Hope Foundation's
International institute of Information Technology
Department of Information Technology

Project Review 2

Enhancing Traditional Voting Systems Using Hyperledger Technology

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Outline

- Problem statement
- Introduction
- Literature Survey/Related work
- Motivation, objectives, and scope of the project
- Resource requirement
- System overview- Proposed system, Architecture and initial phase of design (DFD) and expected outcomes
- References

Problem Statement

Conducting elections has been a very complex process right from the start to declaring the results.

Our web application will try to fill in the enormous gap between the voter and candidate and make it a very smooth process for voters to cast their votes and for the election committee to declare the results with minimum possibility of errors.

Introduction

- Even after advancements in various fields of technology, some processes never evolved with time.
- Conducting elections is one such process that has not reached its full potential.
- From registration to casting the vote, it is a tedious process for both the voter and the authorities.
- With the advent of web3 and blockchain technology, people are finally taking notice of its countless possibilities.
- Our project aims to fill this “lack of technology” with blockchain technology.
- With our solution, casting a vote, managing election process while keeping in mind the privacy and security of the system will be a walk in the park
- Entire process will be recorded in blockchain which will provide outmost privacy and ensure votes are tamperproof.

Literature Survey/Related work

Year and Title	Algorithm	Result	Limitations /Drawbacks
Muhammad Shoaid Farooq, Usman Iftikhar, Adel Khelifi (2022)	Uses one-time password for authentication. One Voting coin (VC) allotted to each voter	Ensures voter‟s anonymity and provides secure authentication.	Dependent largely on mobile technology.
Houpeng Hu, Jiaxiang Ou, Bin Qian, Yi Luo,Peilin He, Mi Zhou, Zerui Chen	Uses ECC algorithm on Ethereum network	A novel blockchain-based voting scheme for IoE system	Not suitable for large scale voting and parallel processing not supported.
S K Geetha (2021)	Simple and standard implementation of blockchain technology for e voting	Reduced operational cost. Increased security of voting process.	Suitable only for online voting. Using a centralized server creates a single point of attack against voting data.
Mustofa Kamila, Po Abas Sunaryab, Untung Rahardjab, Nuke Puji Lestari Santosob, Muhammad Iqbalb	Using blockchain and SUS score analysis	prevent the spread of the Covid19 pandemic at a low cost by high system security and accuracy voting system	Blockchain public network to process every vote transaction that takes 10 to 20 seconds

Literature Survey/Related work:

Year and Title	Algorithm	Result	Limitations /Drawbacks
Polyas. Polyas. 2015. Available online: https://www.polyas.co	ECC	Online-Voting.High security and data protection	Suffers in scalability
Luxoft's E-Voting Platform Enables First Consultative Vote based on Blockchain in Switzerland	ECC/ElGamal	The first customized blockchain electronic voting system used by a significant industry.	Scalability and latency issues
A Security Analysis of Voatz, the First Internet Voting Application Used in U.S. Federal Elections	AES/GCM	A smartphone-based voting system on blockchain.	Requires biometric data and suitable for small scale voting. Vulnerable to Blockchain Ballots
Follow My Vote : The Secure Mobile Voting Platform Of The Future	ECC	a secure online voting platform with polling box audit ability	Not scalable

Aim

- A fully electronic voting system.
- Improvement in the current system.
- A tamperproof encrypted voting system.
- Smooth voting process for voters.
- Ease management of the election process.
- Proper and full use of new technology like blockchain to store the votes.
- Easy and Convenient UI experience for the voter to cast his/her vote.

Objectives

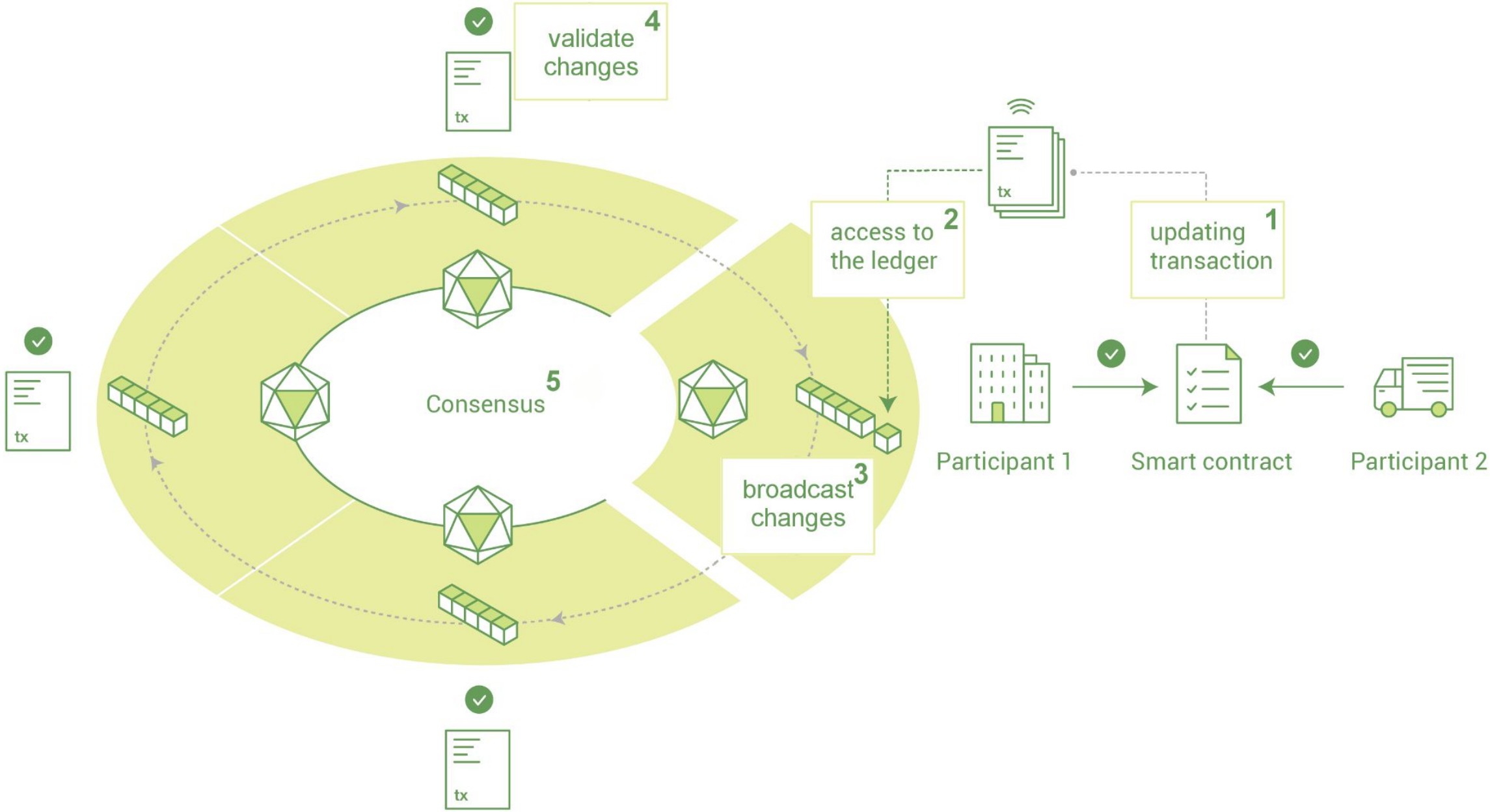
- Minimising the cost of conducting elections.
- Building trust and providing secure, private, convenient voting experience.
- Increasing voter participation.

Scope

- Voting in School and College Elections.
- General Elections at Organization Level.
- Voting for Housing Societies for local society post.
- It can also be used at state or national level with proper implementation.

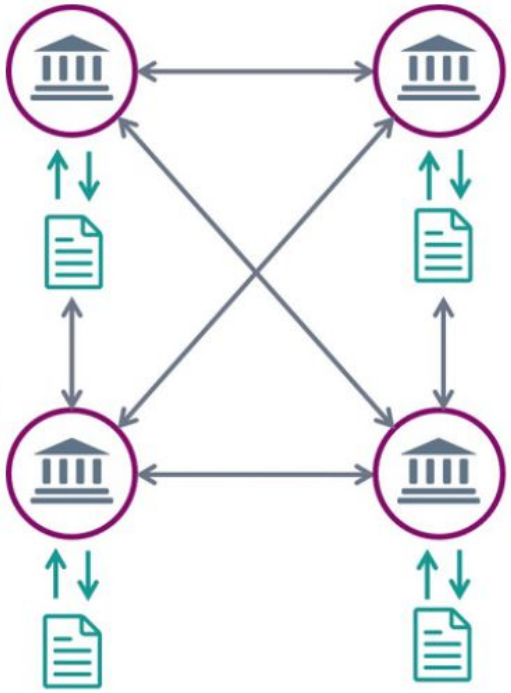
Resource Requirement

System Overview

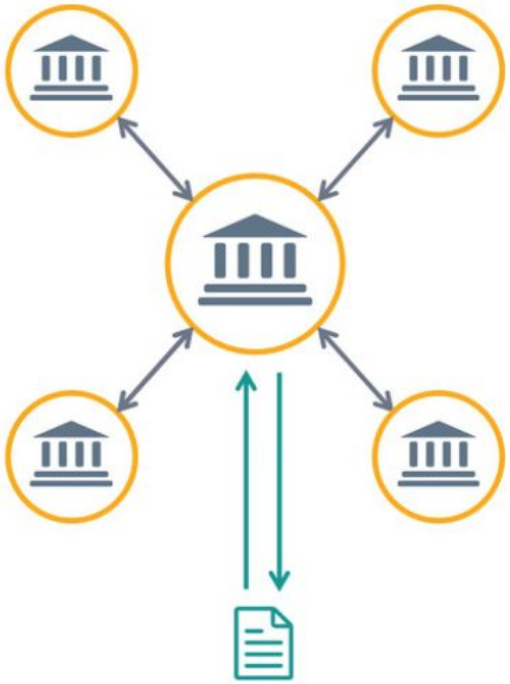

validate changes 4
tx
access to the ledger 2
tx
updating transaction 1
Consensus 5
broadcast changes 3
tx
tx
Participant 1
Smart contract
Participant 2

What is Hyperledger Fabric?

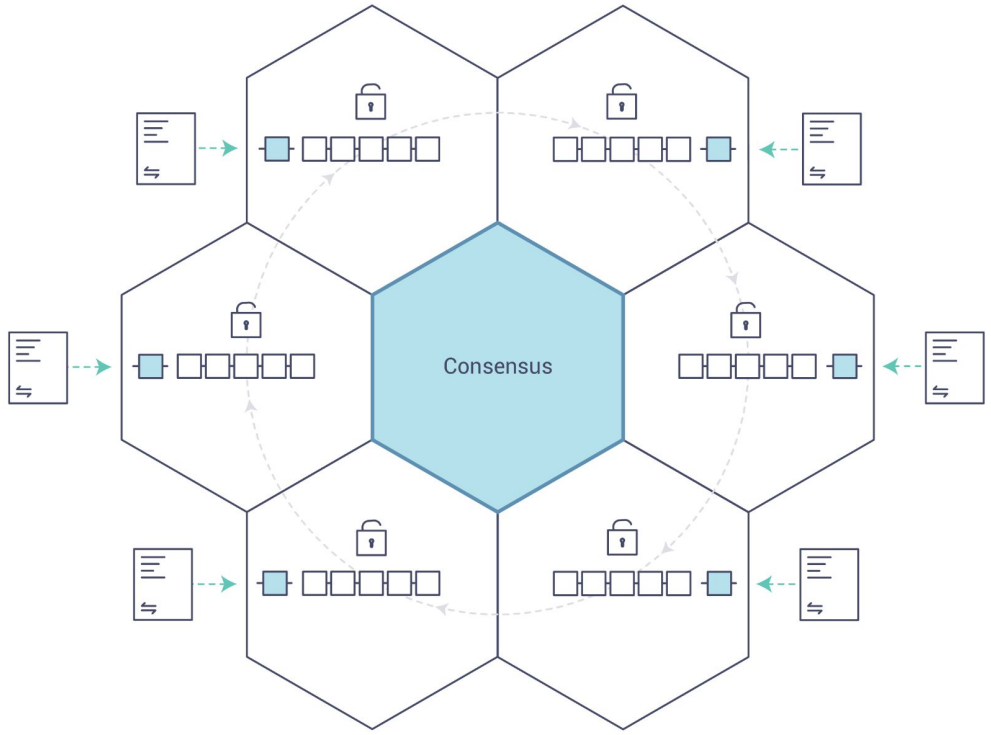
Ledger Architecture



Distributed Ledger Technology (DLT)



Blockchain (Centralised Ledger)



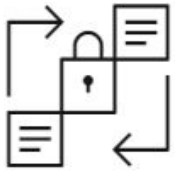
What is Consensus?

A consensus mechanism is a system that is used to validate the authenticity of transactions and maintain the security of the underlying blockchain.

How Smart Contract Works?

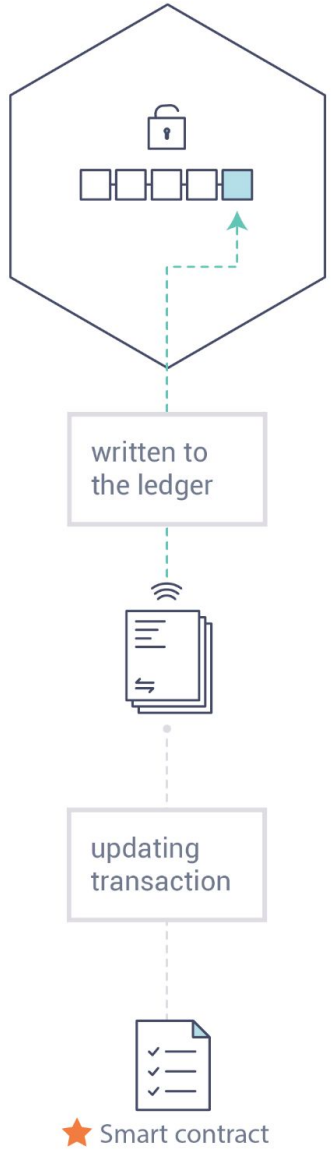
Security

Trust and transparency

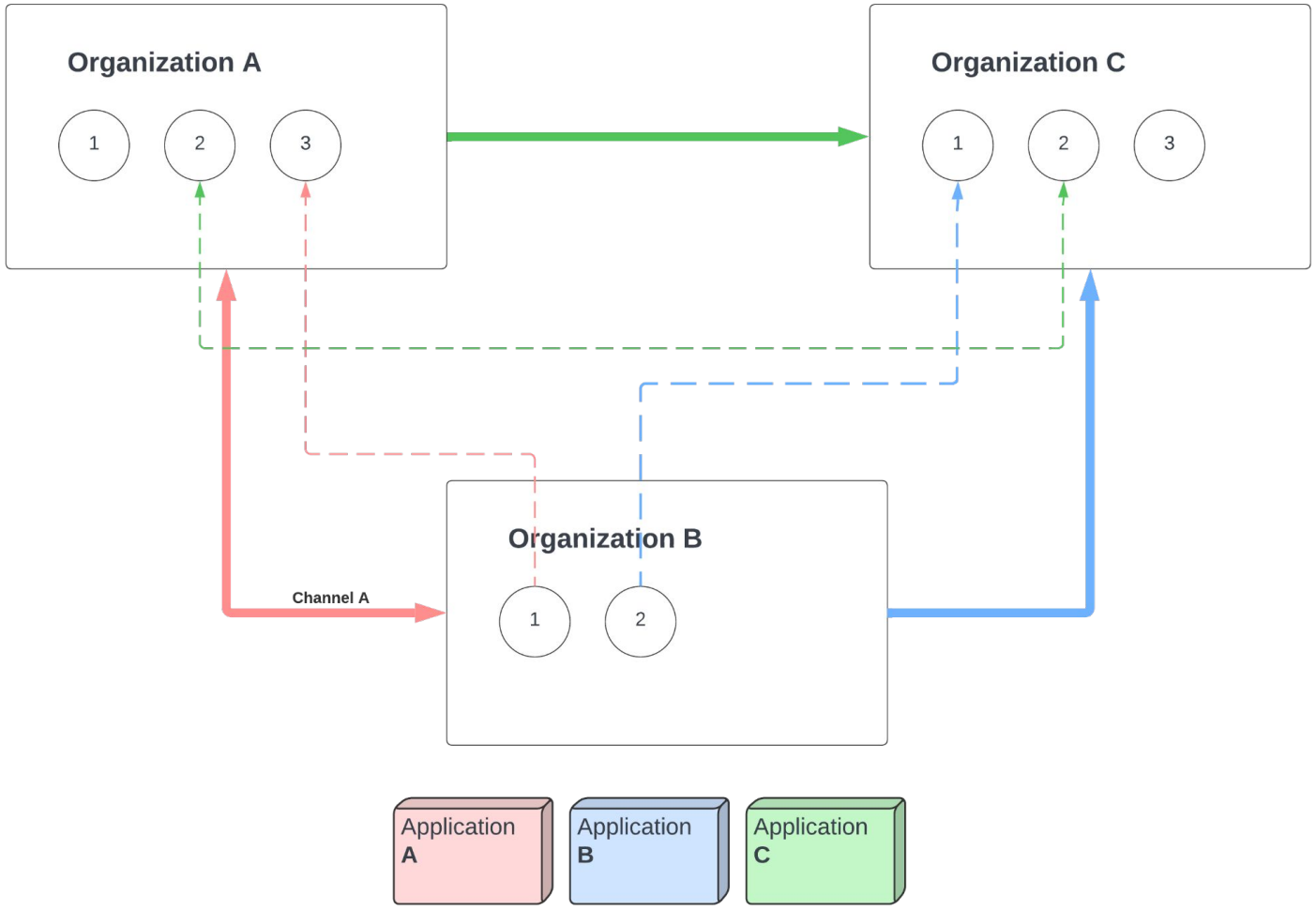


Cost Saving

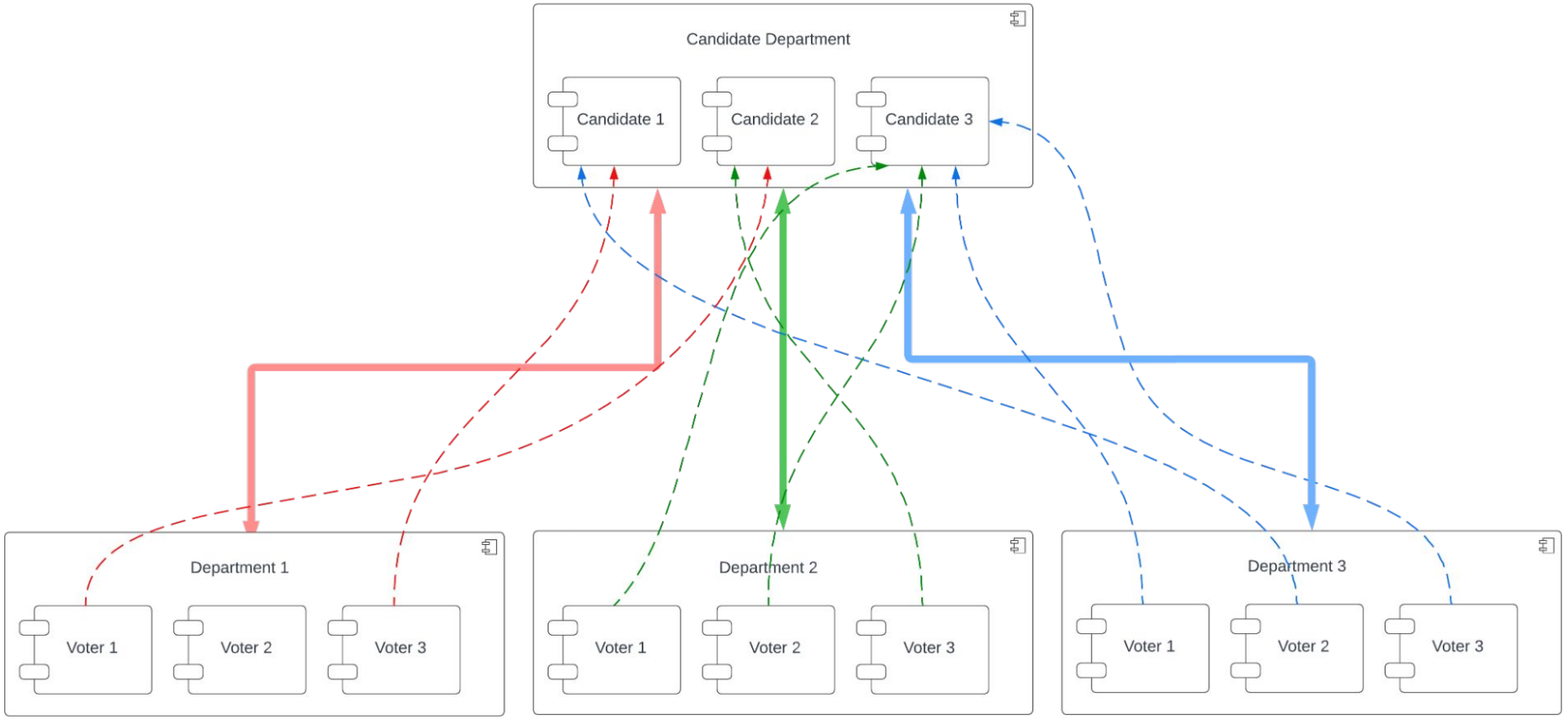
Speed, efficiency and accuracy



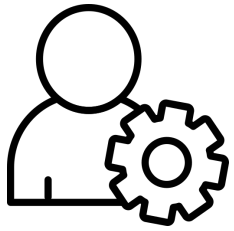
Hyperledger Fabric Network



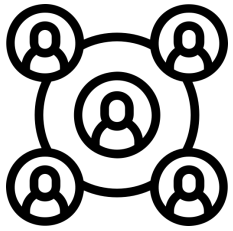
Our Proposed System



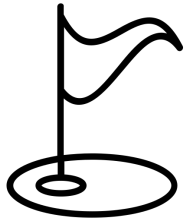
Stakeholders



Administrator



Moderator

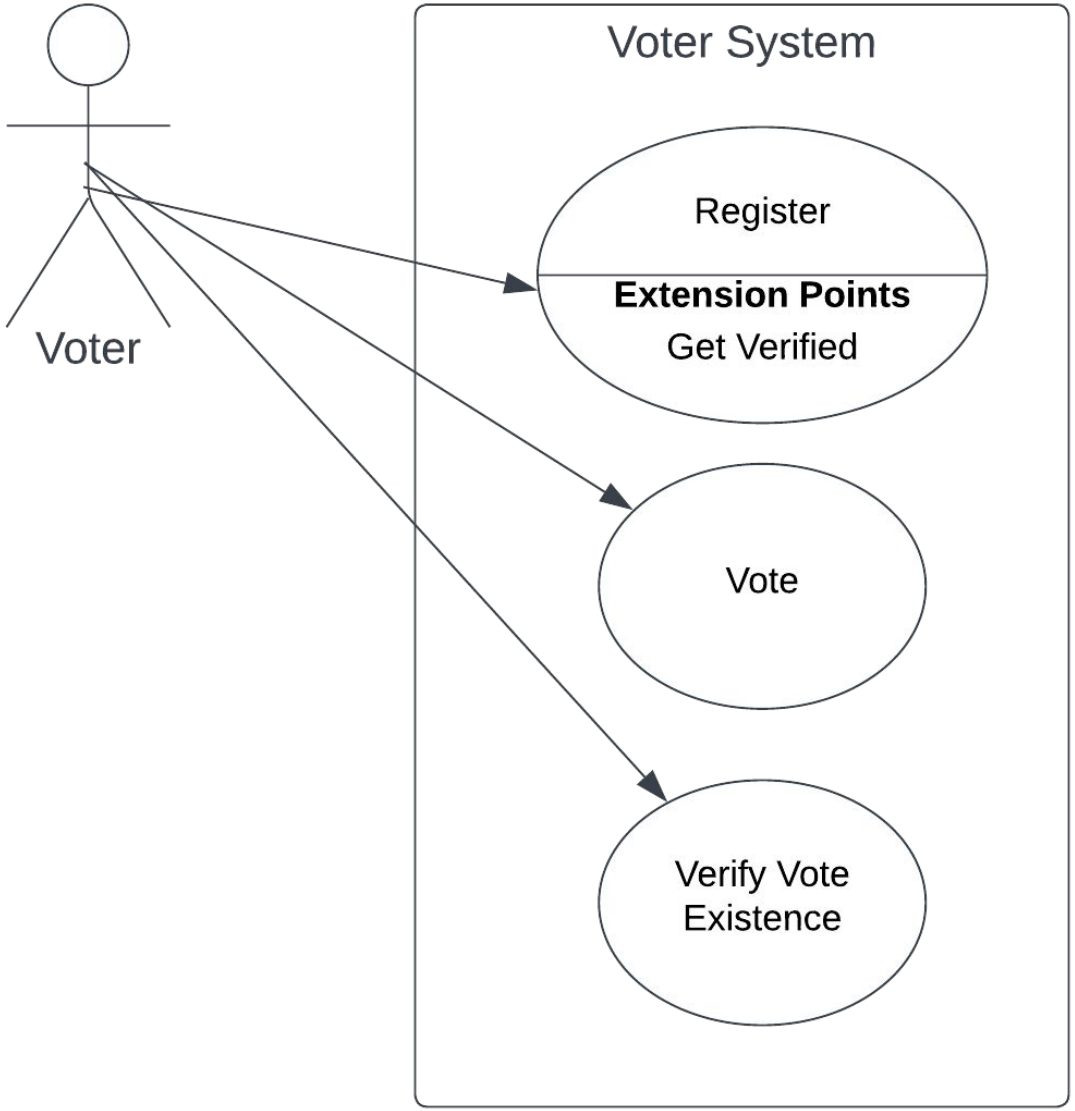


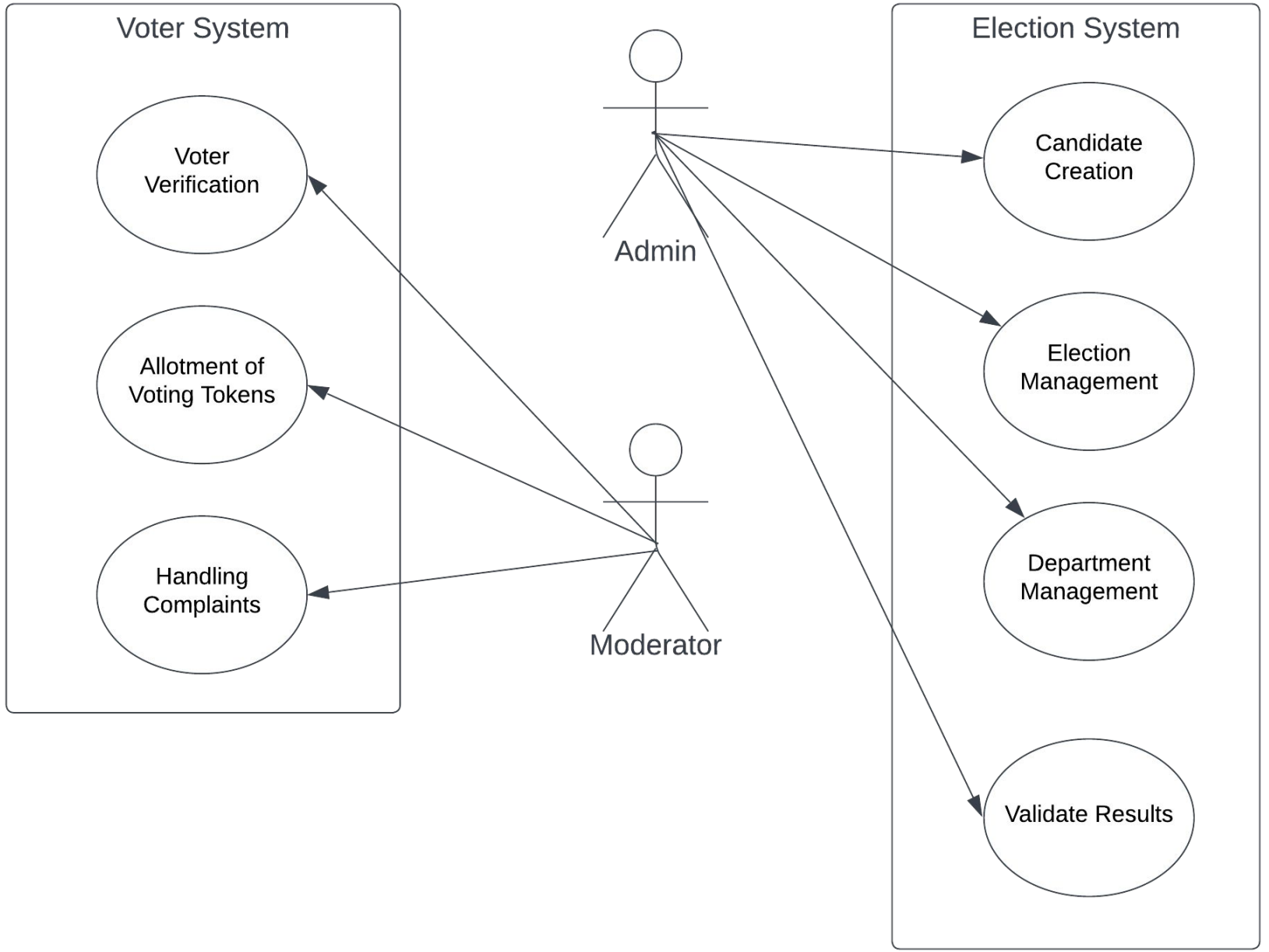
Candidate

Voter

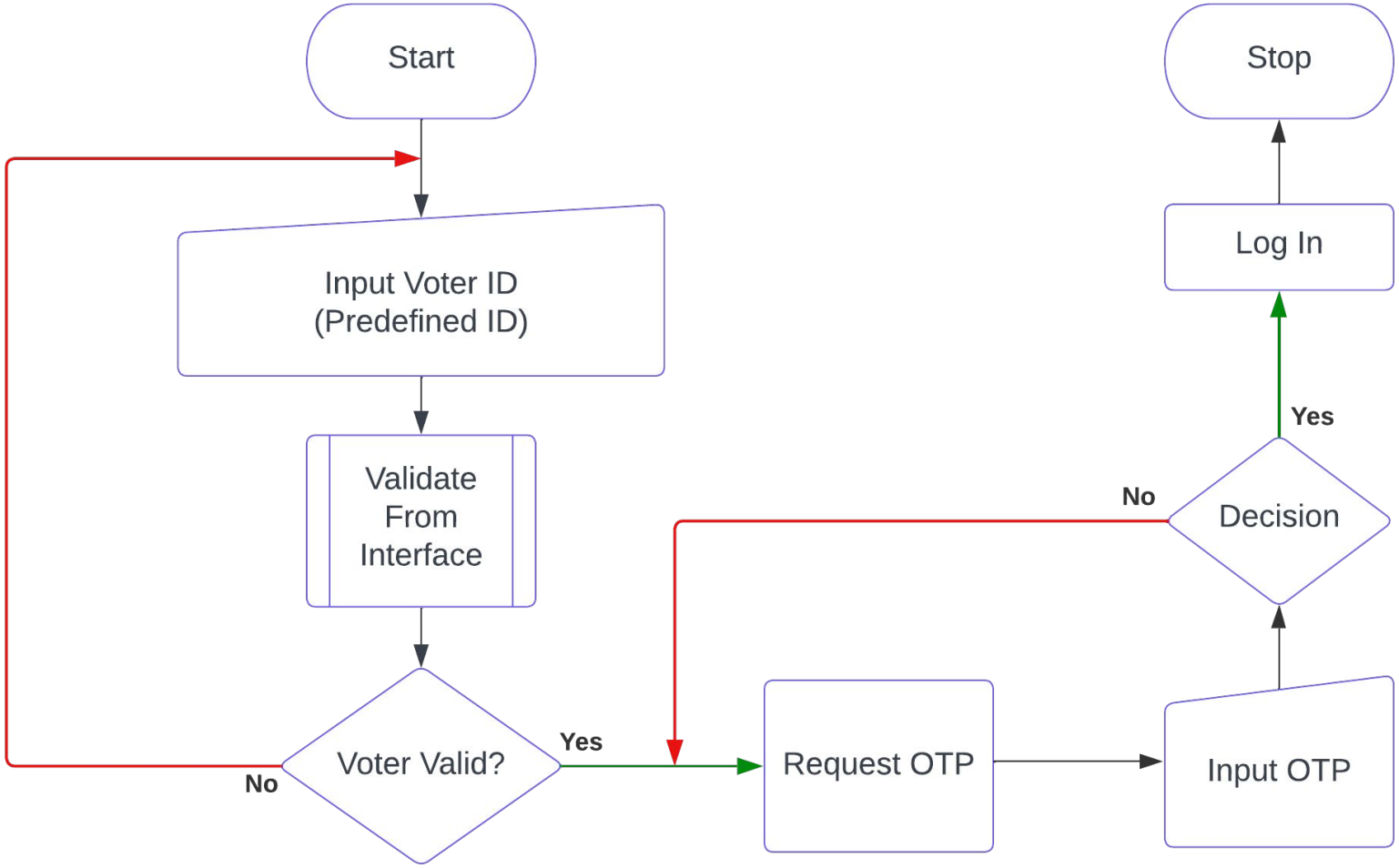
What does Voter do?

- Main Stakeholder
- Perform Voting
- Verify Votes

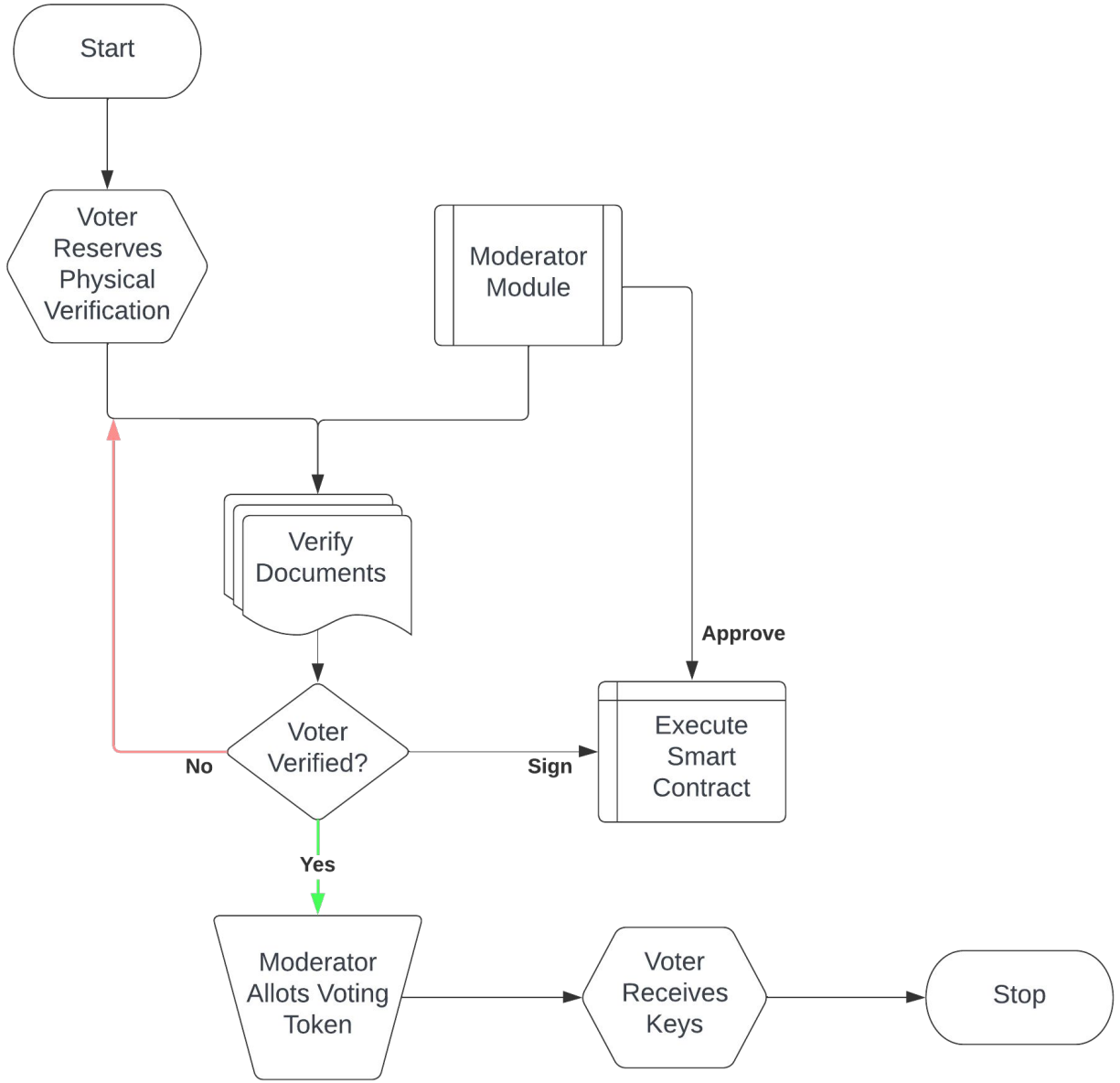



Voter System
Voter Verification
Allotment of Voting Tokens
Handling Complaints
Admin
Moderator
Election System
Candidate Creation
Election Management
Department Management
Validate Results

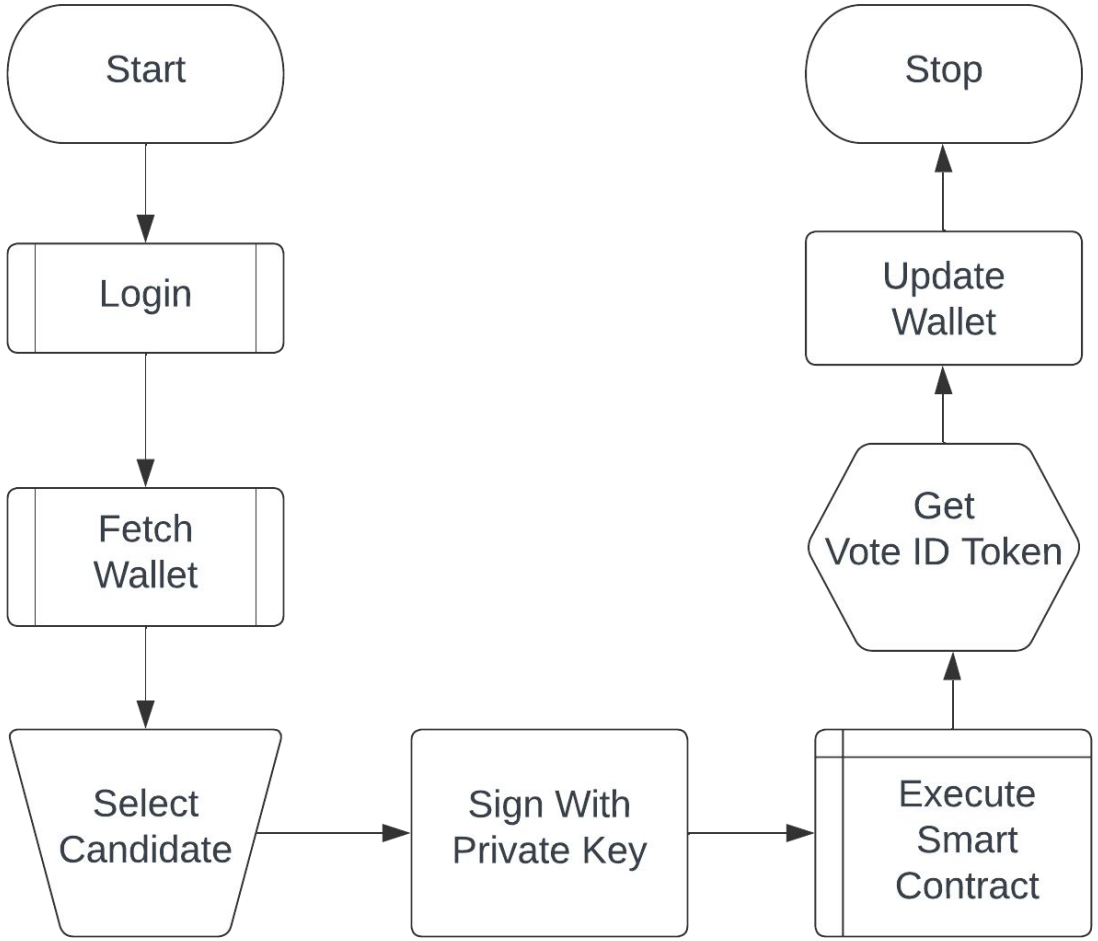
Voter Login


Start
Input Voter ID
(Predefined ID)
Validate
From
Interface
Voter Valid?
No
Yes
Request OTP
Input OTP
Decision
No
Yes
Log In
Stop

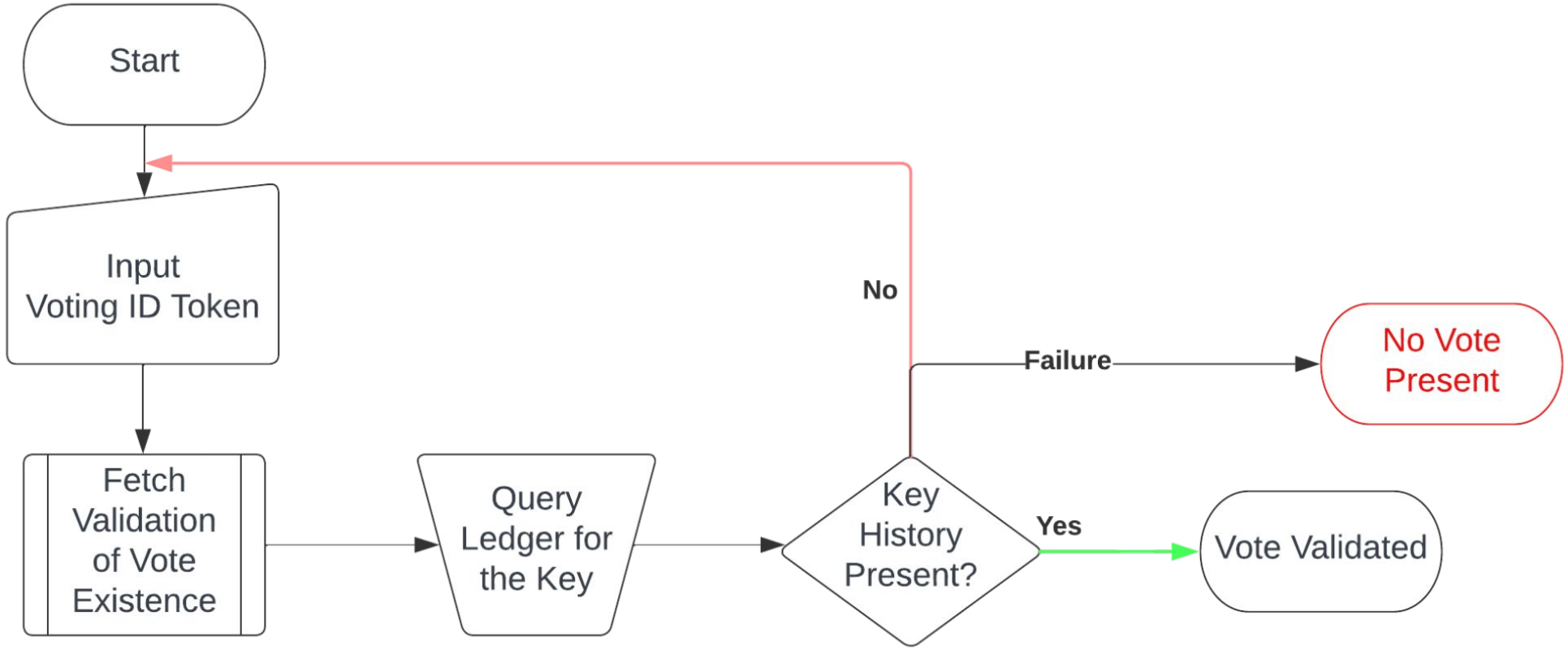
Voter Verification



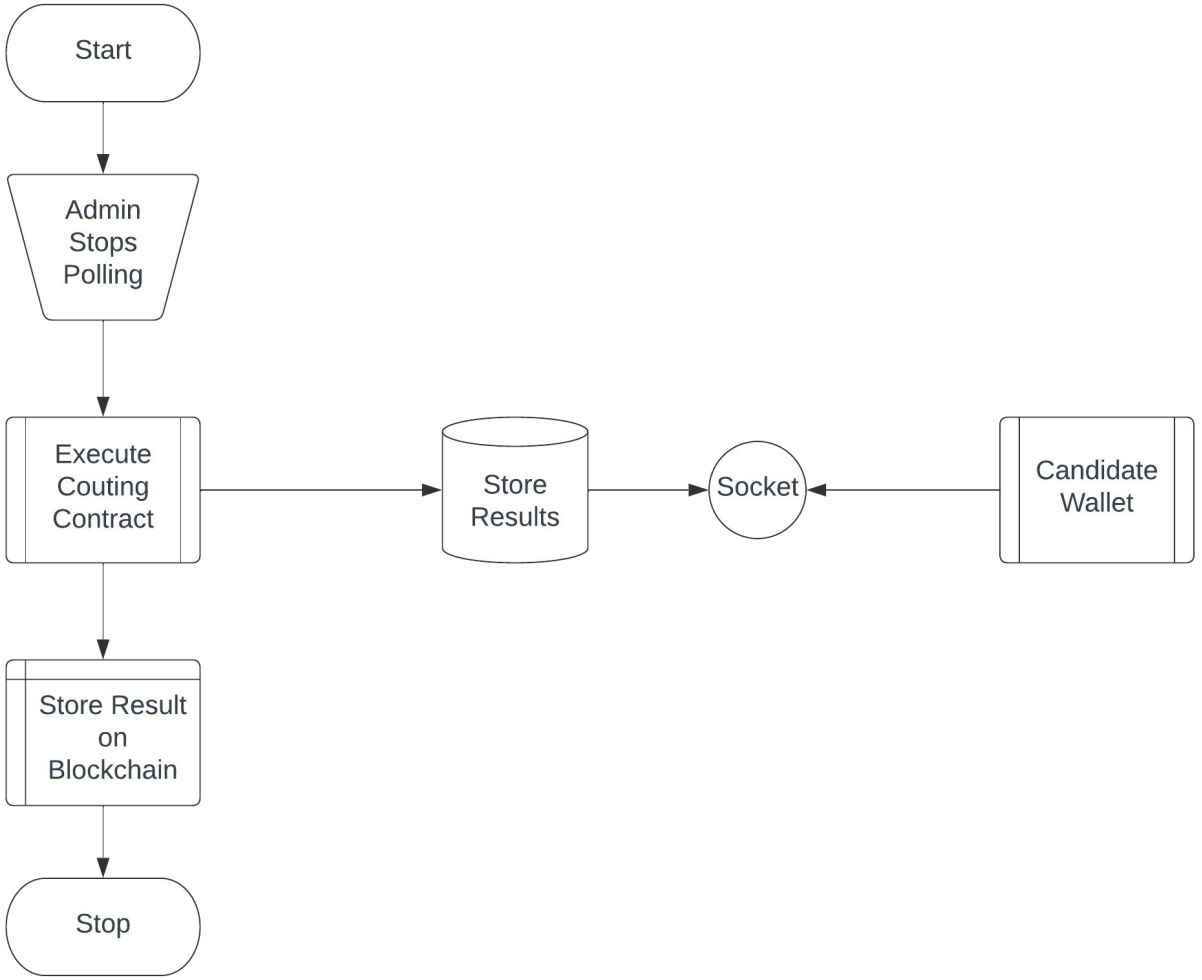
Voting process



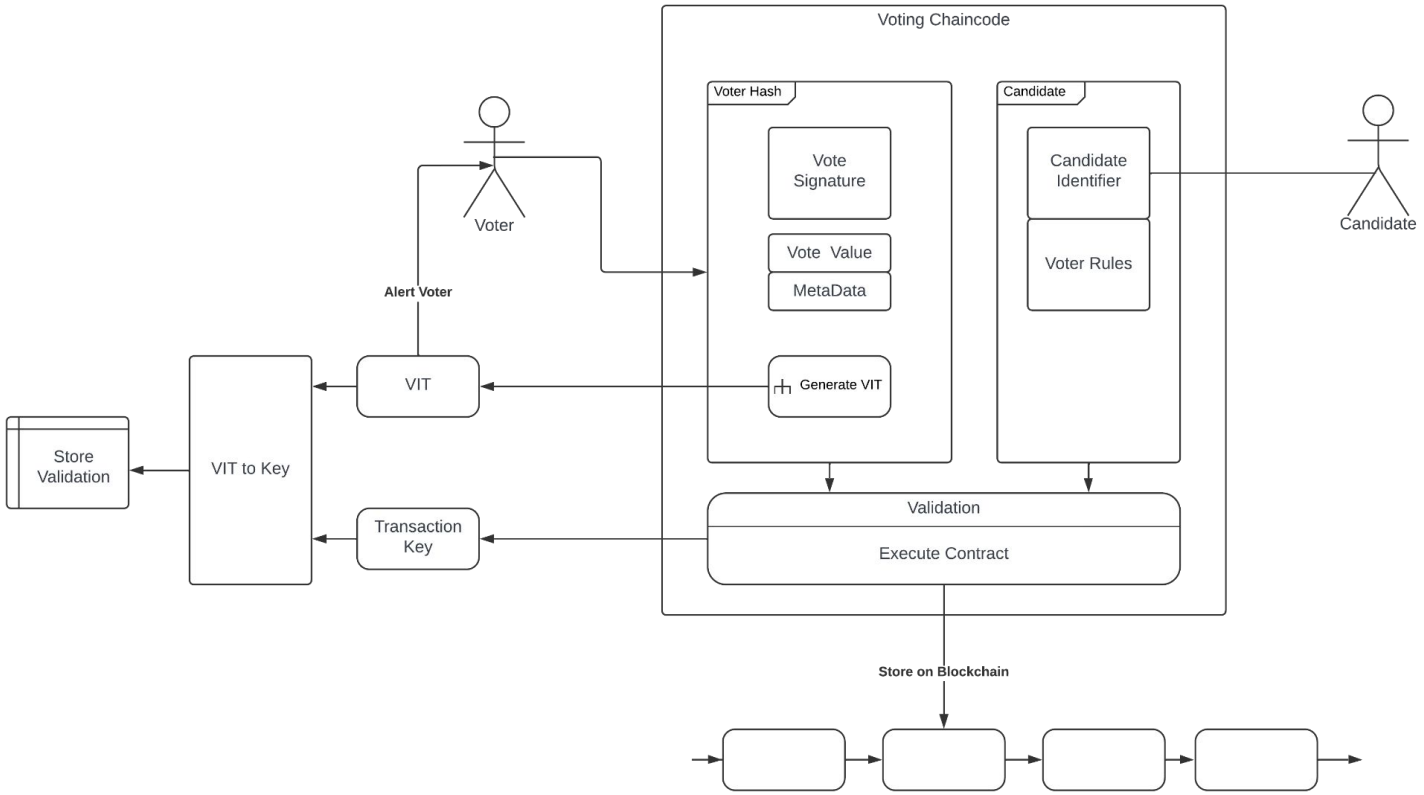
Vote Validation

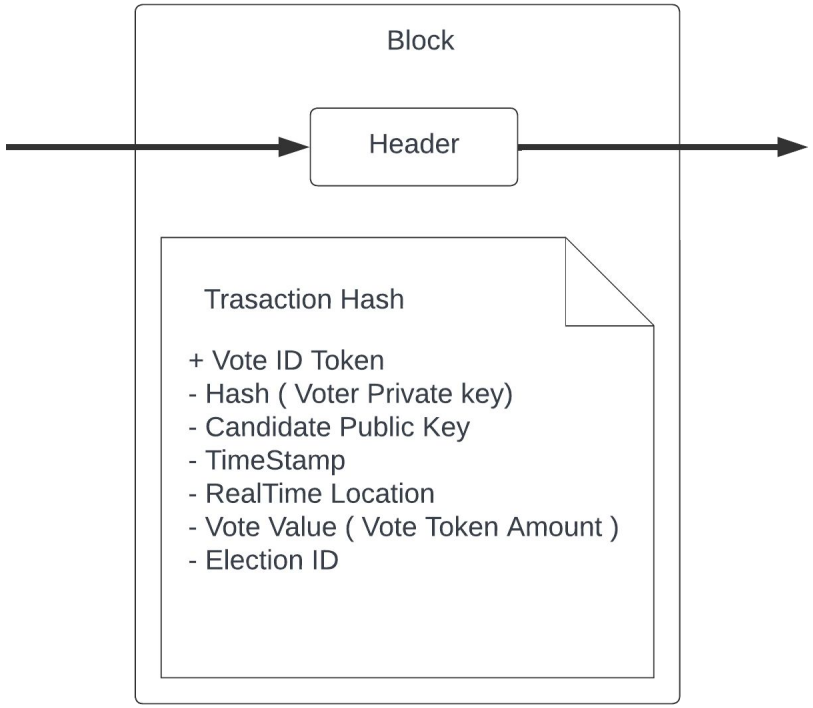


Result Calculation

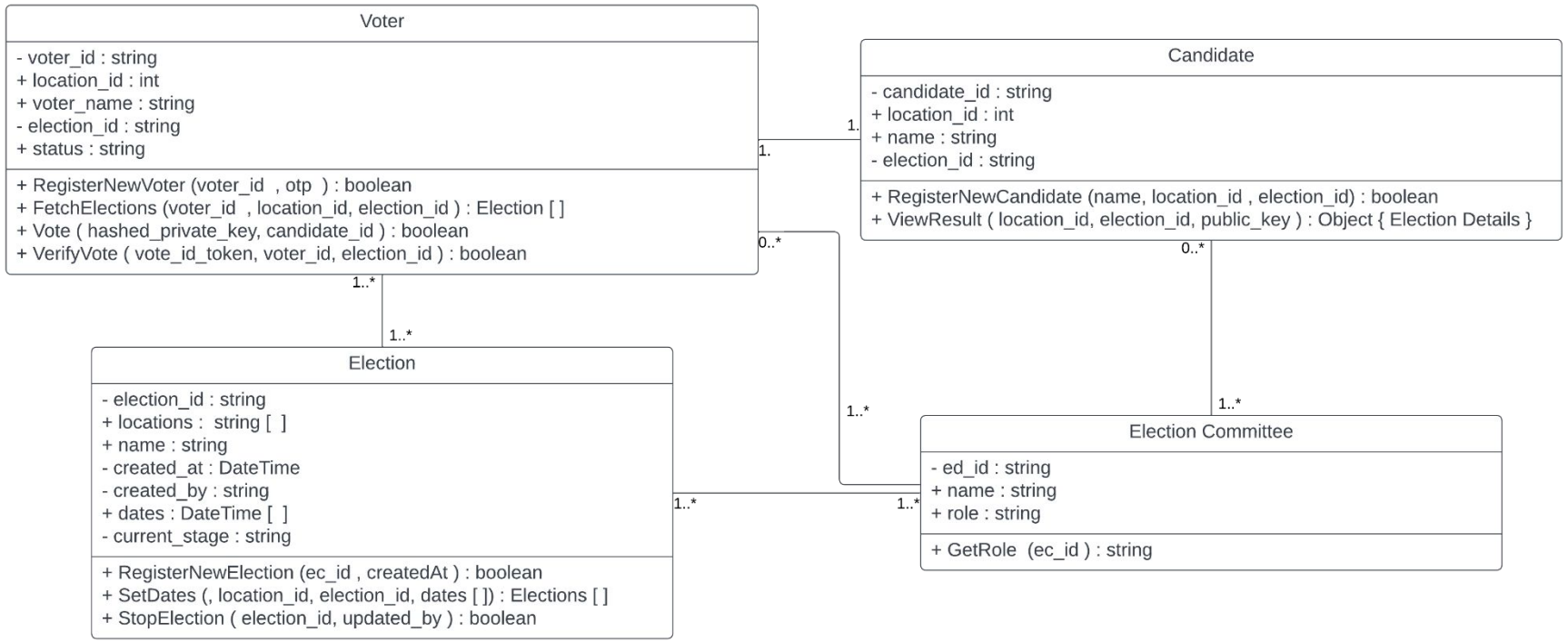


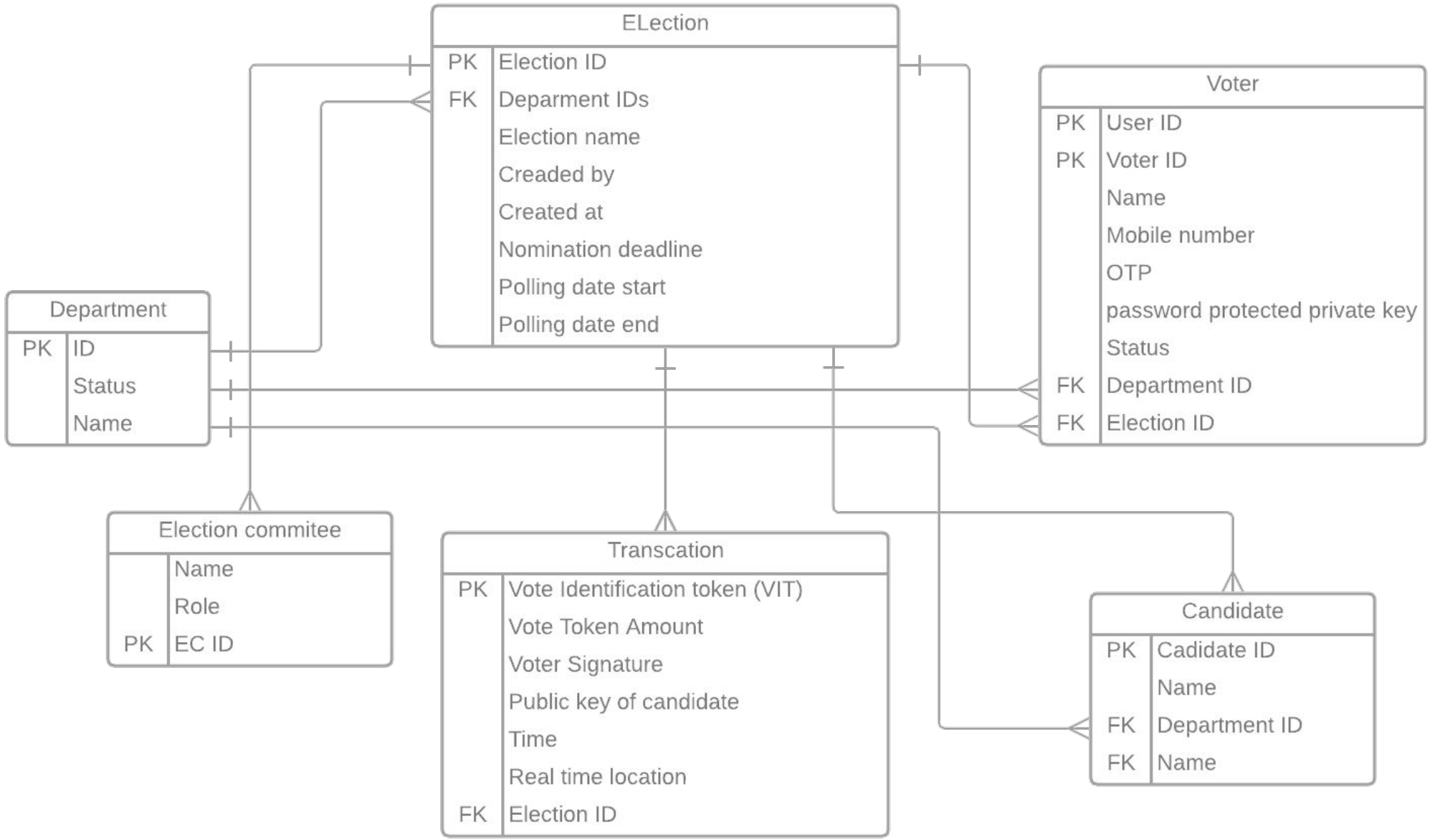
Transaction Structure

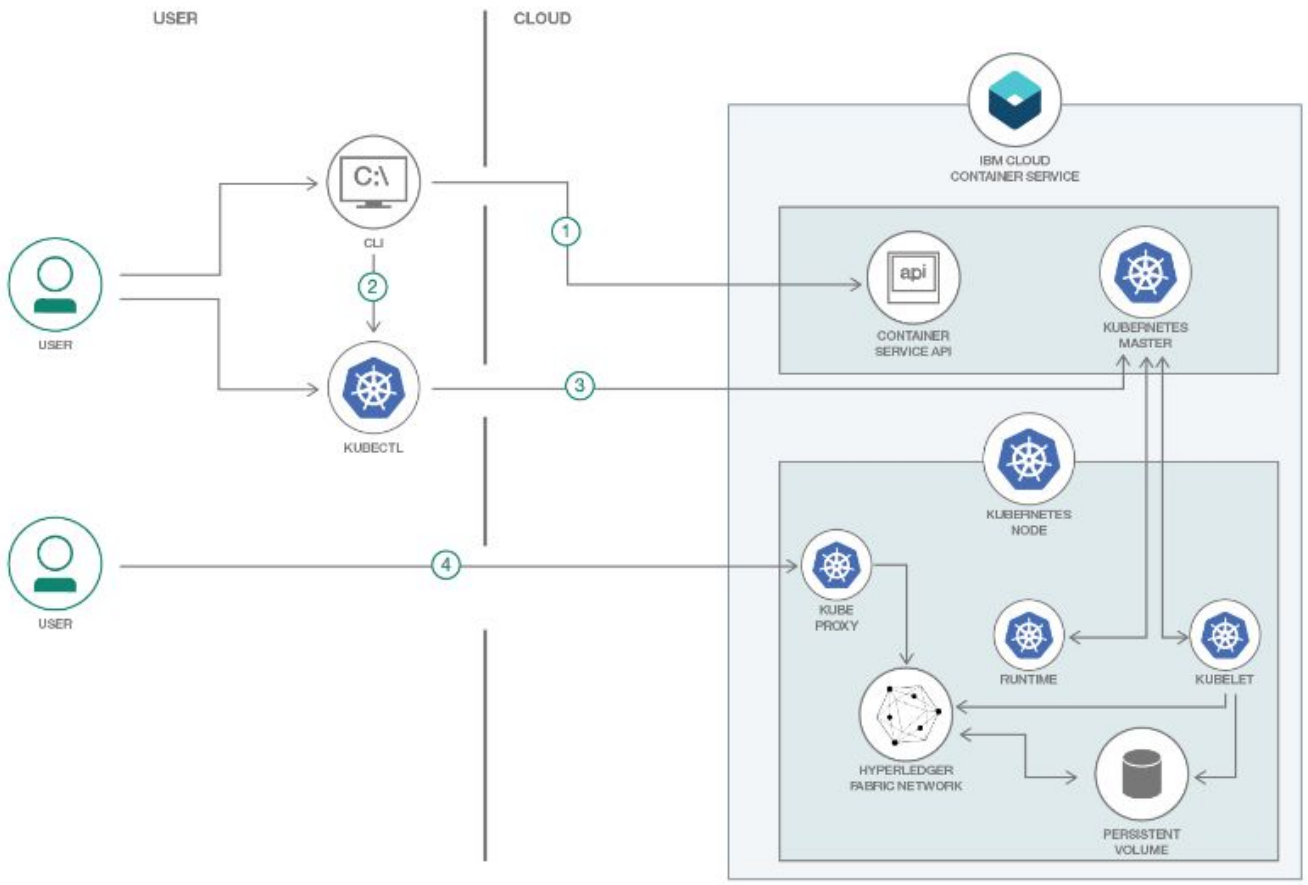




System Classes




ELection
PK Election ID
FK Deparment IDs
Election name
Creaded by
Created at
Nomination deadline
Polling date start
Polling date end
Voter
PK User ID
PK Voter ID
Name
Mobile number
OTP
password protected private key
Status
FK Department ID
FK Election ID
Department
PK ID
Status
Name
Election commitee
Name
Role
PK EC ID
Transcation
PK Vote Identification token (VIT)
Vote Token Amount
Voter Signature
Public key of candidate
Time
Real time location
FK Election ID
Candidate
PK Cadidate ID
Name
FK Department ID
FK Name



Hosting Blockchain

- AWS Managed Blockchain
- Google Kubernetes Cluster
- IBM Native Solution
- Private Docker Containers

Advantages and Limitations

Advantages	Limitations
• Based on highly scalable and secure Hyperledger Fabric. • Support for parallel processing and upto 3500 transactions/sec. • Low latency operation. • Highly Cost effective compared to traditional approach	• High Peer Node side, will consume too much resources for a single voter node, increasing costs. • Limited Connectivity. • Chances of Vote misuse if devices access lost. (mobile devices can be impersonated)

Financial Report

Expenses Analysis for election mechanism in India

- Central election happened in 2019, costed at a total of approximately whooping Rs 50,000 crore ($ 7 Billion).
- State election cost around 1000 crore each state, approximately $ 135 million .
- Maharashtra state election costed around 913 crore ($107 million).
- Even when the states are in debt to central government, these expenses are skyrocketing.

Approx spending on traditional voting:

- Transportation: 2.62 billion rupees
- General costs related with EVMs.
- Advertisement: 26 billion rupees
- Dummy candidates catching: 120 million rupees
- Manpower : 20 billion rupees

AWS

You are charged for network membership, peer nodes, peer node storage, data written to the network, and data transfer. The costs associated with shared network components are included in your hourly network membership rate, which is billed per second.
Amazon Managed Blockchain for Hyperledger Fabric pricing:

Membership rate : $ 0.55 per hour
(The membership rate includes a Hyperledger Fabric certificate authority (CA) and other shared network costs)

On Demand Peer Node Pricing : Bc.t3.small: $ 0.034 per hour, Bc.t3.medium: $ 0.067 per hour
(Cost of blockchain peer nodes created)

Peer node storage : $0.10 per GB-month

Data written : $0.10 per GB
(The amount of data you written to the Hyperledger Fabric network.)

Project Plan 2.0

Implementation for college campuses

- School Club Voting
- Class Representative elections
- Elective Selection
- Any other school votes or elections

Roles of Voting System

Administrator

Head of the Department

Candidate

Student candidates

Voters

Students

Tech Stack

Frontend

Static Website Generation
(Least Dynamic Content)

- Next JS
- Tailwind CSS

Backend

Hyperledger Fabric Provides
Node JS SDK for interfacing.

- Node JS
- Express JS
- HL Fabric
- SQL ,MongoD

Hosting

Deploy containerized nodes

- Docker
- AWS (managed blockchain)

Modules

3
Frontend

- Voter UI
- Candidate UI
- Committee UI

3
Backend

- Election
- Voter
- Voting

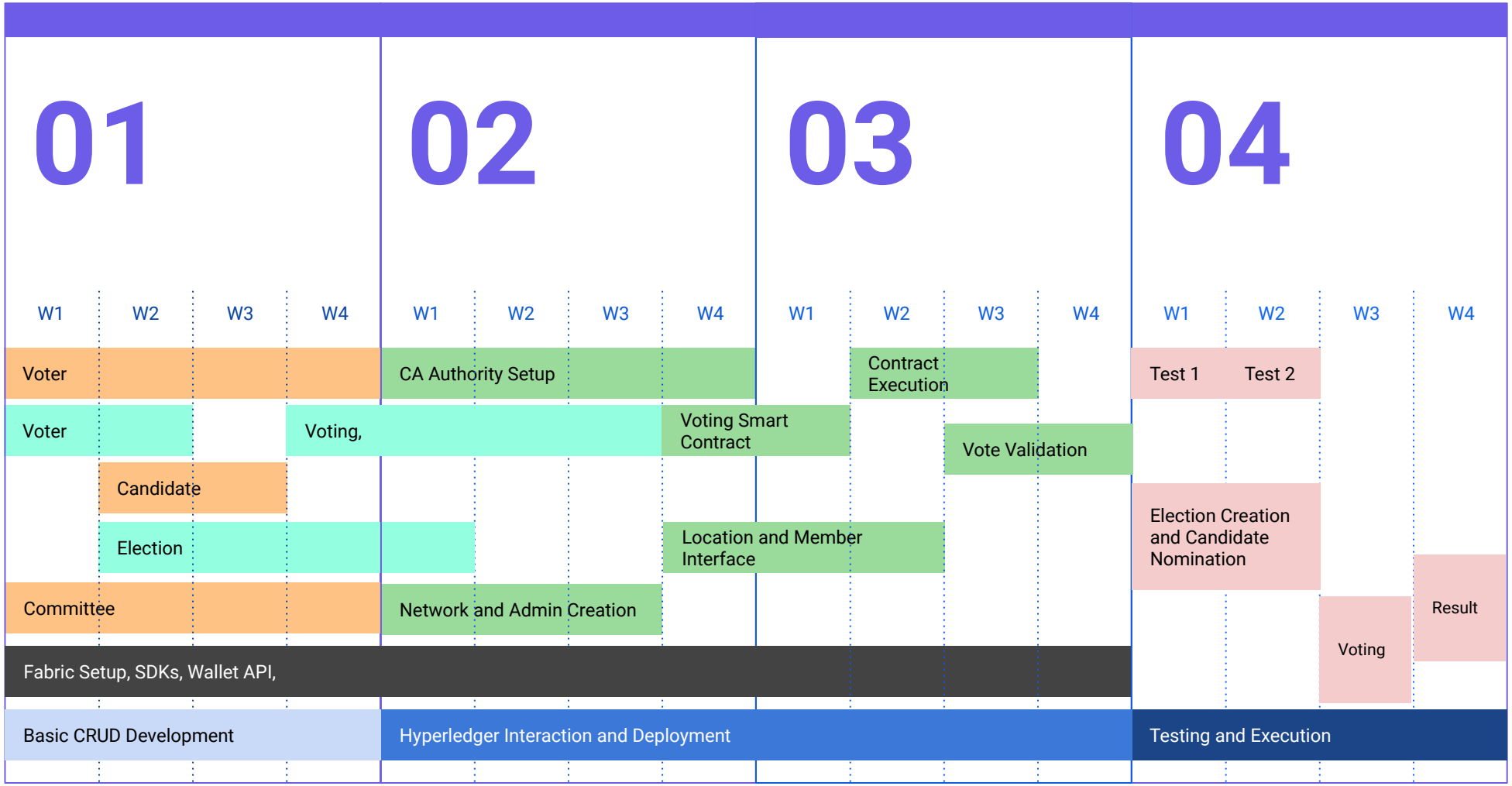
6
Interfaces

- Network
- CA
- Organisation
- Node
- Smart Contract
- Vote Verification

2
Tests

- Test 1
- Test 2
- Live Run

Implementation Phases



Back End APIS

Frontend

Hyperledger

Blockchain Connection

Testing and College Elections

Outcomes

- Conduction of election based on hyperledger technology at school or college level.
- Transparent, trusted and end to end encrypted tamperproof e-voting system.
- Convenient voting process for voters, ease of management of election process.
- Proper use of new technologies like blockchain and hyperledger.

Conclusion

- Blockchain technology is relatively new, yet to explore its functionalities and capabilities.
- The purpose of this project is to build trust between all the parties involved in the voting process.
- Proposed system aims to minimize costs and logistics associated with traditional system.
- The proposed system is to implement a method to conduct voting on hyperledger fabric and take advantage of its characteristics like non-repudiation, immutability and tamper-proof nature.
- By providing convenience to the voter, the number of people voting may drastically increase.

References

- [1]Muhammad Shoaid Farooq, Usman Iftikhar, Adel Khelifi “A Framework to Make Voting System Transparent Using Blockchain Technology,” date of current version June 10, 2022. Digital Object Identifier 10.1109/ACCESS.2022.3180168
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