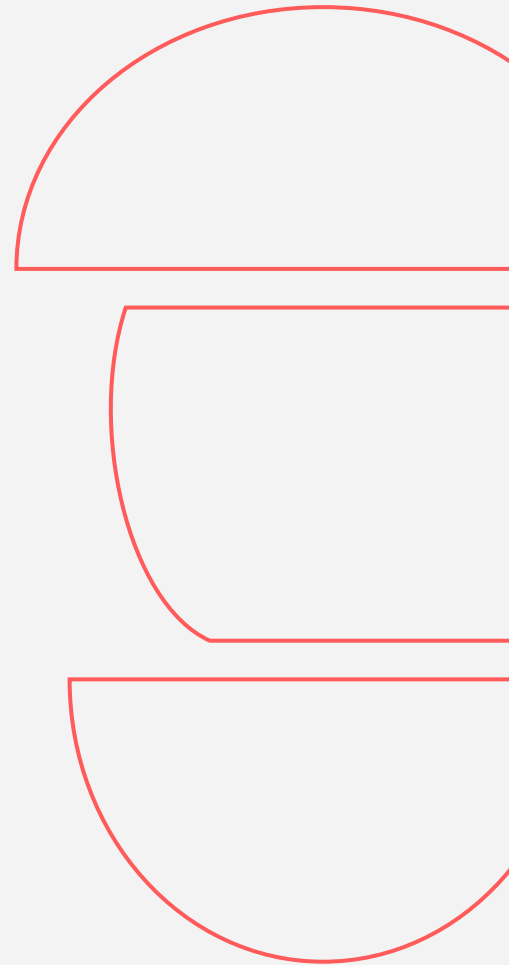


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01

PROBLEM STATEMENT

PROBLEM STATEMENT

With the rise of democracy, elections have been accused quite a lot for the lack of transparency and security. Although societies worldwide are rapidly adopting technology, creating a secure E-voting system that offers fairness and anonymity to current voters while ensuring transparency & flexibility has always been a challenge for a long time. The current EVM system reduces the time for casting a vote and announcing the results compared to the traditional paper ballot system; however, it still has many issues that can put the election authorities at risk. People need to know that their vote is not being tampered with and is successfully accounted for by the system. General e voting system uses a centralized system which gives one organization complete control over the system. Hence the E-voting system can be implemented using Blockchain technology, which would provide a secure and decentralized e-voting platform, i.e., peer-to-peer transaction, and maintains a ledger where every vote cast will be considered allowing the users to see the results in real time without having the permission to edit the vote after election gets over. It involves using Hyperledger fabric and Chaincode to create a highly maintainable, large-scale, and cost-effective E Voting solution within a personalized private blockchain.



02

OBJECTIVES

OBJECTIVES

1. To design a system which conducts the election process in a decentralized fashion. Thus keeping the entire process fair, open and independently verifiable.
2. To design a system which registers the voters and also authenticates or verifies the voters who are eligible to vote thus preventing malicious people from faking votes.
3. To design a system which allows the people to vote anonymously from anywhere and at any time within a pre-disclosed time frame. The system needs to be designed in such a way that the voter is not allowed to vote more than once.
4. To design a system which prevents the tampering of votes once registered i.e maintains the integrity of data thus ensuring that each vote is recorded as intended and cannot be tampered with in any manner, once logged.
5. To design a system which verifies the votes and produces results by tallying all the votes registered in the system.

ARTICLE 324

The duties of the ECI as set out in Article 324 of the Constitution include ensuring that elections conducted by it are free and fair, and reflect the will of the voters. To be considered free and fair, the international standards an election has to meet are:

- Individuals have to be accurately identified as eligible voters who have not already voted;
- All voters are allowed only one anonymous ballot each, which they can mark in privacy; the ballot box is secure, observed and, during the election, only able to have votes added to it by voters: votes cannot be removed; when the election ends, the ballot box is opened and counted in the presence of observers from all competing parties.
- The counting process cannot reveal how individual voters cast their ballots; if the results are in doubt, the ballots can be checked and counted again by different people; as far as the individual voter is concerned, he must be assured that the candidate he casts his vote for, actually gets that vote.
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- as far as the individual voter is concerned, he must be assured that the candidate he casts his vote for, actually gets that vote.

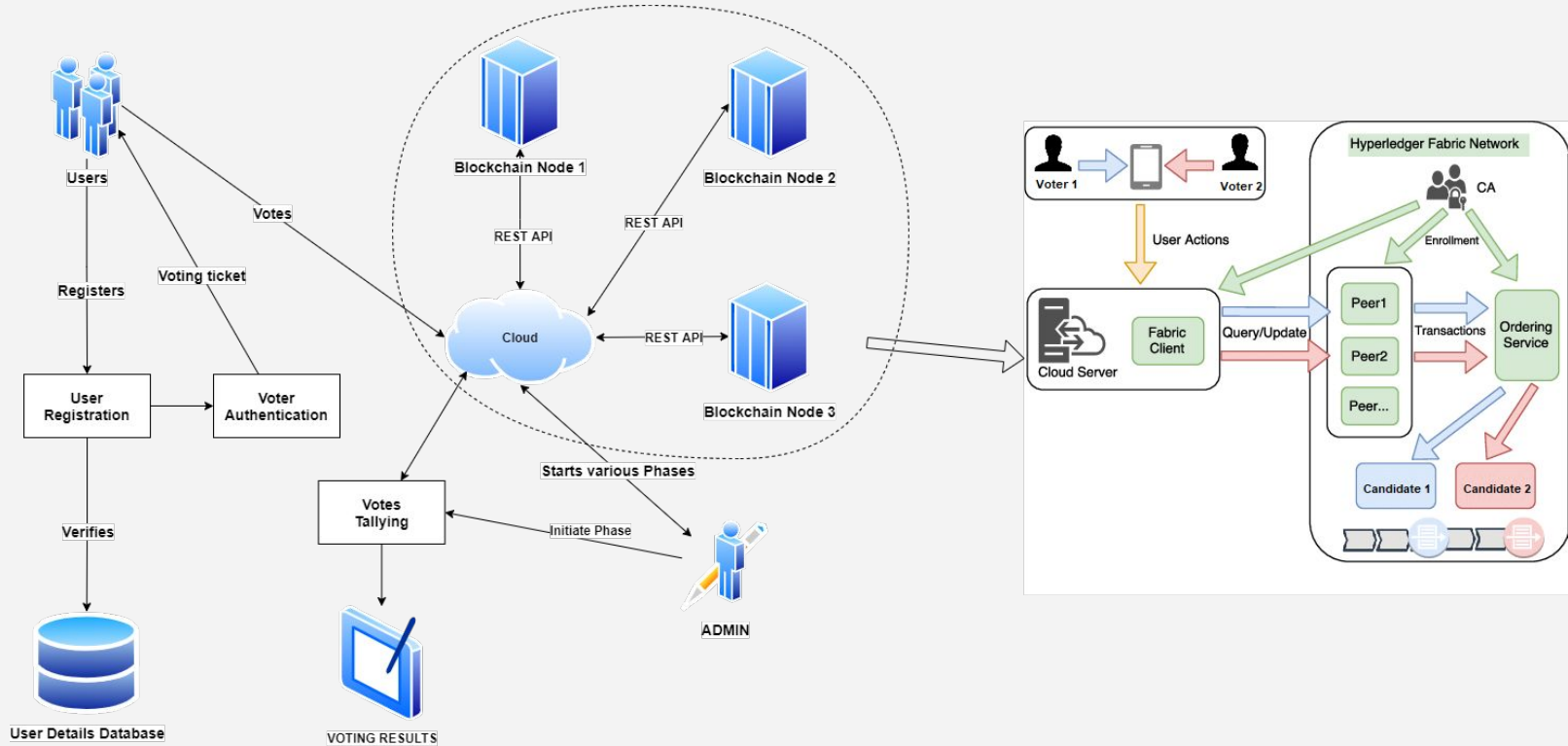
Source: <https://www.thehindu.com/opinion/op-ed/The-problem-with-EVMs/article13369610.ece>



03

**PROPOSED
SYSTEM**

PROPOSED SYSTEM

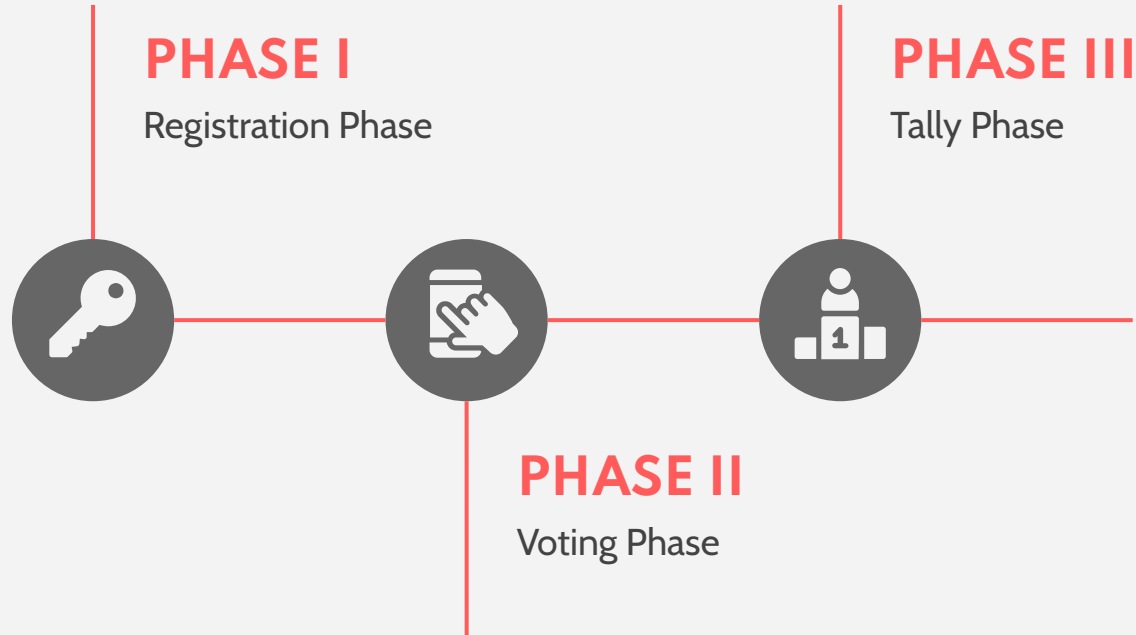




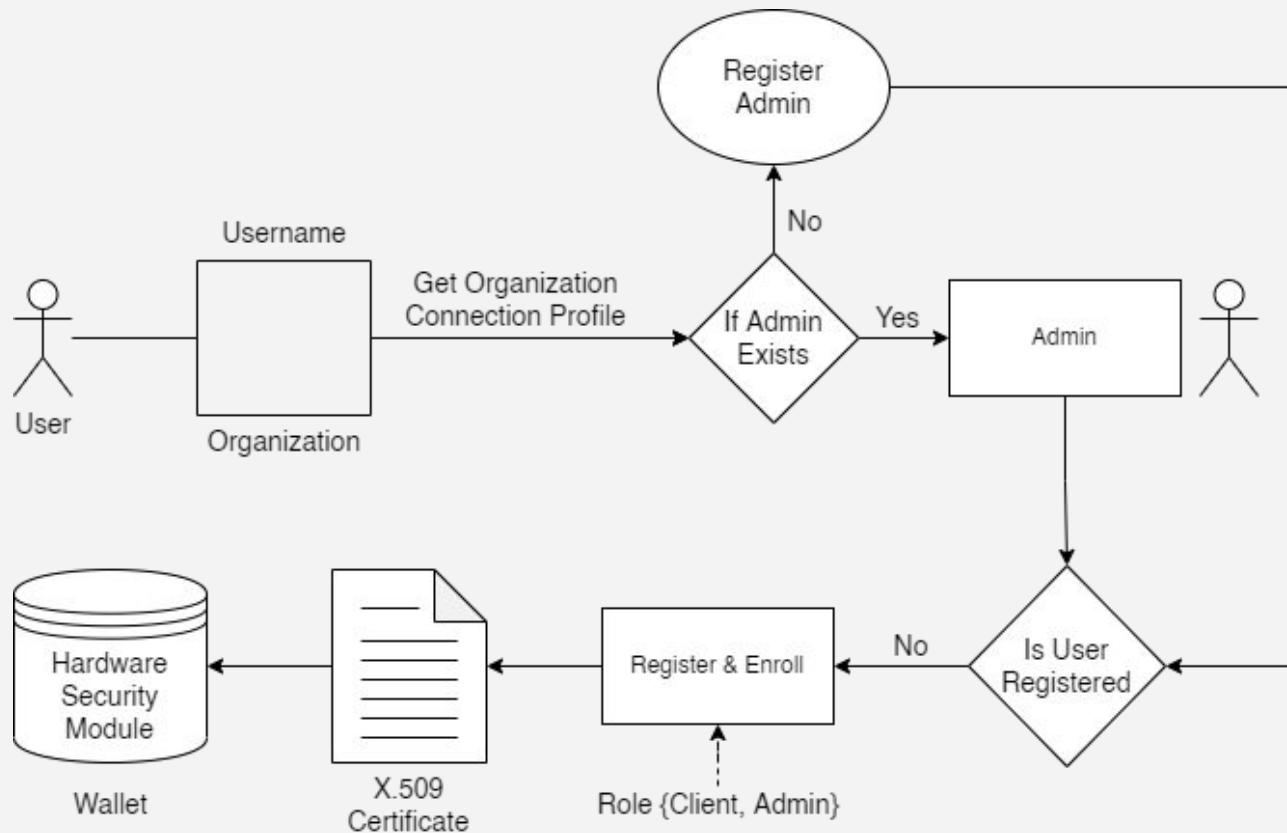
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METHODOLOG Y

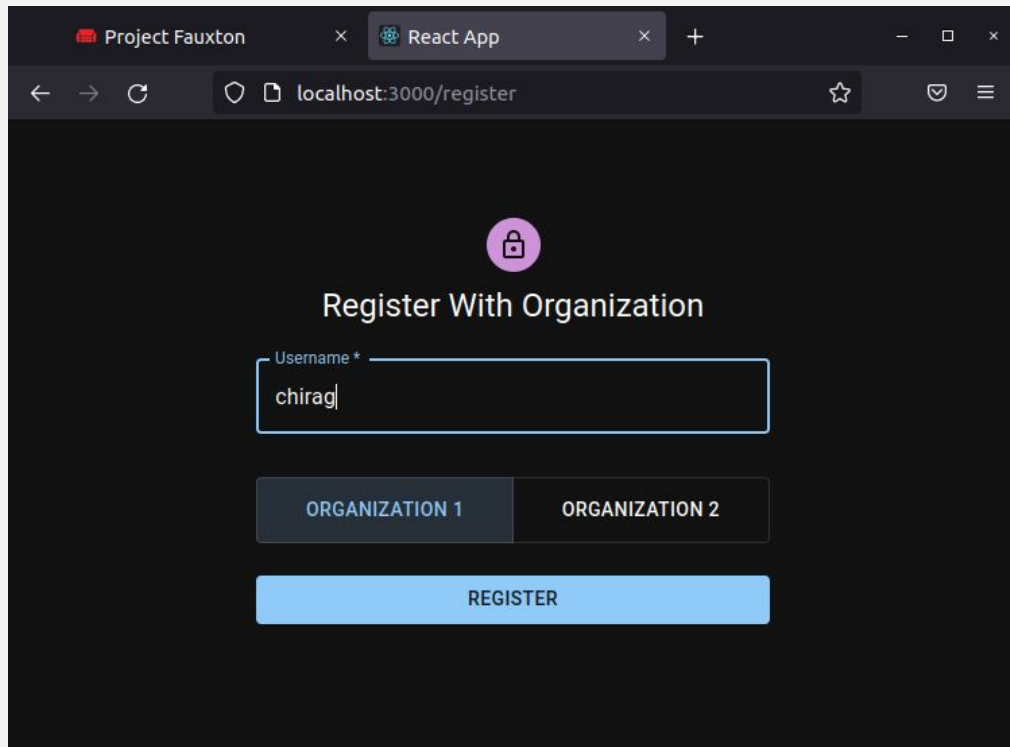
METHODOLOGY



REGISTRATION PHASE




REGISTRATION PHASE



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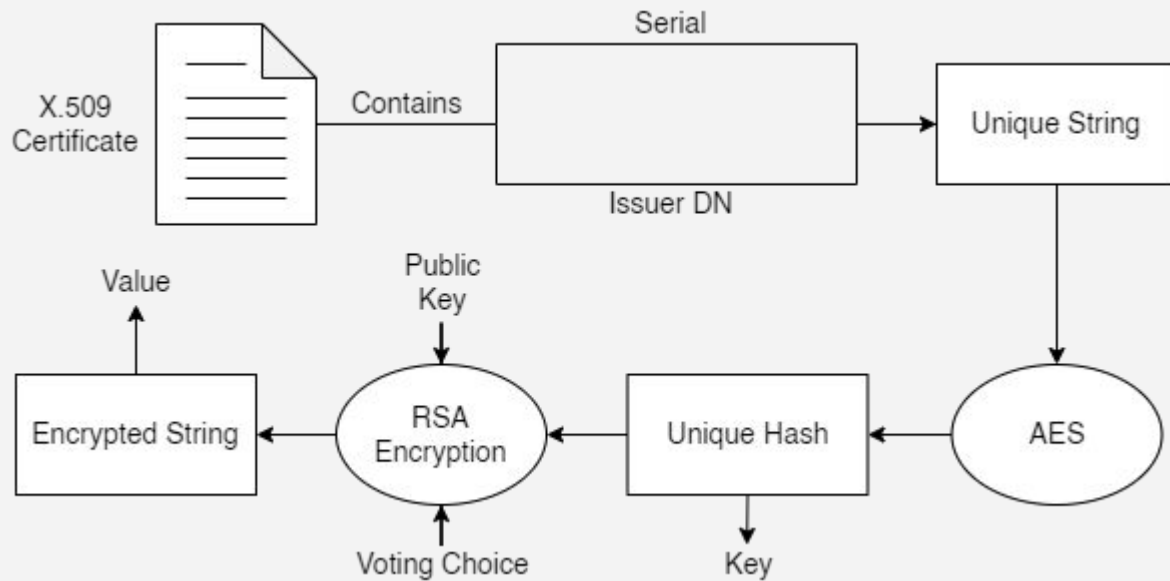
Register With Organization

Username *

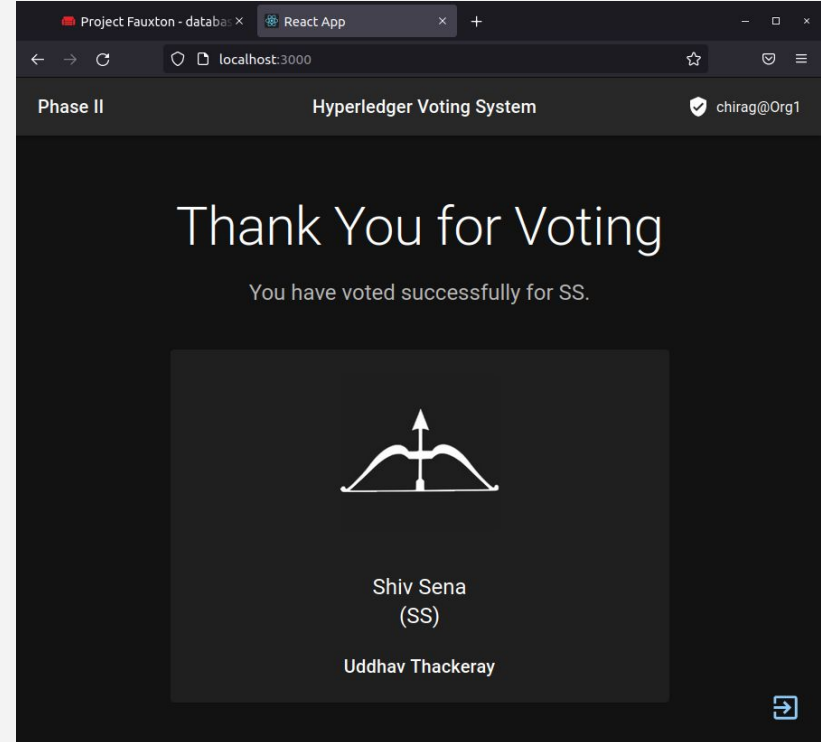
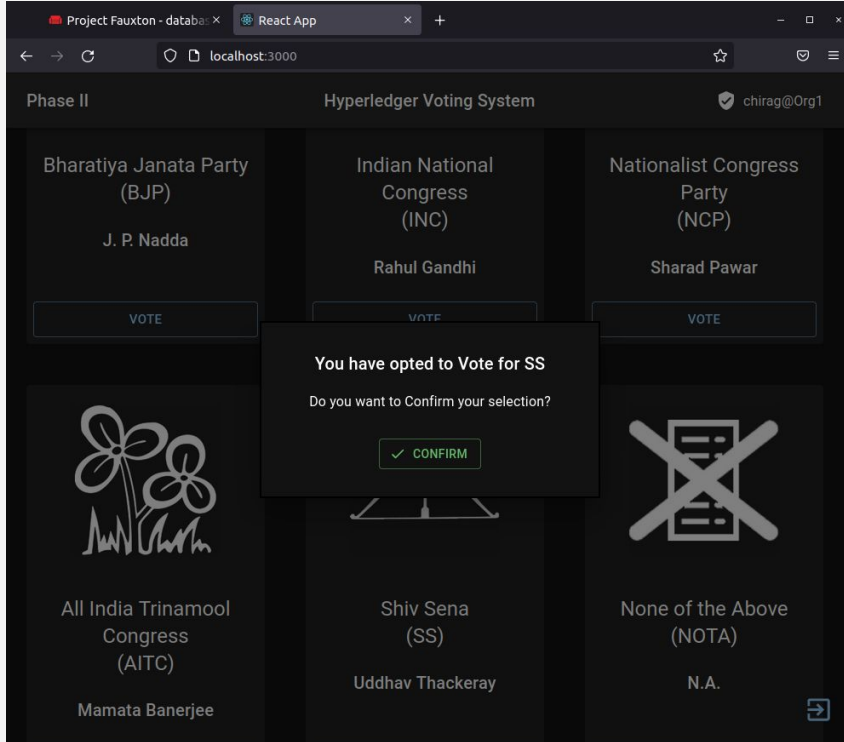
ORGANIZATION 1 ORGANIZATION 2

REGISTER

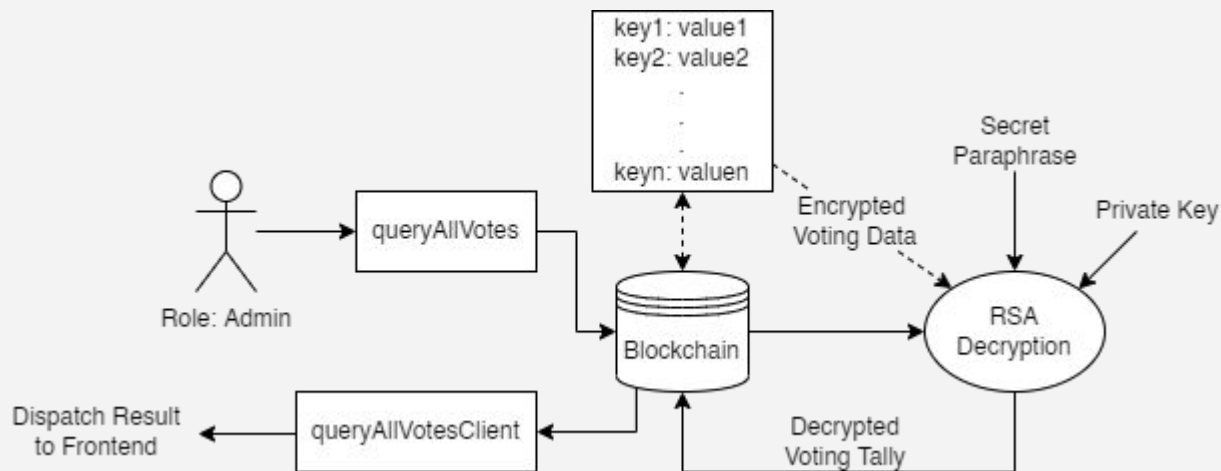
VOTING PHASE



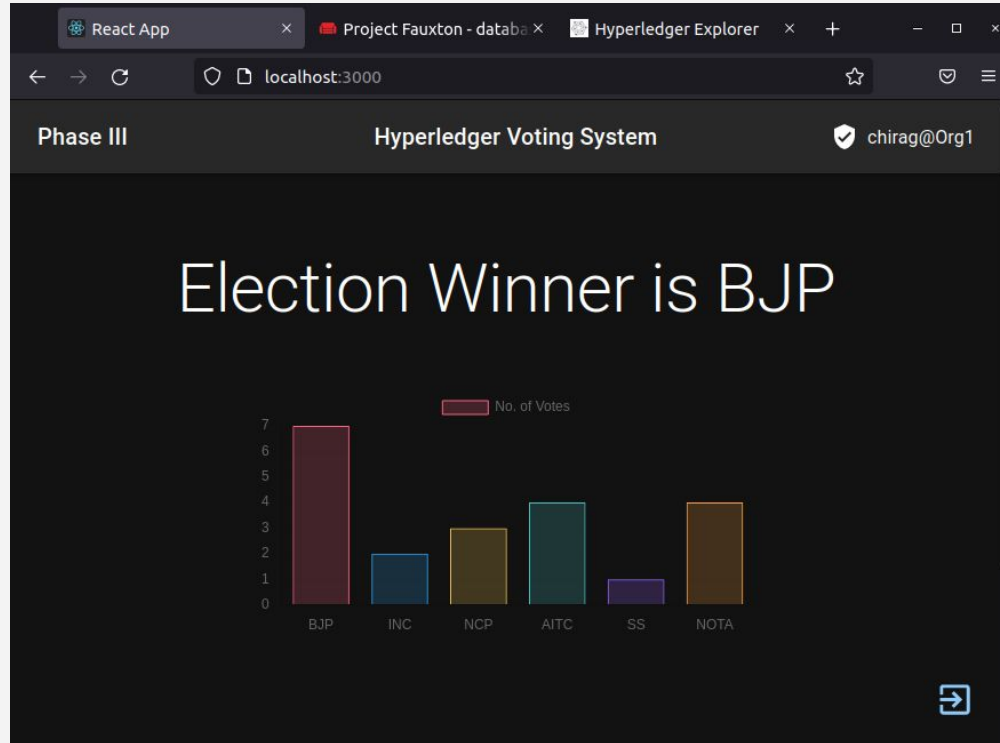
VOTING PHASE



TALLY PHASE



TALLY PHASE

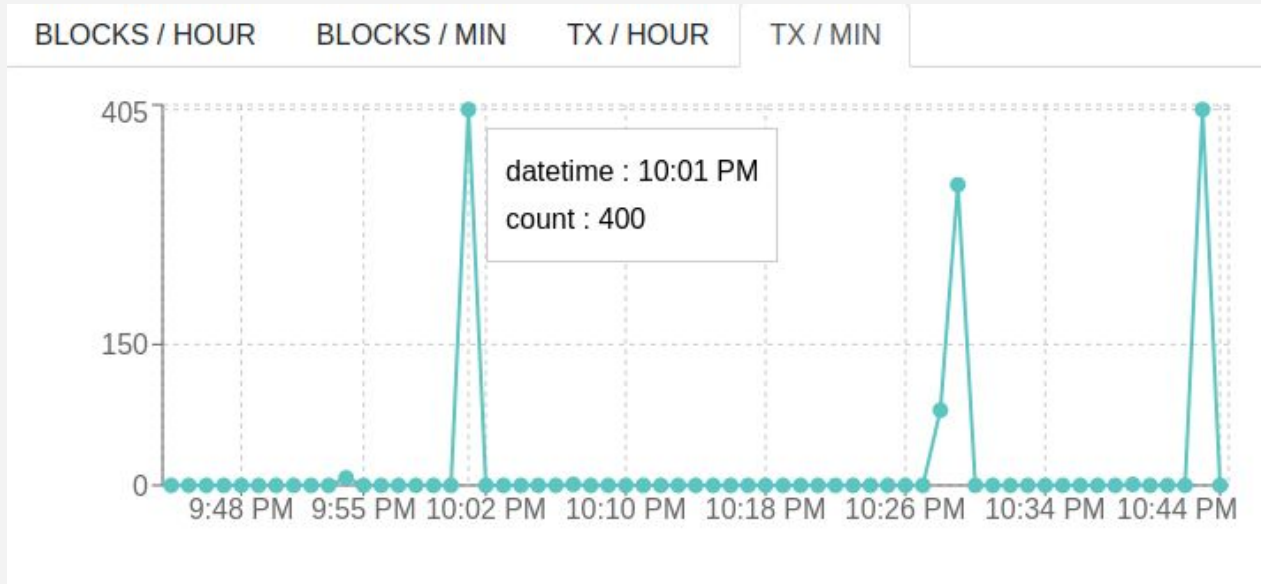




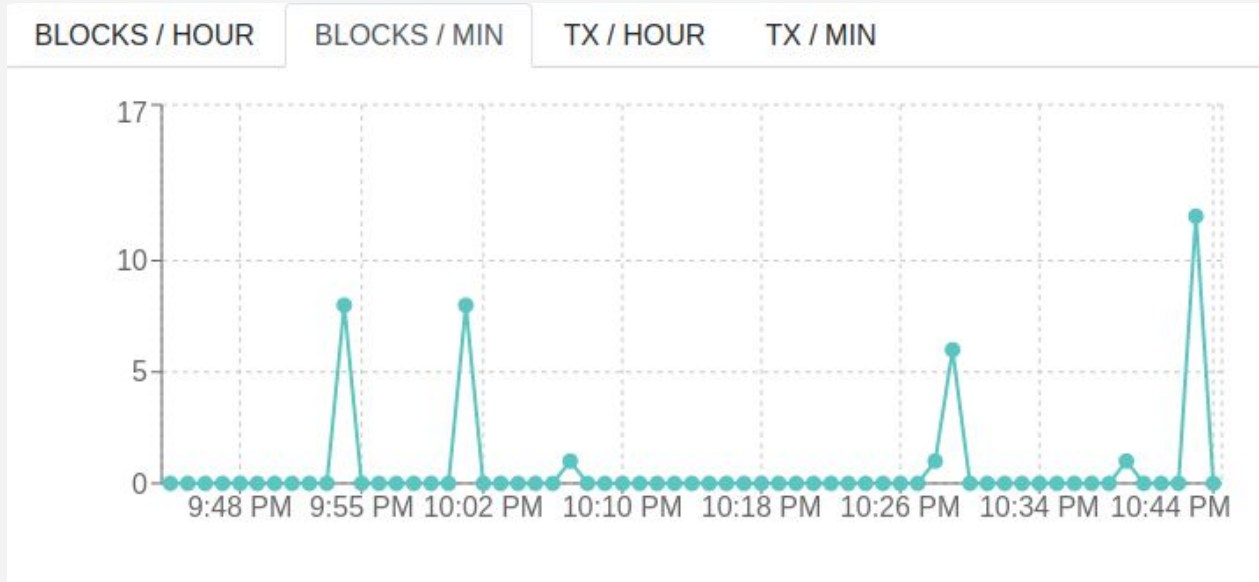
05

**RESULTS &
OBSERVATIONS**

TRANSACTIONS PER MINUTE



BLOCKS GENERATED PER MINUTE



RESULT SUMMARY

READ (QUERY)

Avg. Latency : 0.15193 secs
Avg. Throughput : 399.98806 tpm

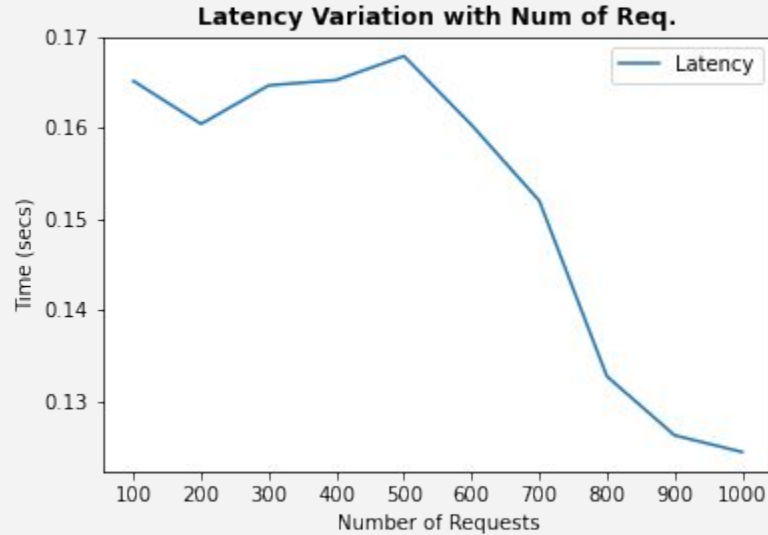
TRANSACTION (INVOKE)

Avg. Latency : 0.22128 secs
Avg. Throughput : 271.534162 tpm

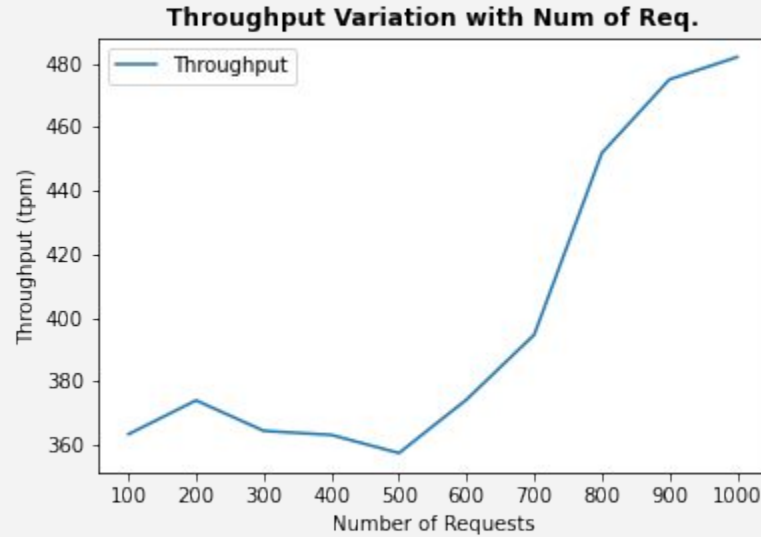
LOAD TESTING

400 Concurrent Requests
(On a Single Node Server)

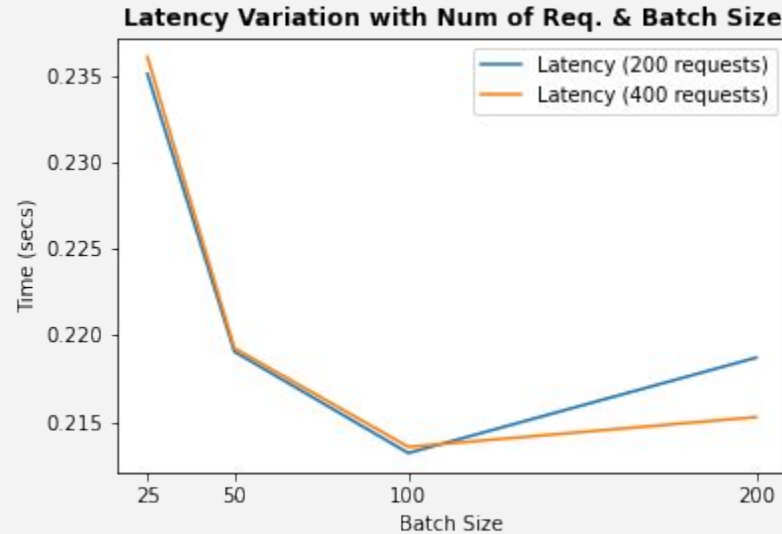
READ (QUERY) LATENCY



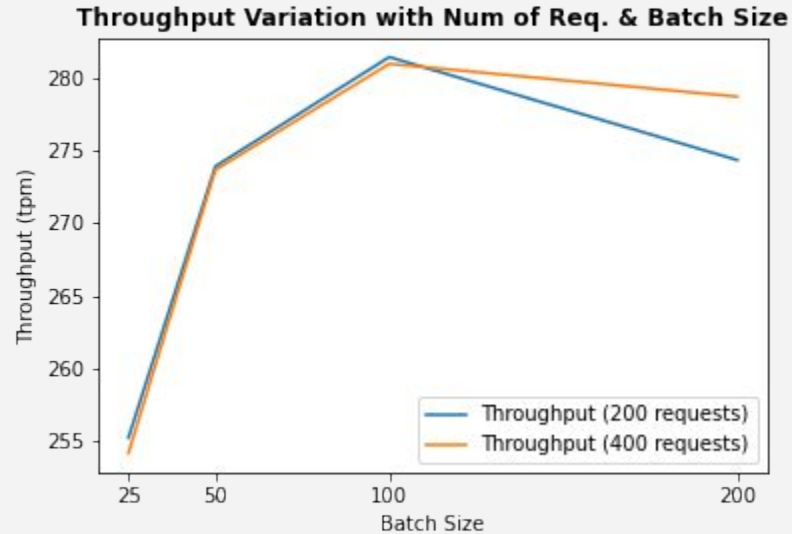
READ (QUERY) THROUGHPUT



TRANSACTION (INVOKE) LATENCY



TRANSACTION (INVOKE) THROUGHPUT





06

CONCLUSION

CONCLUSION

In this project we have designed a Permissioned Blockchain System which is decentralized for conducting Elections digitally in a fair, open, and independently verifiable manner. An eligible user can register themselves with the Blockchain system to get a X.509 Identity using which they can vote once in the Elections. The Blockchain was designed using Hyperledger Fabric with a Single Channel. The E-voting System was designed using 2 Organizations - Org1 & Org2 each of them having 2 Peers; Also, there were 3 Orderers in the System which used RAFT Ordering Algorithm. We implemented the Smart Contracts (Chaincode) which make sure that the User can only vote once completely Anonymously and only when the admin permits users to vote by controlling the Phase. We developed several APIs using NodeJS and Node SDK to allow clients to interact with the blockchain. We developed a Web Application using ReactJS using which a User can vote from any place and at any time within the Voting Phase to make his/her vote. We were able to achieve 400 concurrent Transactions using the Node SDK. We performed Load Testing & measured parameters like Latency & Throughput. The average Transaction Latency we obtained was 0.22128 s and the average Transaction Throughput was 271.534162 transactions per minute. The average Read Latency we obtained was 0.15193 s and the average Read Throughput was 399.98806 transactions per minute.



07

**FUTURE
WORK**

FUTURE WORK

Our current implementation is a Proof of Concept for conducting Election process Digitally where we have fulfilled all the criteria as mentioned in Article 324 of the Constitution. We have designed our system with certain assumptions which have to be taken care of in a production level network. The number of organizations in the network will depend on the number Wards in the country. Also, the number of Peers per Organization need to increase which further increases the performance of the system. Currently we are assuming that the voter's eligibility is verified against a Government Database which needs to be implemented. Also, a user can register himself with any organization and can vote for any candidate but in a real-world scenario the voter can only register using an organization in his ward and can only vote for candidates present in his ward. Thus, these things can be added to the proposed technique to further enhance the performance of the system which could be used potentially to conduct Elections globally.



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