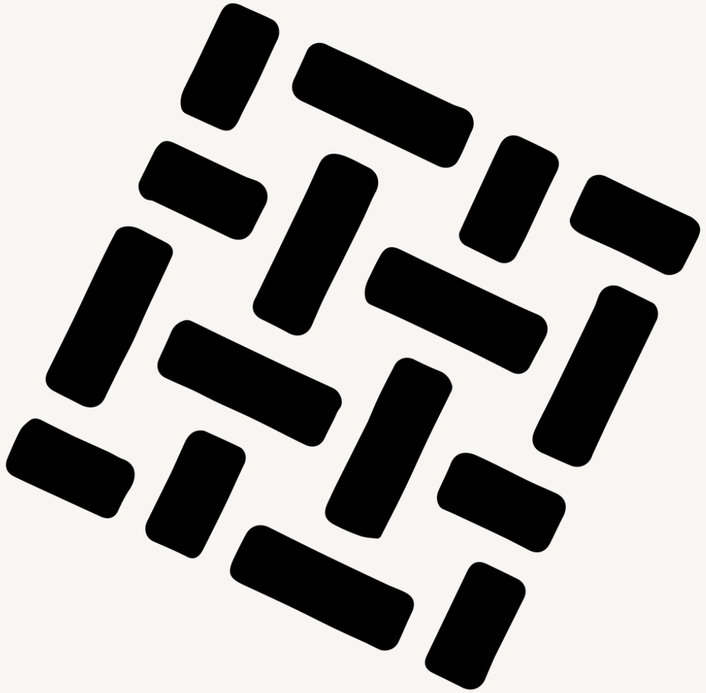
Hyperledger Fabric

A Modular Blockchain Framework



Agenda

1. Introduction to Hyperledger fabric
2. Membership & Blockchain Services
3. Distributed Ledger
4. Consensus Services
5. Peer2Peer Protocol
6. Channels
7. Transactions
8. Chaincode Services
9. Applications and its Model
10. References

What is Hyperledger Fabric

1. Fabric = Collection of components providing foundation layer that can be used to deliver a blockchain network.

2. Hyperledger Fabric = Permissioned Blockchain Framework, developed by IBM and Digital Assets, provides a modular, flexible architecture for building enterprise level blockchain

3. Depending on the requirement of the network, an appropriate Consensus Algorithm can be plugged into the network

4. Likewise, APIs, Access Controls etc can be plugged into network, using any language to develop Smart Contracts. (Docker based)

Hyperledger Fabric vs Other Blockchains

Feature	Hyperledger Fabric	Ethereum	Bitcoin
Network Type	Permissioned	Permissionless	Permissionless
Consensus	Pluggable	PoS	PoW
Smart Contracts	Chaincode	Solidity	Not supported
Privacy	High	Limited	Limited
Use Case	Enterprise solutions	Decentralized apps	Digital currency

Membership Services

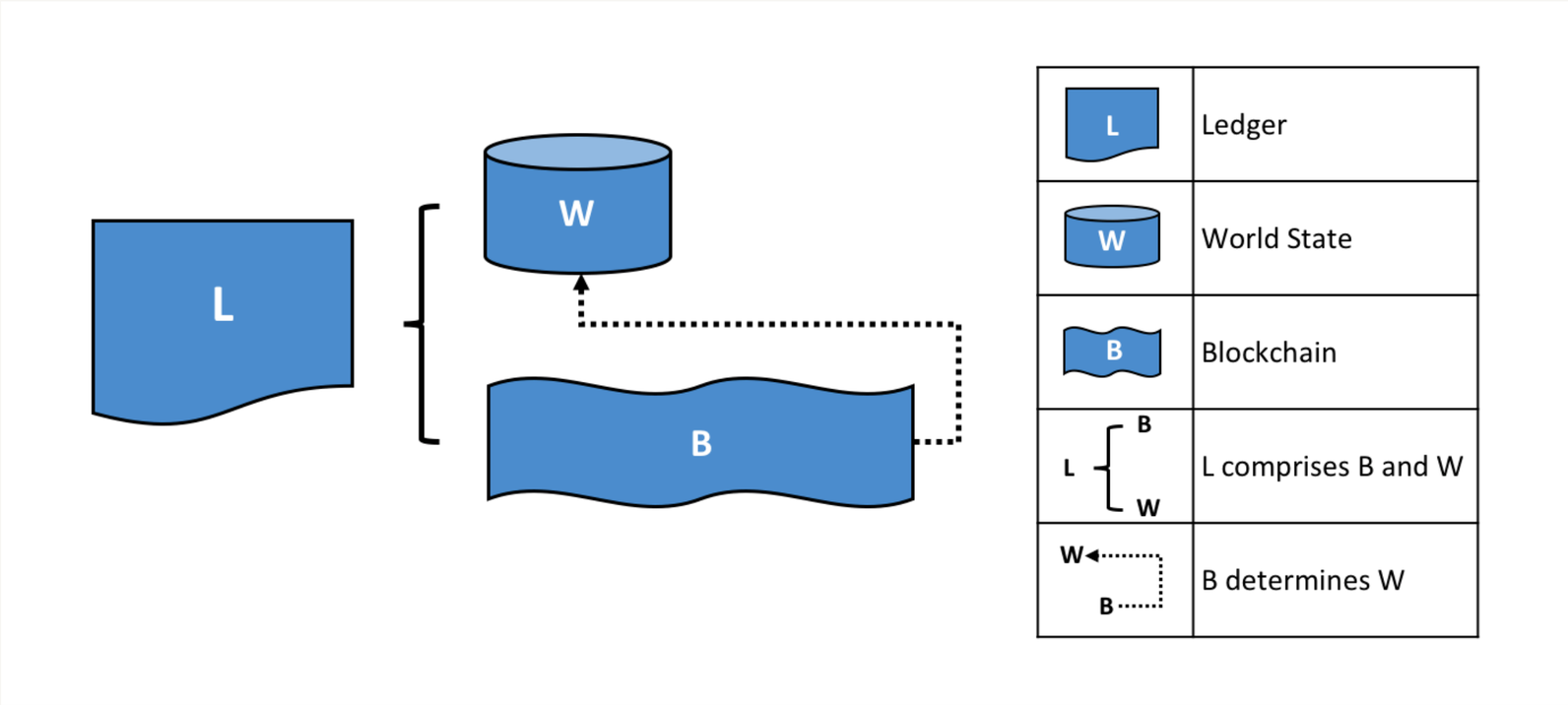
- Access control through functions like:
  1. User Identity Verification
  2. Registration
  3. Roles & Permissions
- Certificate Authority is used to provide Authorization Operations.
- Internal (Fabric CA) & External CA issues Enrollment Certificates.
- Fabric CA’s E-Certs are provided by Enrollment Certificate Authority (E-CA).
- Temporary Certs (T-Certs) can be provided for One-Time Transactions

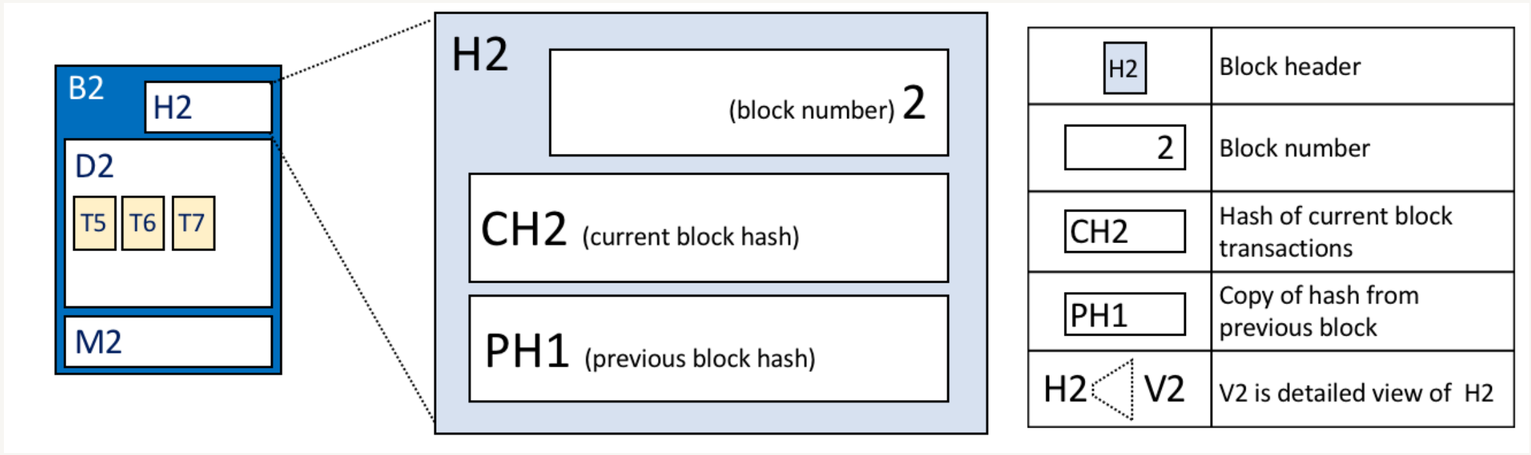
Blockchain Services

1. Distributed Ledger
2. Consensus Services
3. Peer-to-Peer Protocol
4. Channels
5. Transactions
6. Chaincode

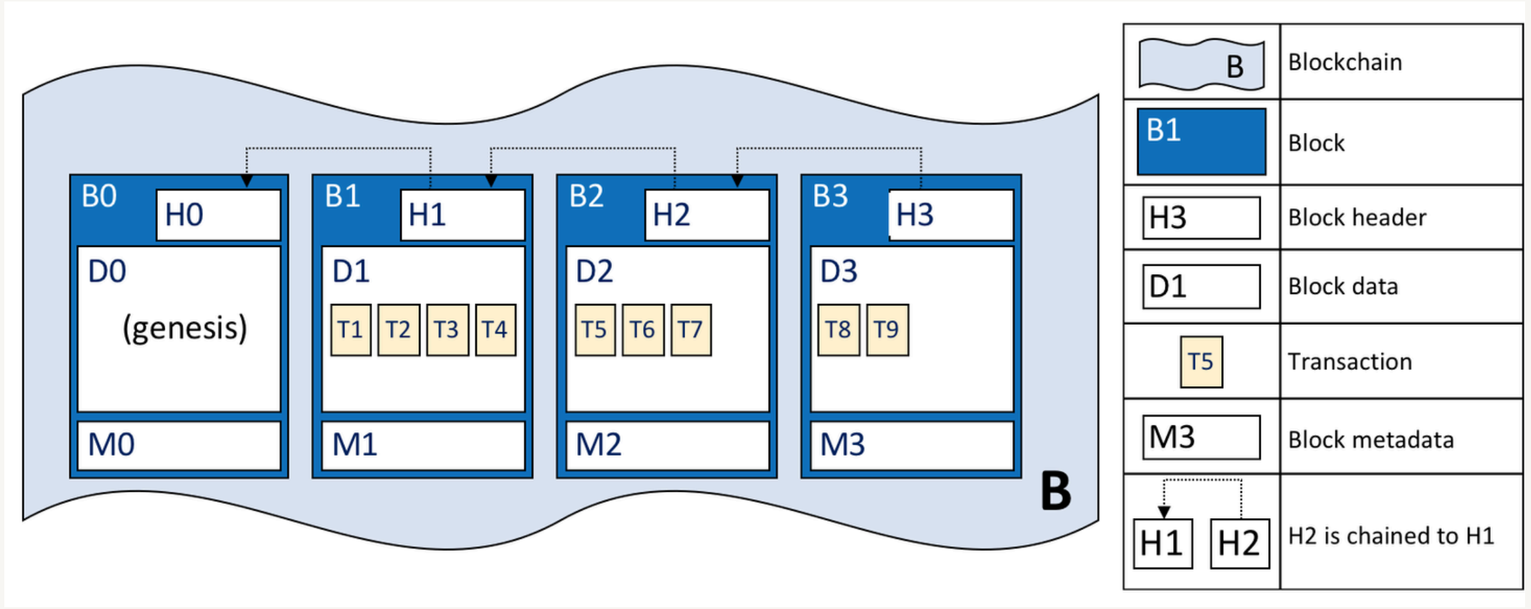
Distributed Ledger

1. Blockchain = Cryptographically Linked List of Blocks.
2. World State = A key-value database, Smart Contracts store states during Txns
3. Fabric Allows pluggable Datastores, can use LevelDB or CouchBD.





Block structure



Consensus Services

Provides interfaces to the consensus mechanisms, pluggable data validator.

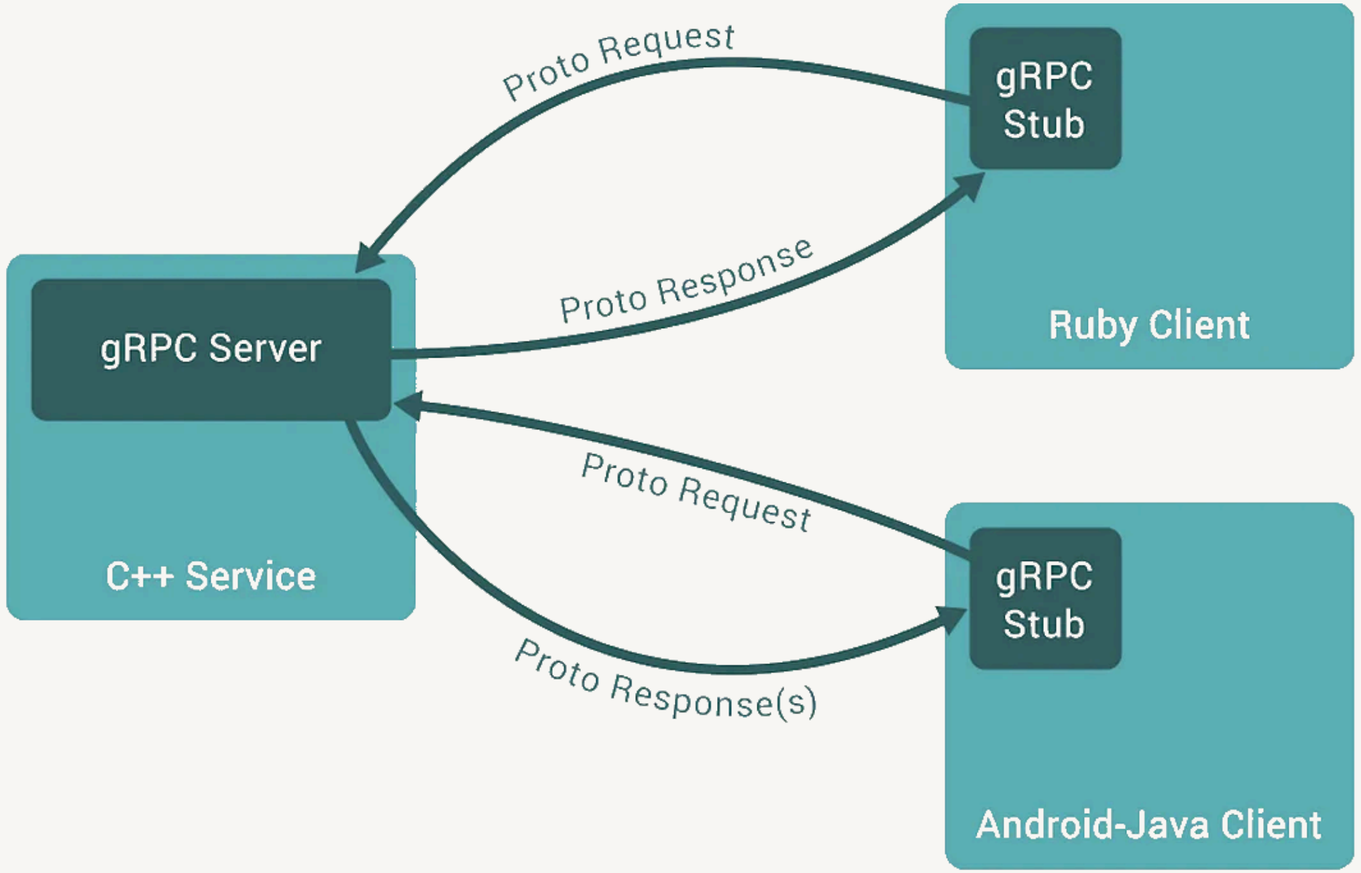
Consensus Mechanism	Description	Use Case	Fault Tolerance
SOLO	single-orderer	Dev and Testing	No FT
Kafka	similar to Distributed streaming platform	Production environments	CFT
SBFT	handle both faulty and malicious nodes	enhanced security	BFT

Peer2Peer Protocol

The P2P protocol in the Hyperledger Fabric is built using google RPC (gRPC)

Types of Message

1. Discovery
2. Transaction
3. Synchronization
4. Consensus

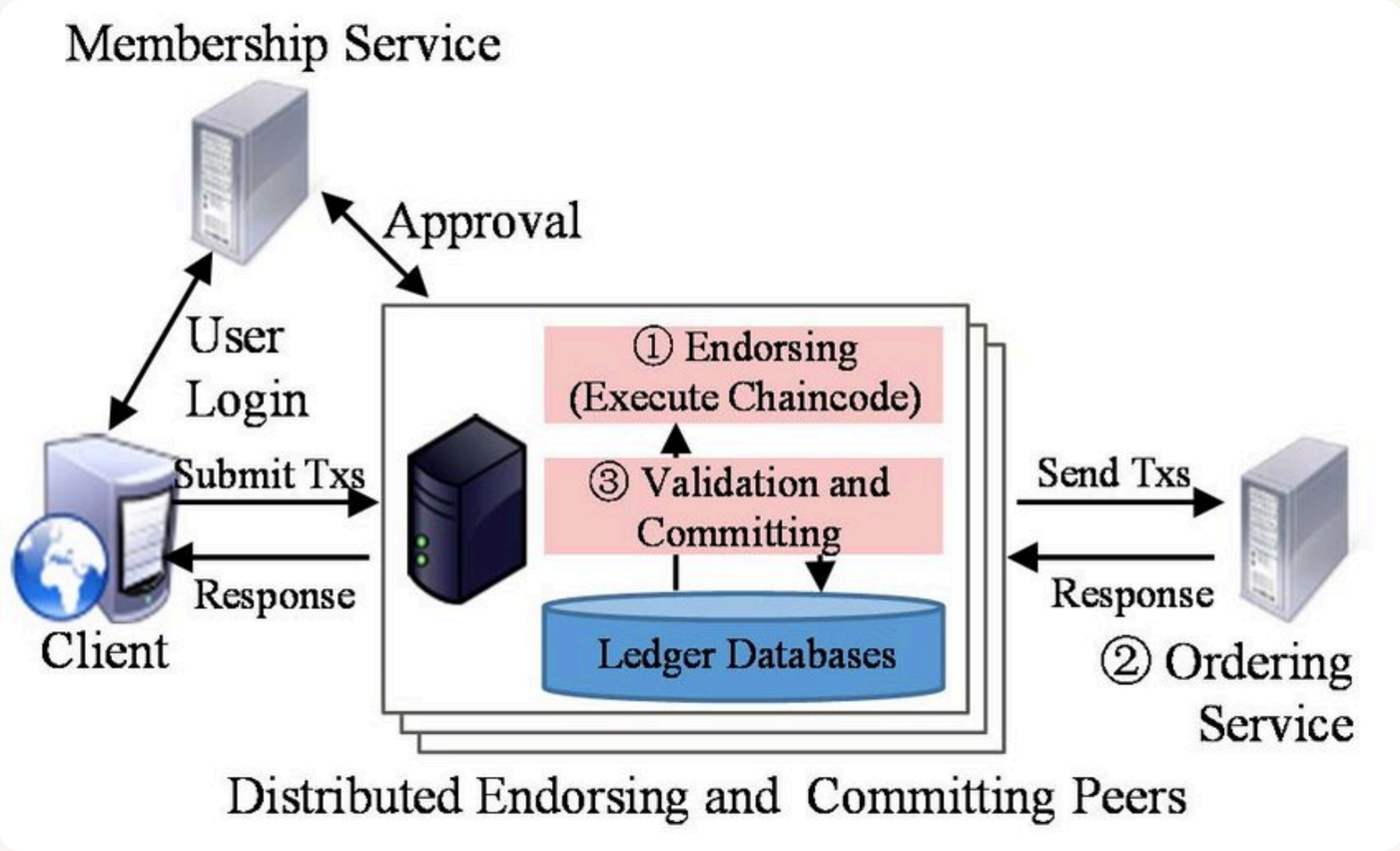


Types of Peers

Communication => Gossip Protocol

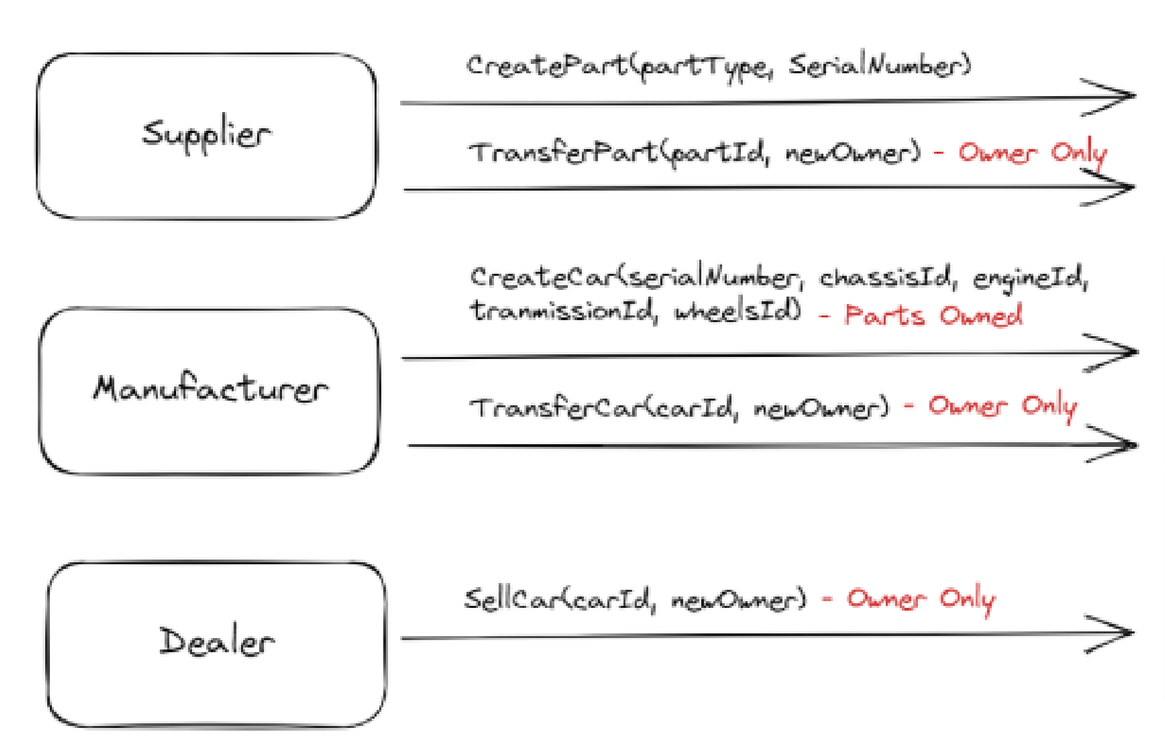
Types of Peers

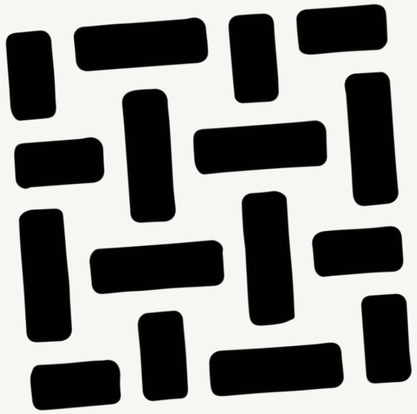
1. Endorsing
2. Committing
3. Submitter



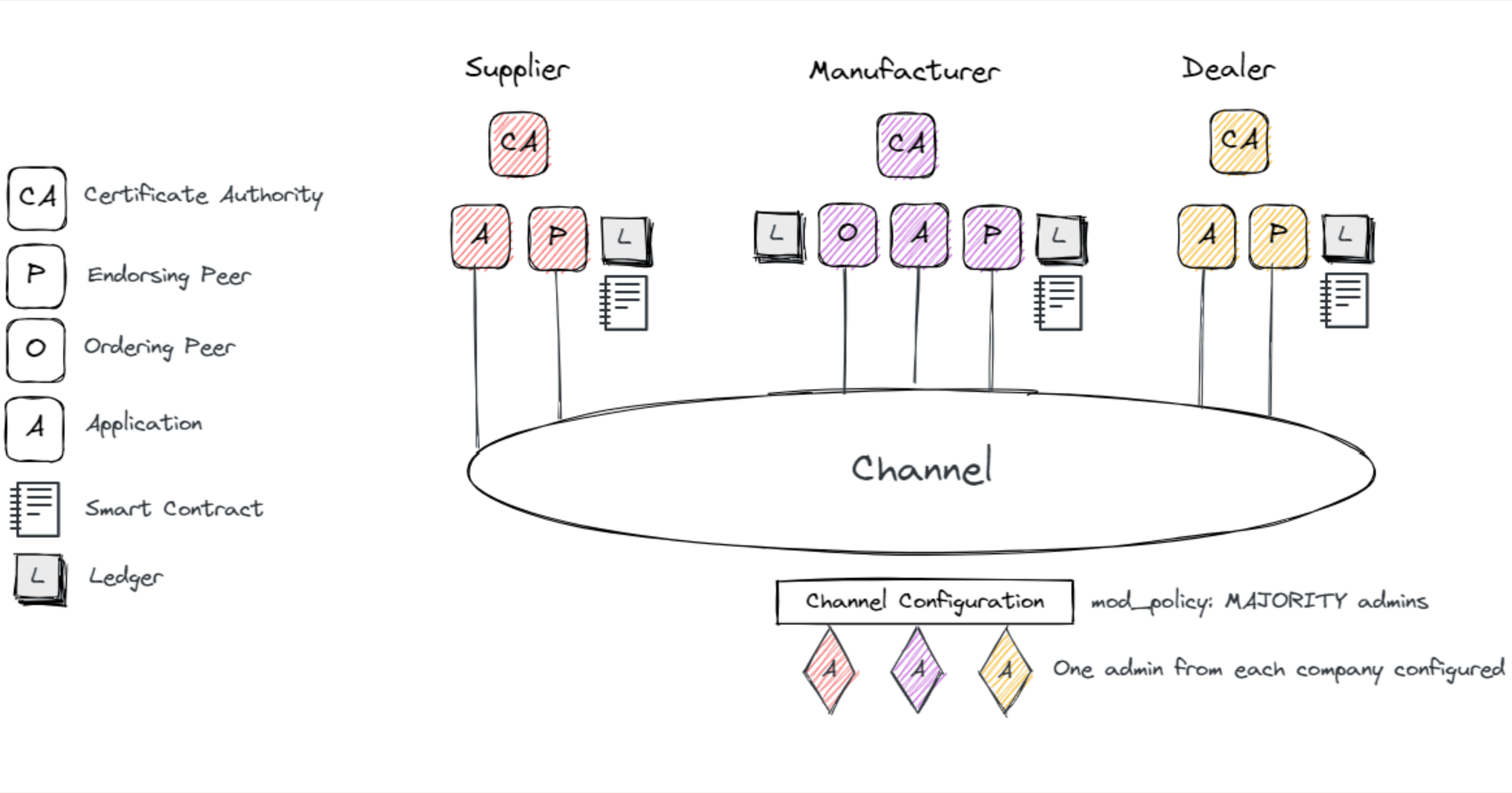
Channels

1. Private Communication Layer in Hyperledger Fabric Network.
2. Participants/Nodes join in a Channel they are Authorized to.
3. Channels comprise of Its own private Ledger.



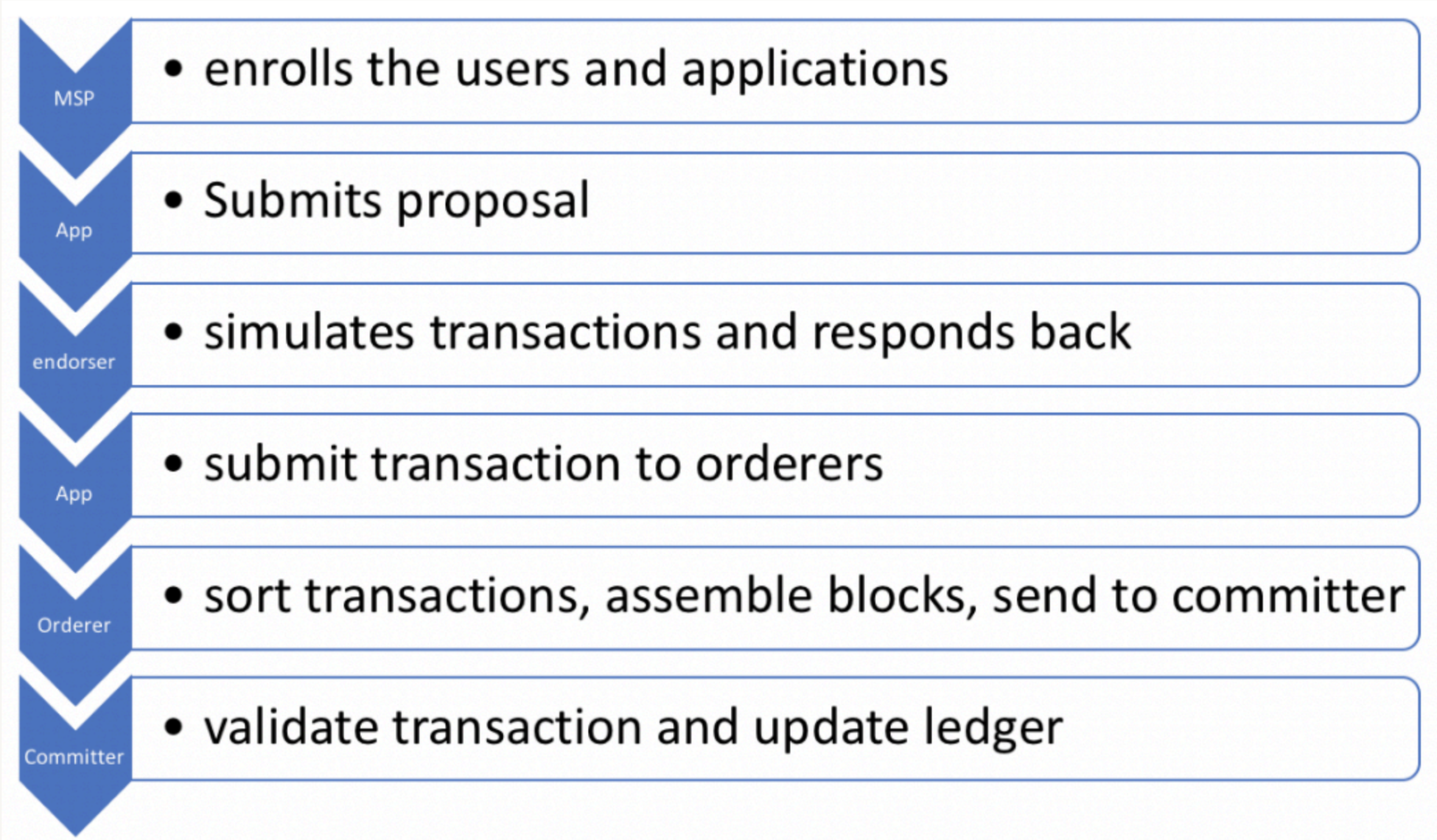


Car Company

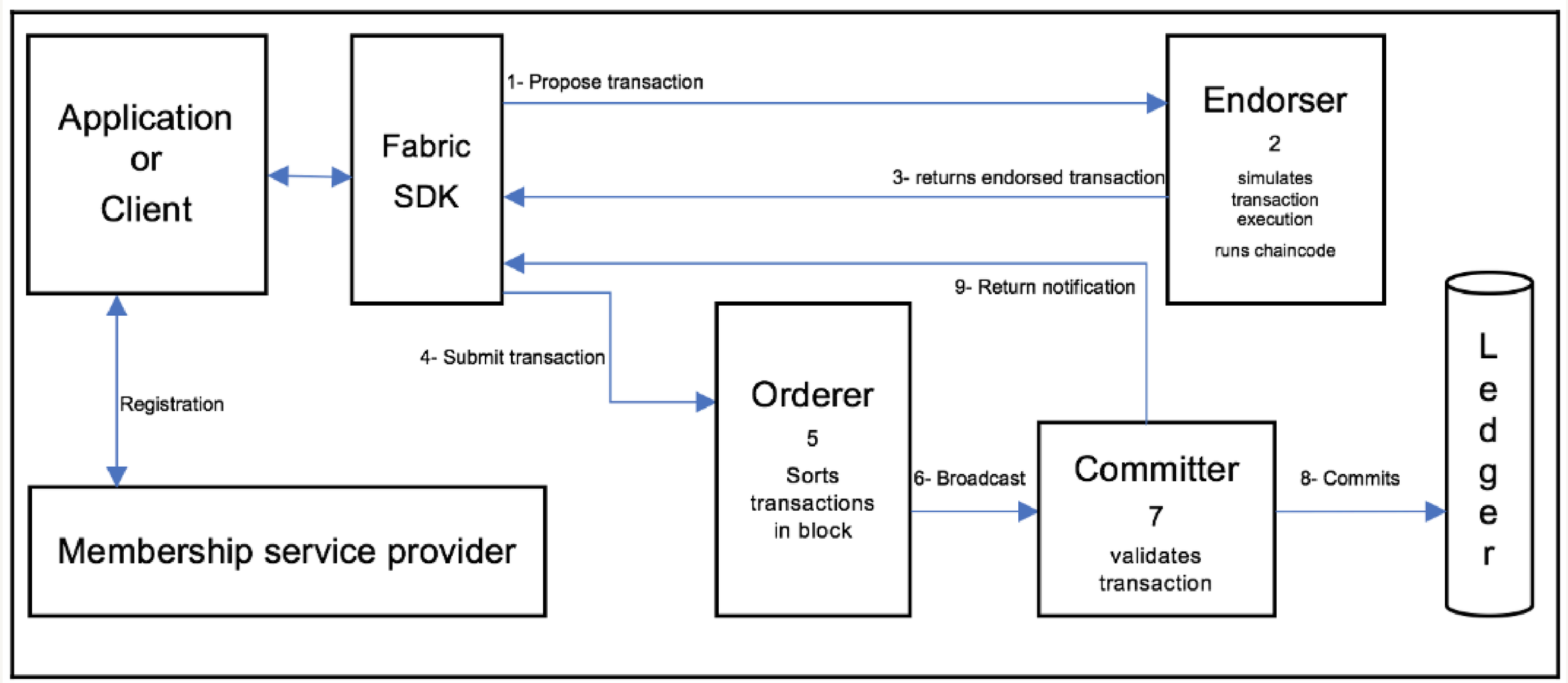

CA
Certificate Authority
P
Endorsing Peer
O
Ordering Peer
A
Application
Smart Contract
L
Ledger
Supplier
Manufacturer
Dealer
CA
CA
CA
A
P
L
L
O
A
P
L
A
P
L
Channel
Channel Configuration
mod_policy: MAJORITY admins
A
A
A
One admin from each company configured

Transactions

1. Deployment Txns => To deploy New Chaincode to the Ledger.
2. Invocation Txns => To call the functions from Smart Contracts



Flow Architecture



Chaincode Services

1. Chaincode services allow creation of secure containers.
2. Secure Container = Locked down Sandboxed Docker container, using GoLang.
3. Secure Registry = Record of the Images that contains Smart Contracts.

Events

These events are triggered by Endorsers, which Adapters of other apps listen to and perform handling functions.

APIs and CLIs

APIs = Exposing the Fabric through REST Endpoints.
CLIs = Used for quick testing.

Membership Service Provider

MSP manages identities and authenticates clients in a Hyperledger Fabric network. It uses a Certificate Authority (CA) for identity verification and binding.

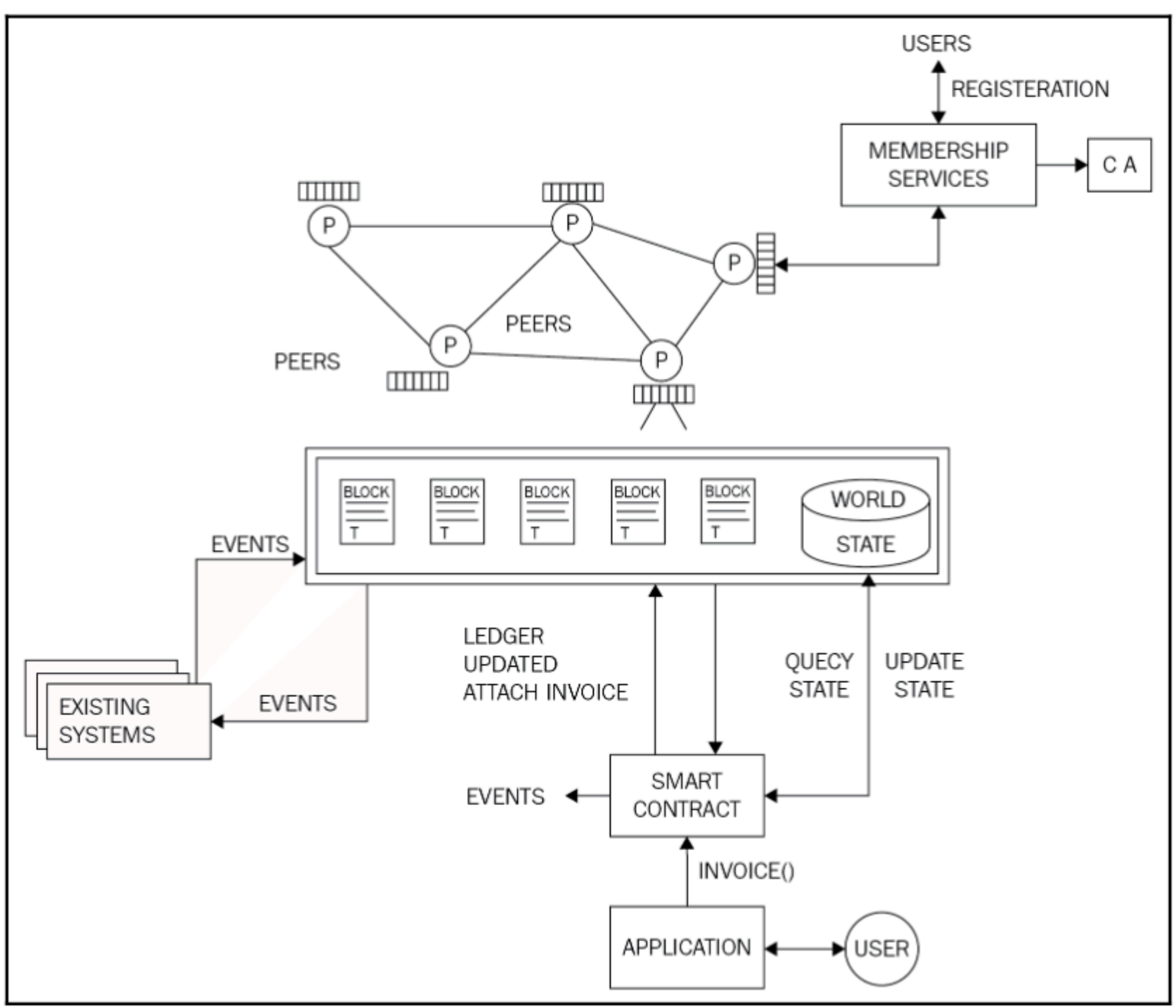
Crypto service provider

The cryptographic service in Hyperledger Fabric provides key management, signature verification, and encryption-decryption for secure blockchain operations. It works with the Membership Service Provider (MSP) to authenticate endorsers, clients, and peers. This ensures secure transactions and identity management in the network.

Chaincode Implementation

Written in GoLang or Java

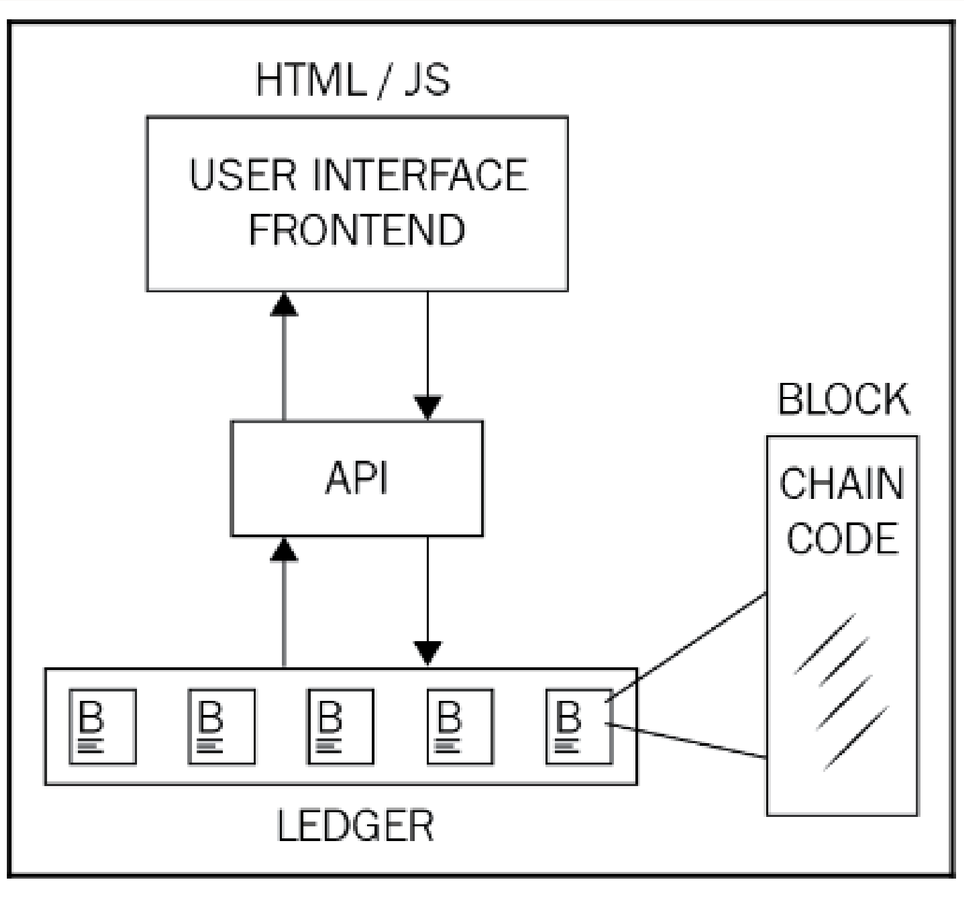
1. `Init()`
2. `Invoke()`
3. `Query()`
4. `4()`



Application Model

Hyperledger Fabric applications follow the MVC-B pattern

1. View logic
2. Control logic
3. Data model
4. Blockchain logic



Applications on blockchain

A Fabric app has a UI interacting with chaincode via an API layer.

References

1. Imran Bashir (2018) Mastering Blockchain, Packt Publishing 2008, *Second Edition*

2.Channels - https://insights.encora.com/insights/car-supply-chain-on-hyperledger-fabric-blockchain

3.Hyperledger Official Documentation - https://hyperledger-fabric.readthedocs.io/en/latest/index.html

Thank You