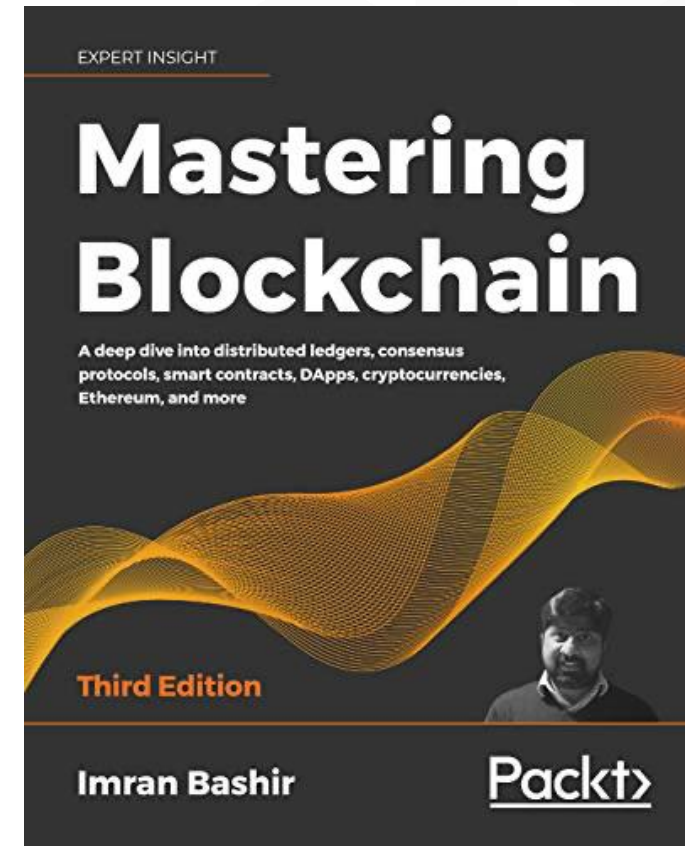# Mastering Blockchain

Third Edition
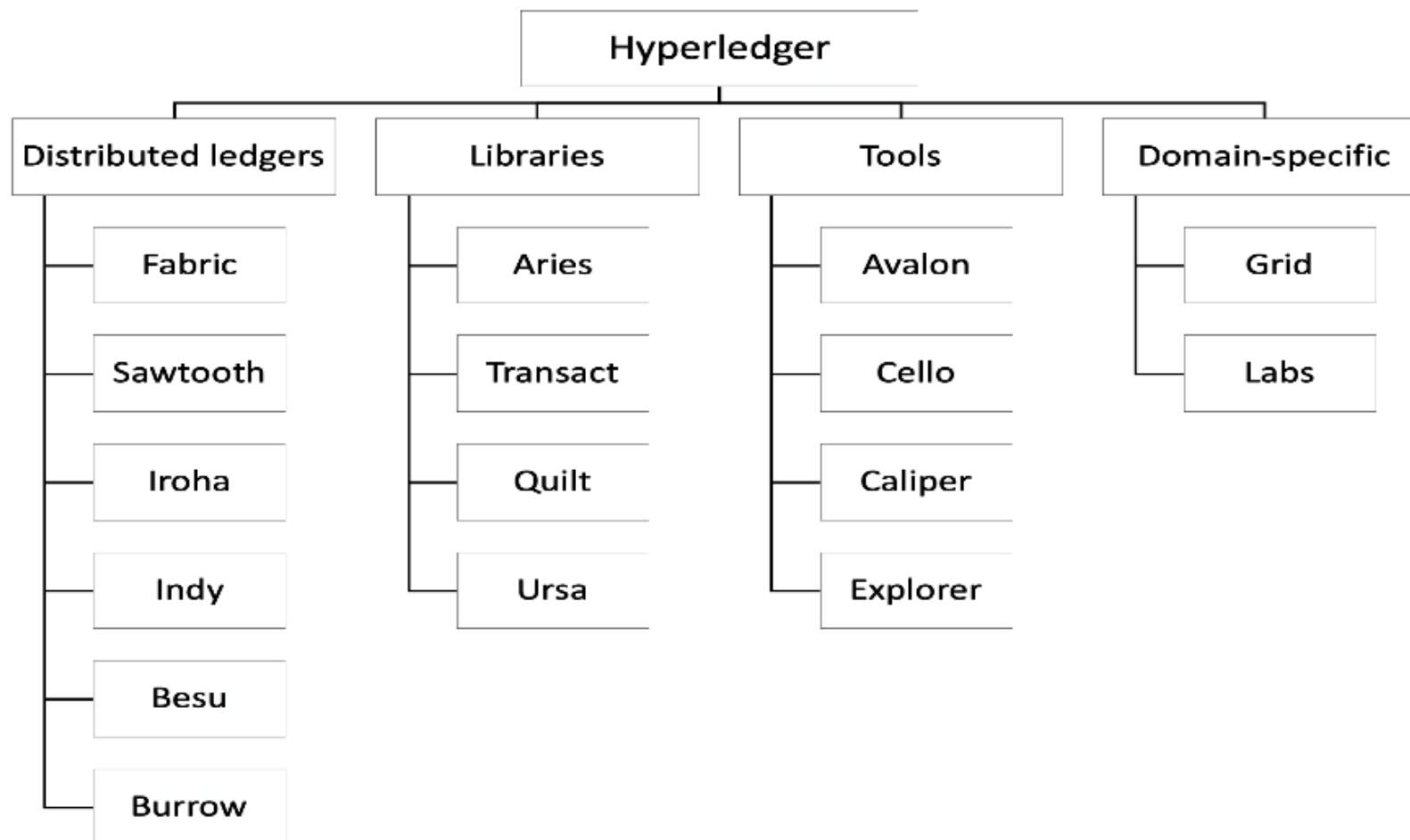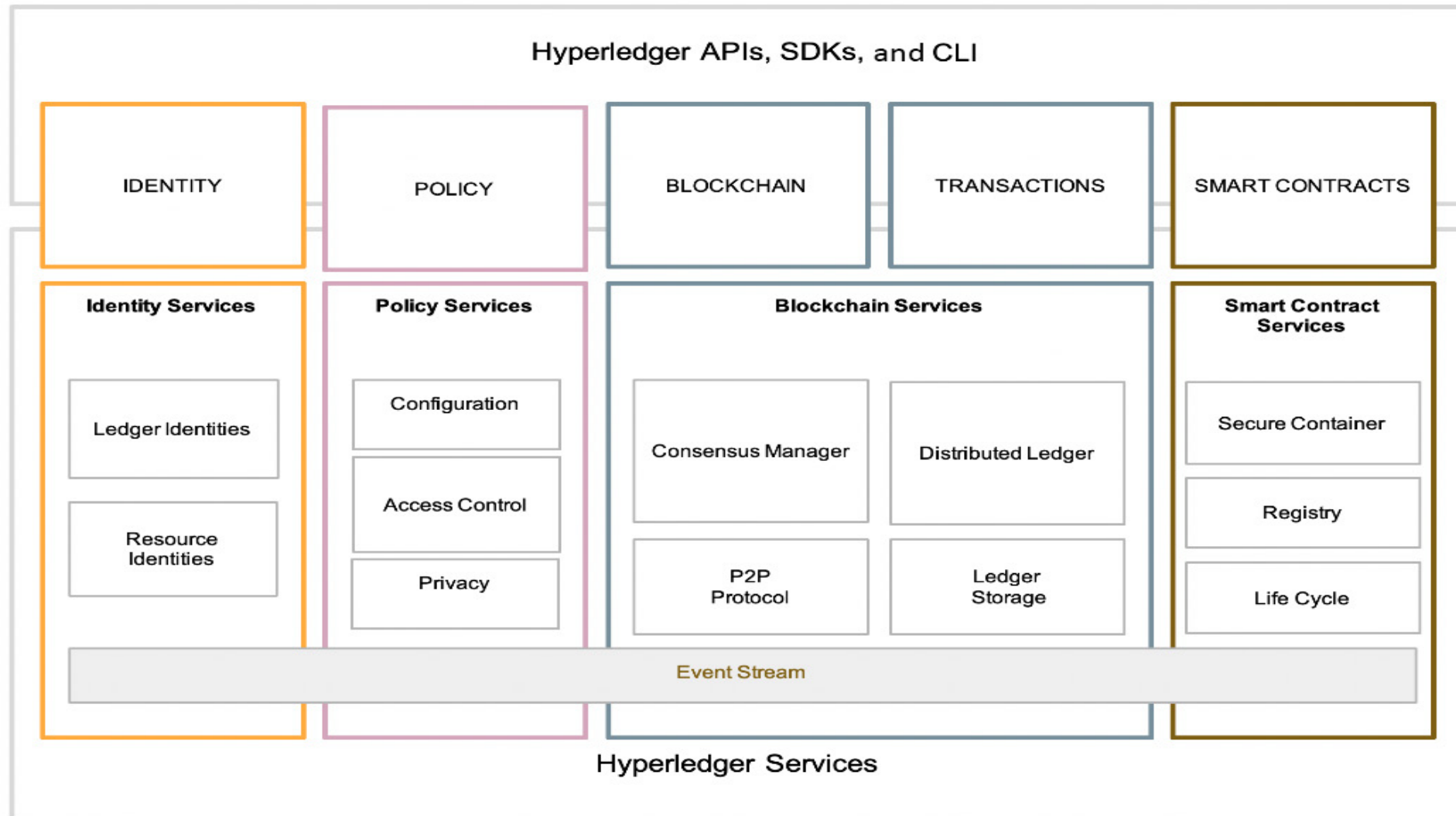
Chapter 17, Hyperledger

Outline

- Projects under Hyperledger

- Hyperledger reference architecture

- Hyperledger Fabric

- Hyperledger Sawtooth

- Setting up a Sawtooth development environment

Hyperledger

There are many projects under Hyperledger umbrella. Some of them are shown in the following diagram

Hyperledger reference architecture

# Hyperledger Fabric: blockchain and transaction structure

Hyperledger Fabric is an enterprise-grade permissioned distributed ledger framework, which provides a framework for the development of blockchain solutions and applications.
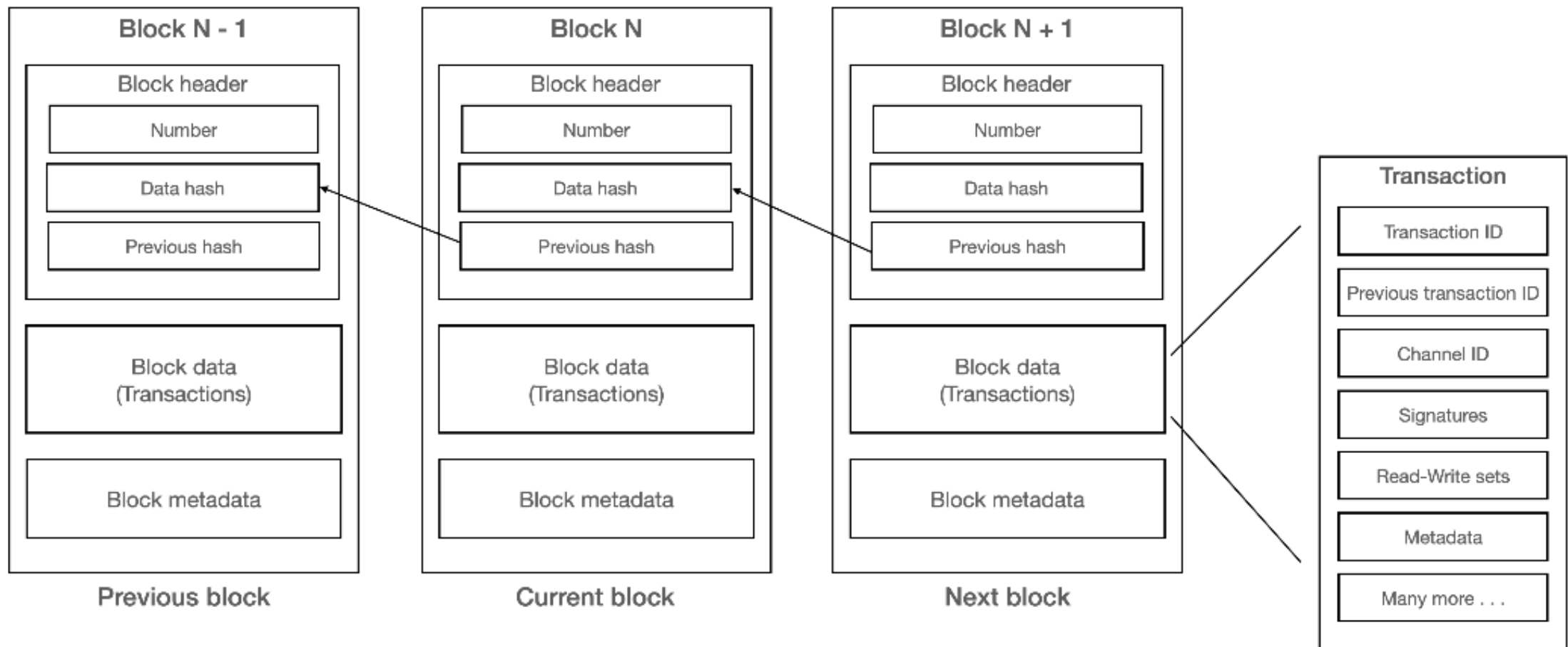
Fabric application

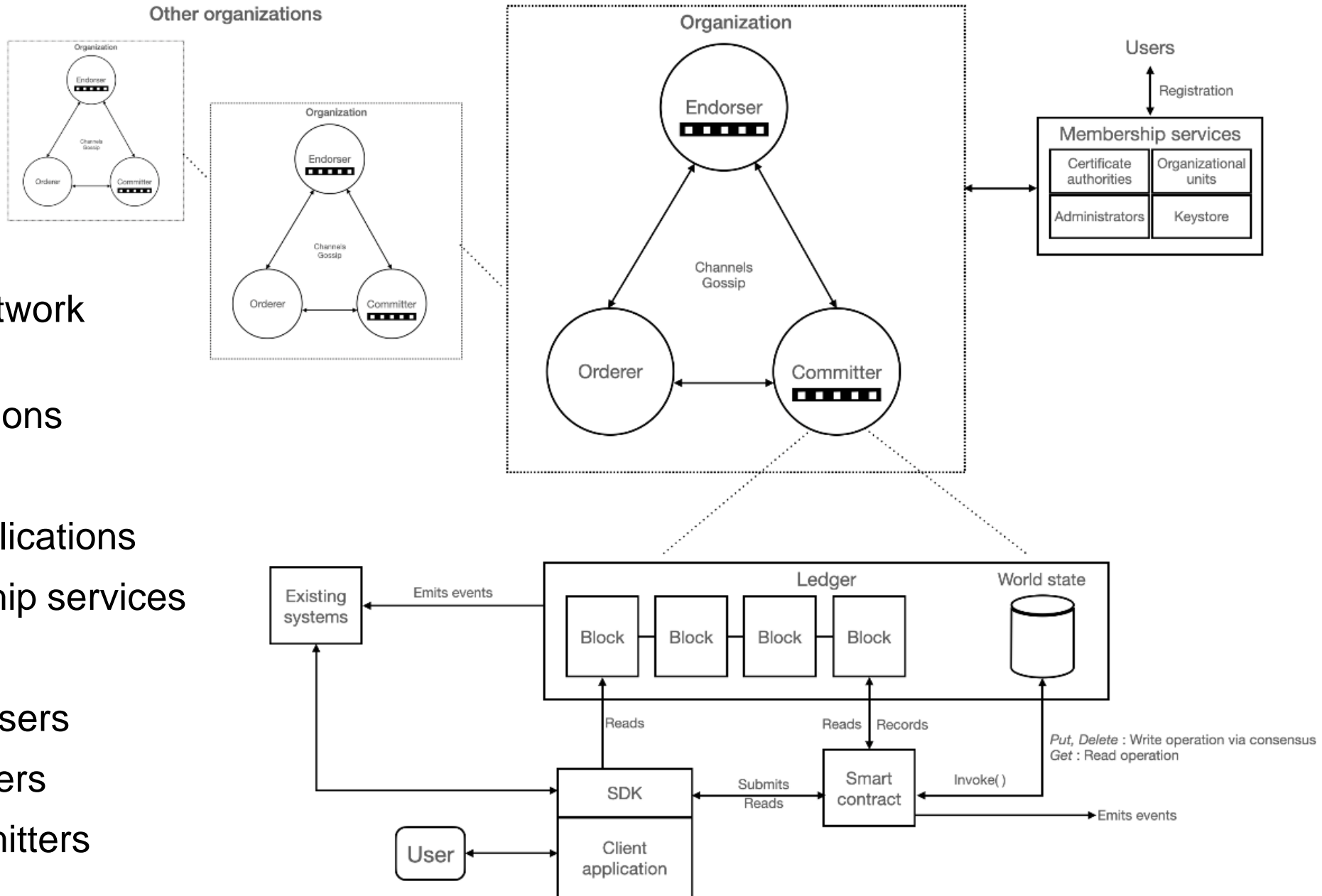A Fabric application consists of:

- A user frontend
- An API which allows interface with the ledger
- A ledger
- Chaincode (the equivalent of a Smart contract)
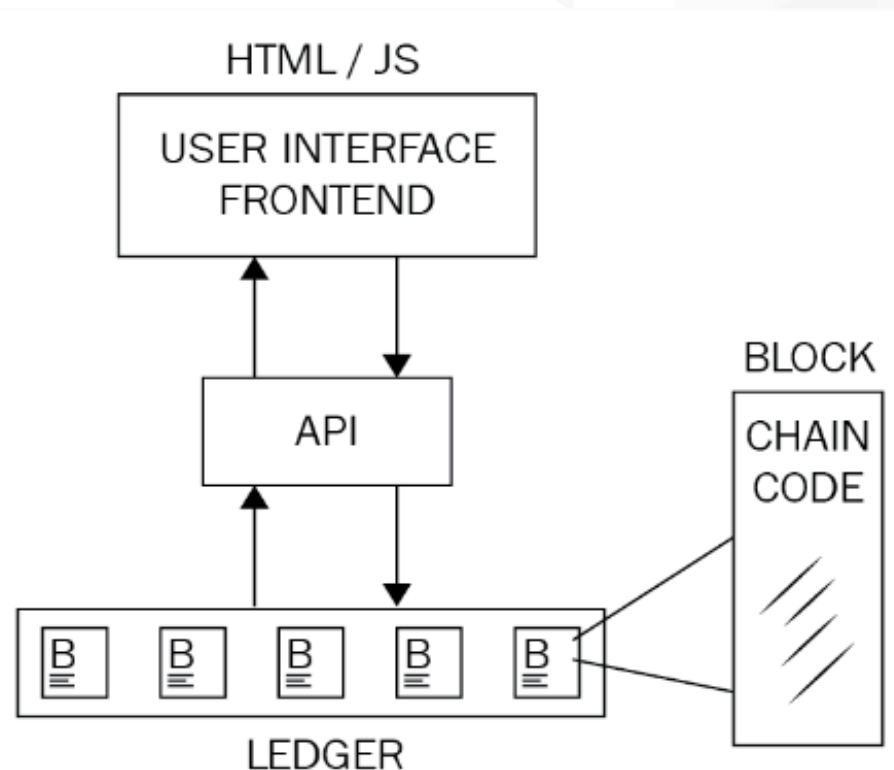
Fabric network

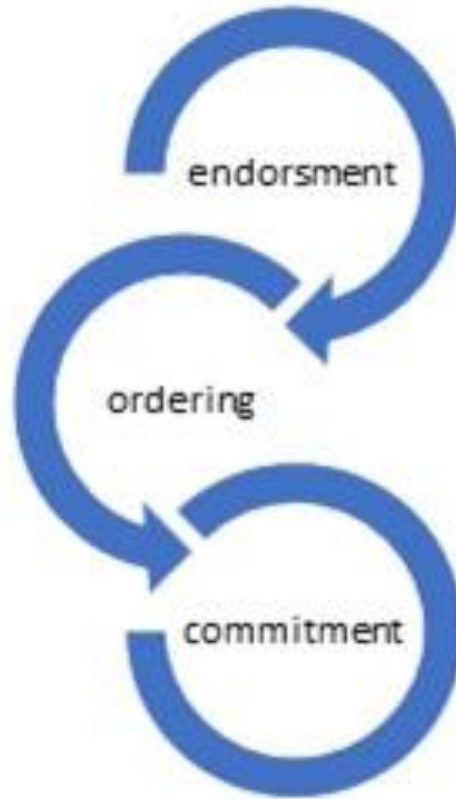The Fabric network consists of:

- Organizations

- A ledger

- Client applications

- Membership services

- Nodes

  - Endorsers
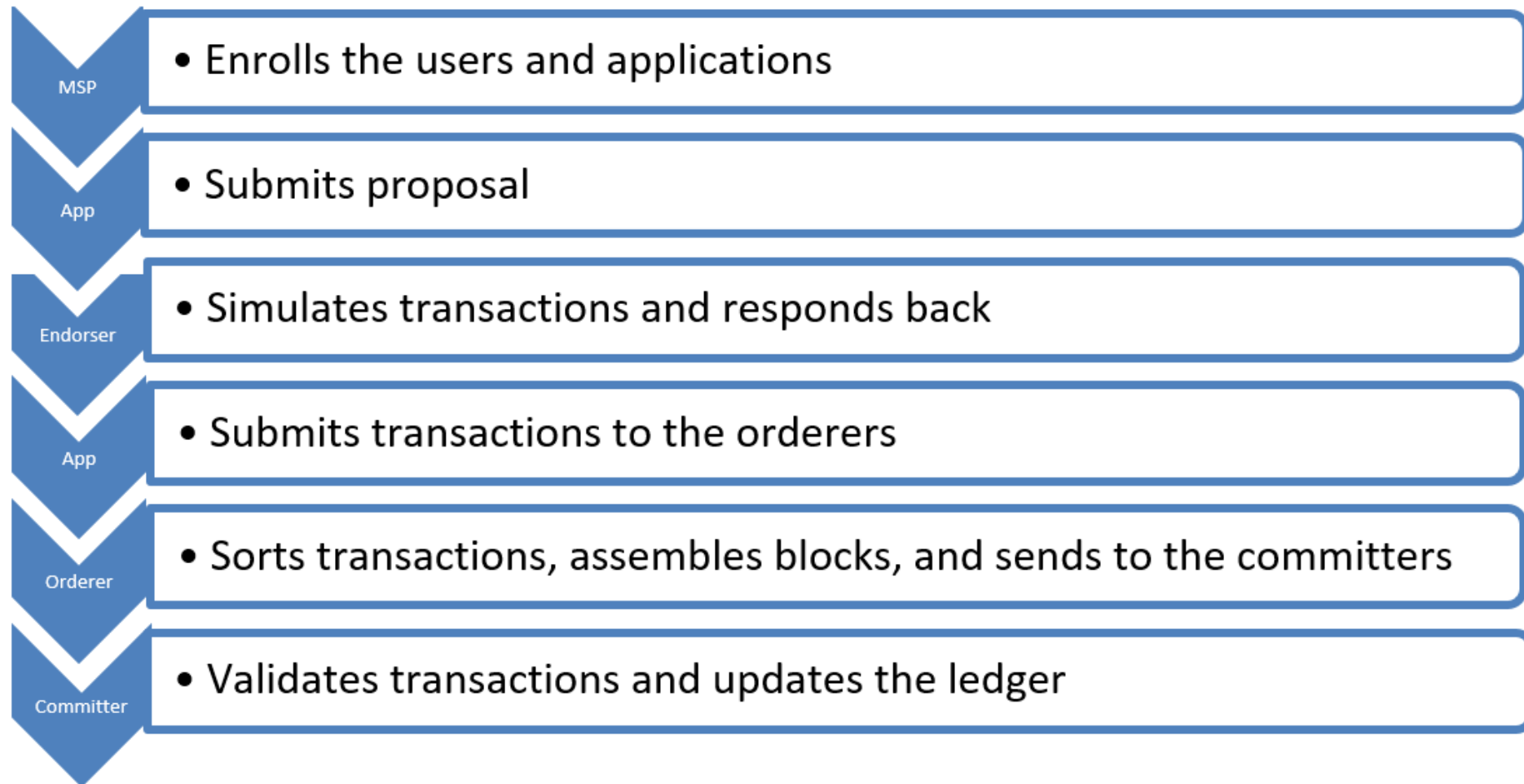
  - Orderers

  - Committers

Consensus mechanism

Fabric's consensus mechanism comprises of three operations:

- Endorsement
- Ordering
- commitment

The transaction lifecycle in Hyperledger Fabric

MSP
- Enrolls the users and applications

App
- Submits proposal

Endorser
- Simulates transactions and responds back

App
- Submits transactions to the orderers

Orderer
- Sorts transactions, assembles blocks, and sends to the committers

Committer
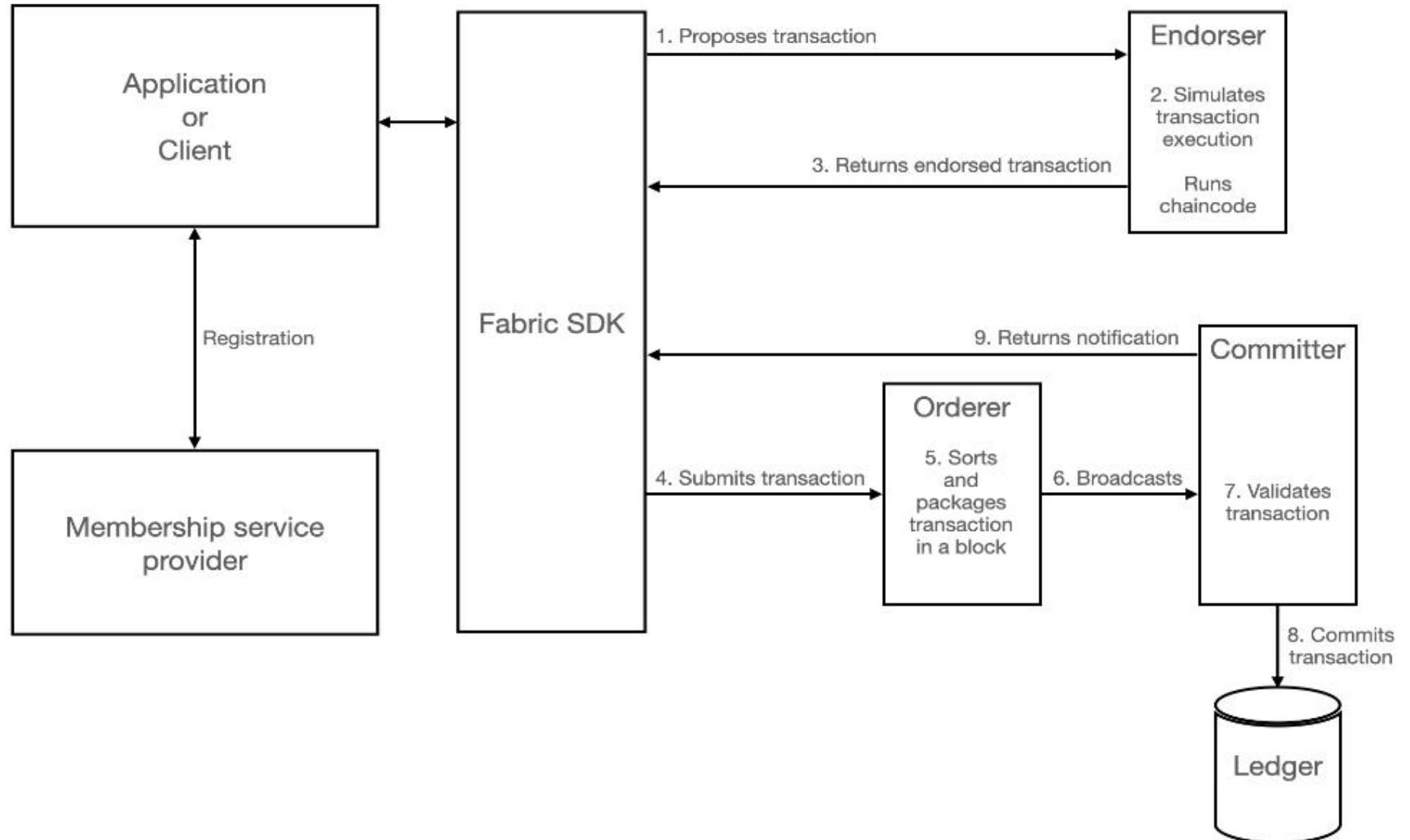- Validates transactions and updates the ledger

Hyperledger Fabric transaction flow

1. Proposes transaction
2. Simulates transaction execution (runs chaincode)
3. Returns endorsed transaction
4. Submits transaction
5. Sorts and packages transactions in a block
6. Broadcasts
7. Validates transactions
8. Commits transaction
9. Returns notification

Hyperledger Sawtooth

Sawtooth is an enterprise-grade distributed ledger that can run in both permissioned and non-permissioned modes.

- Modular design

- Parallel transaction execution

- Global state agreement

- Dynamic and pluggable consensus algorithms

- Multi-language support

- Enhanced event mechanism

- On-chain governance

- Interoperability

Consensus in Sawtooth

- PoET (Proof of Elapsed Time)

  - PoET CFT

  - PoET SGX

  - Devmode

- PBFT

- Raft

Transaction lifecycle

The transaction lifecycle in Hyperledger Sawtooth takes the following steps:

1. Client submits a transaction

2. It is propagated across the validator network

3. A leader validator creates a candidate block and publishes it on the network

4. The candidate block is propagated across the entire validator network

5. When validators receive this block, it is validated

6. In addition, transaction processors validate and execute all transactions present in the candidate block. Once the block is validated and verified, it is written in its respective local storage and the state is updated accordingly.
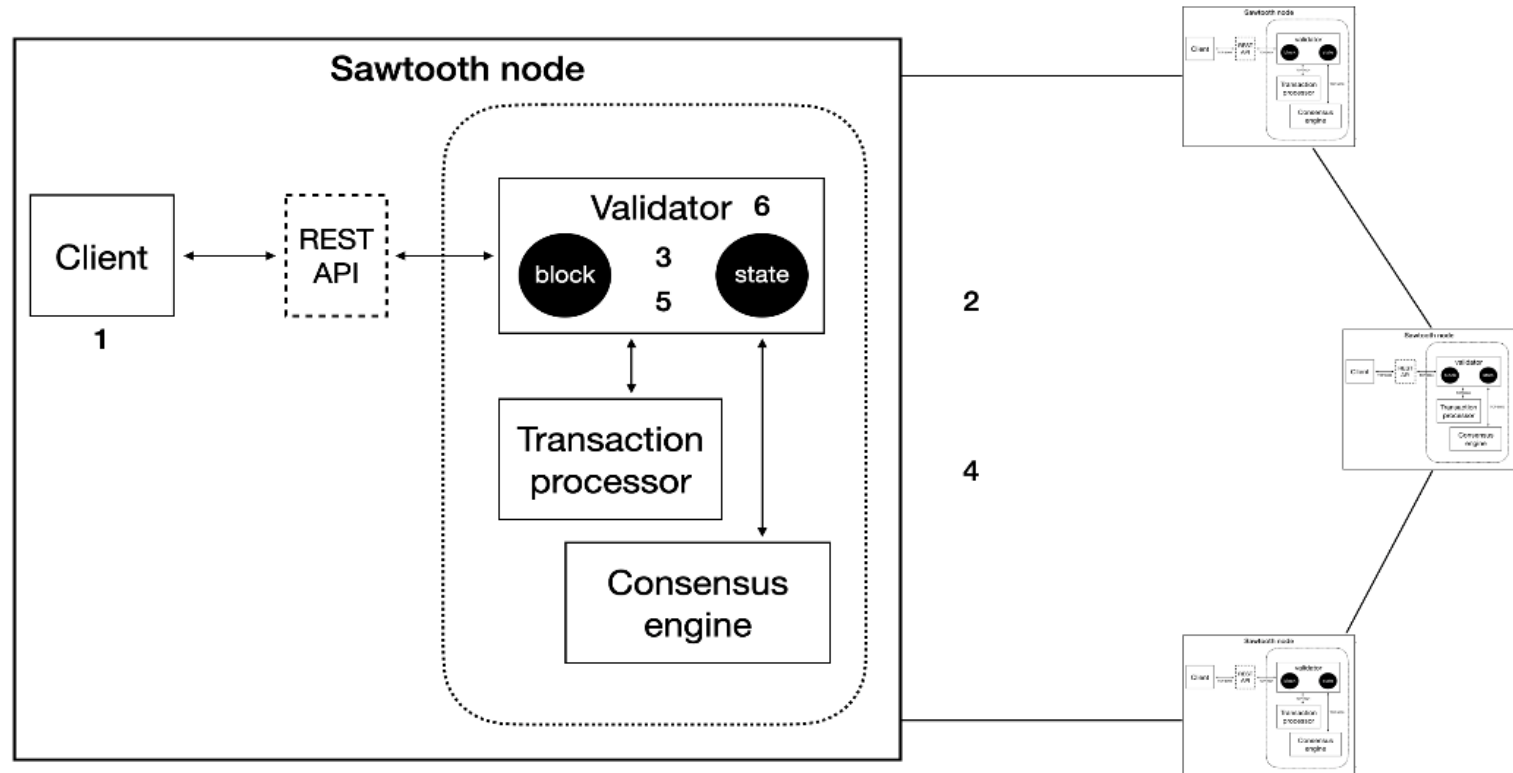
Sawtooth Components

A generic Sawtooth network contains the following components:

- Client
- Rest API
- Validator
- Transaction processor
- Consensus engine
- Other nodes
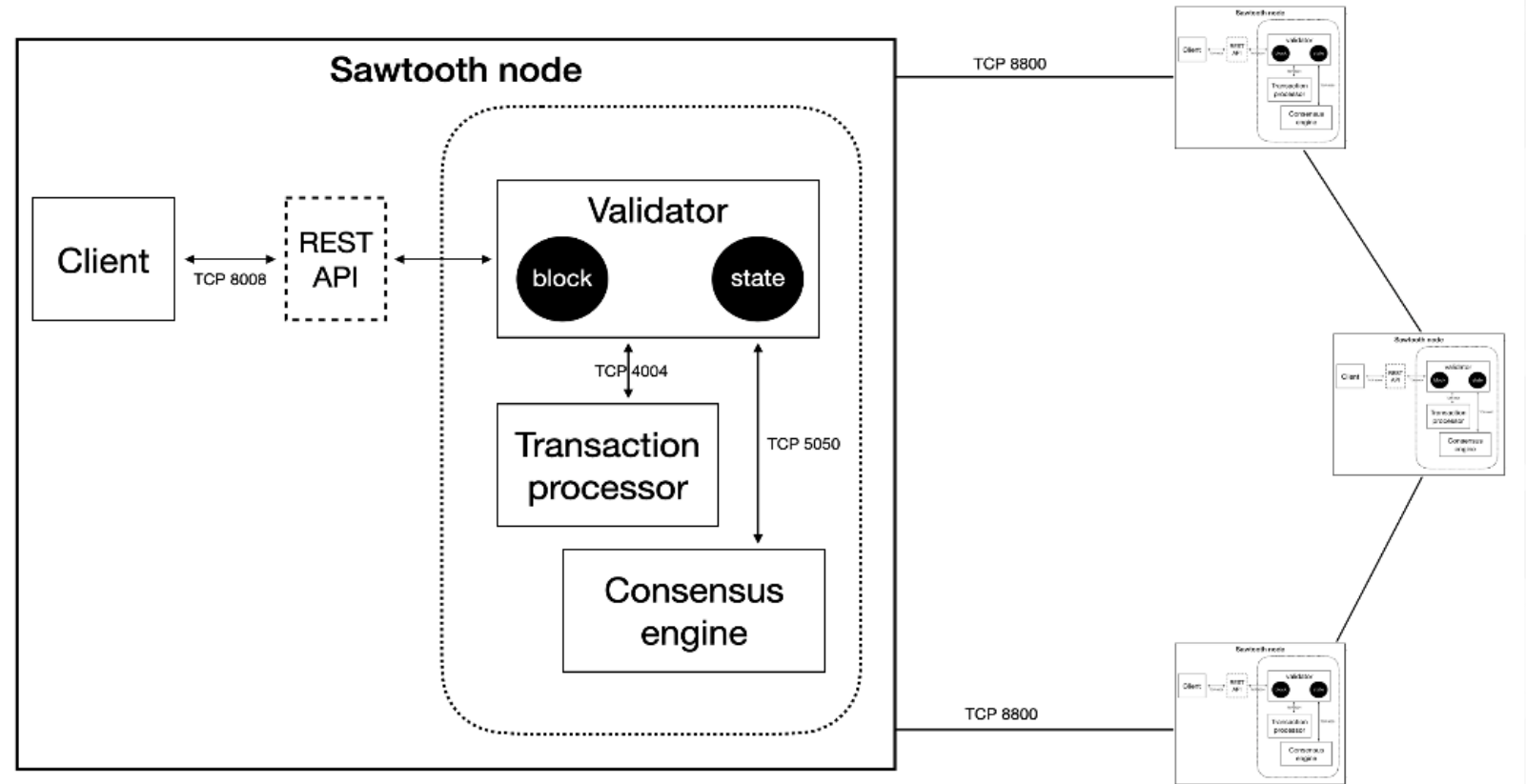
Transaction families

Transaction families are a combination of a data model and a transaction language that implements a logic layer for a specific domain. The data model represents the current state of the blockchain (ledger), whereas the transaction language modifies the state of the ledger.

The diagrams below demonstrate the architectural differences between a traditional smart contract model, and Sawtooth's transaction families model, which uses domain-specific rules for different services.
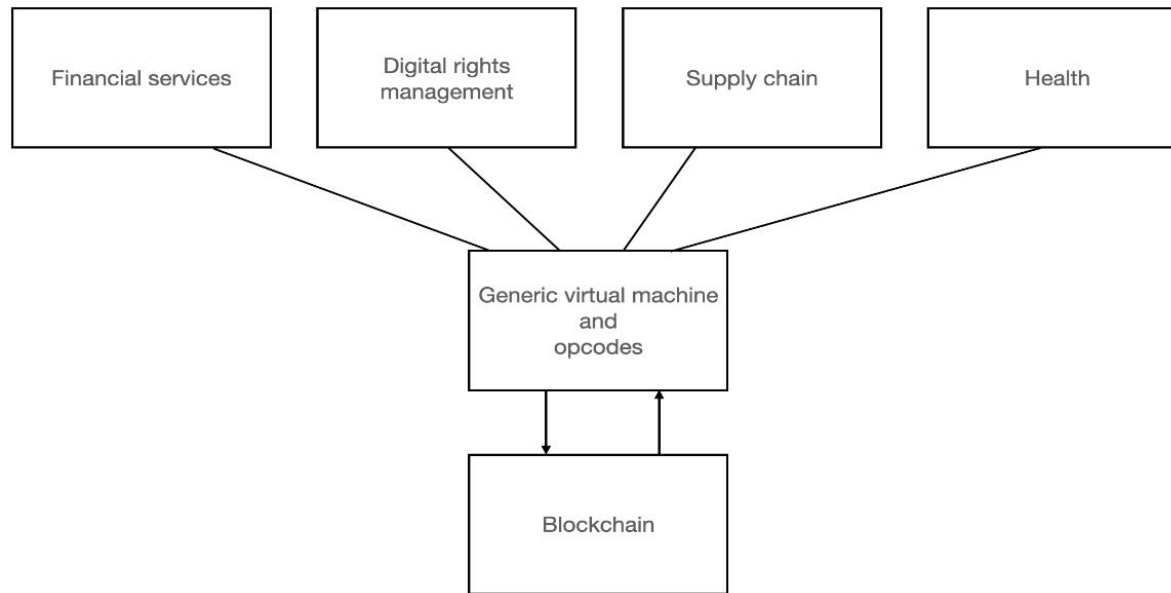
Traditional
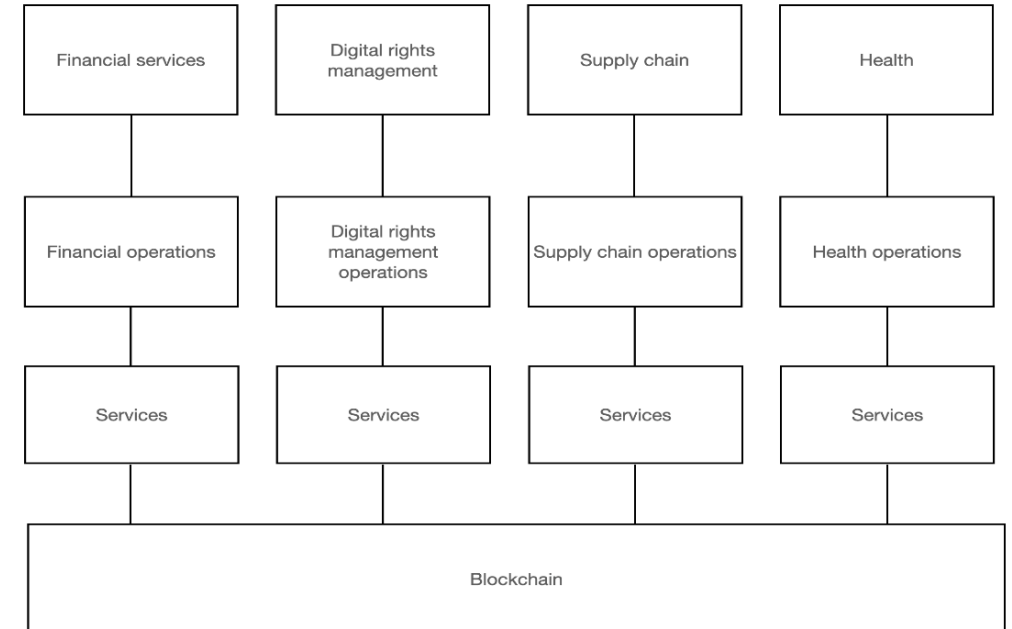
Sawtooth

Exercise

Set up a Sawtooth network and development environment, following the steps described in the core *Mastering Blockchain* book.

Summary

In this presentation, we discussed:

- Projects under Hyperledger

- Hyperledger reference architecture

- Hyperledger Fabric

- Hyperledger Sawtooth

- Setting up a Sawtooth development environment