Chaincode

Wrapping up Problem Statement

Participant

Asset

Chaincode

Transaction

Ledger

World State

- **World State** store the current value of a business object (Asset)
- It stores as **key value pairs**

- For Eg:
  - `{key= Car-01, value= Audi} Version: 0`
  - `{key= Car-02, value= {type:Sedan,color:Red,owner:Mike}} Version:0`

Chaincode

- Fabric uses **Chaincode and Smart Contract** Interchangeably
- A chaincode is a computer program (written in node.js, java, or go)
- It defines the **business logic** of your application.
- A chaincode is a **collection of smart contracts**.
- A Smart Contract is the code that defines the **agreements or rules** of a transaction.

Chaincode Operations

Ledger Operations

A smart contract accesses two distinct pieces of the ledger

1. **A blockchain**, which immutably records the **history of all transactions**
2. **A world state** that holds a cache of the **current value** of the state

Operations

1. **Put, Get** and **Delete** states in the **world state**.
2. **Query** the immutable **blockchain record** of transactions.

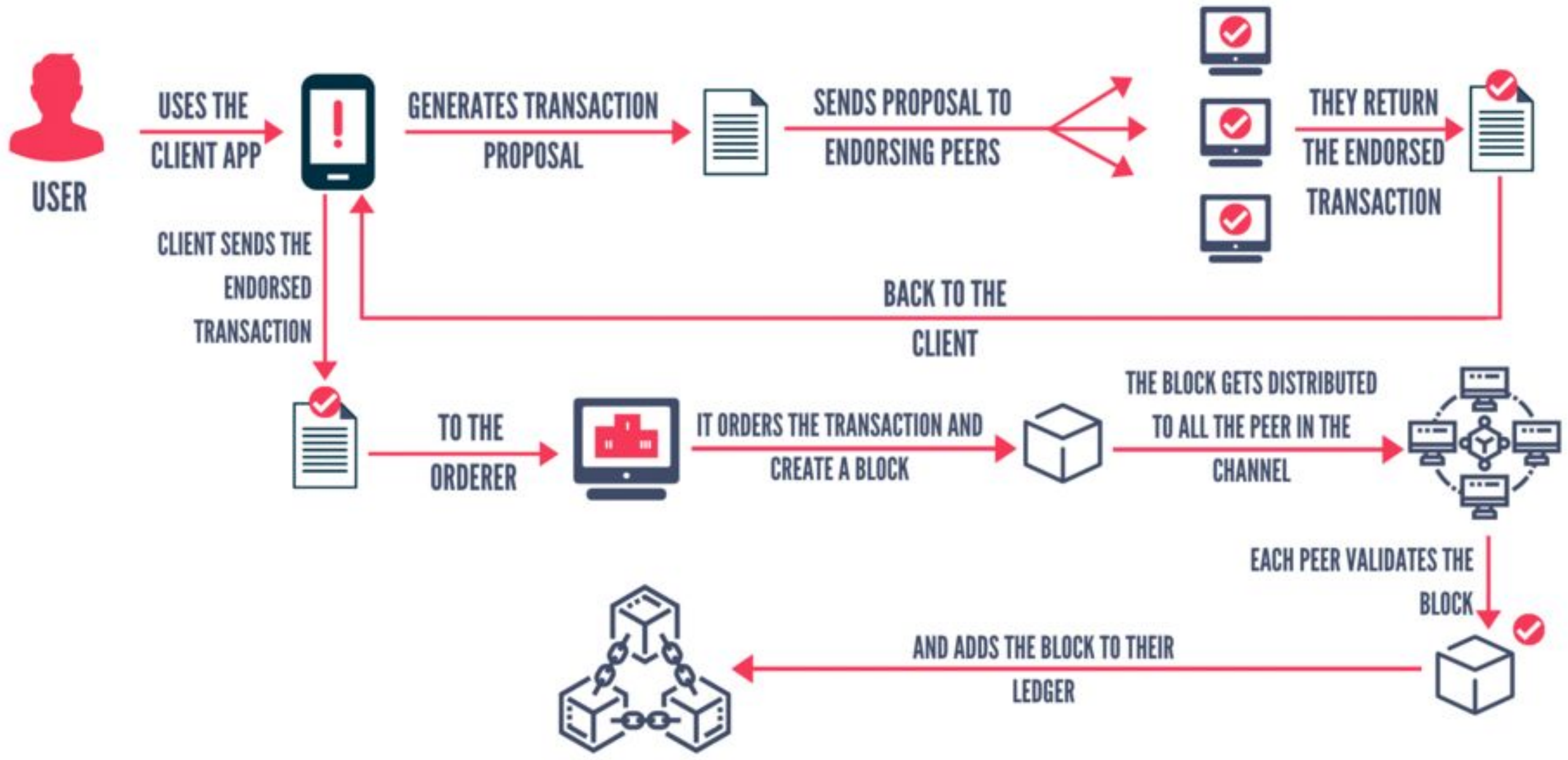
These Smart Contracts operations will done by the way of **Invoking** and **Querying** transactions

Transactions

1. **Invoke**
    - Update the Ledger
    - Eg: Creating an asset, Updating an asset, Deleting an asset

2. **Query**
    - Reads the ledger
    - Eg: Read state of an asset

Transaction Flow


USER
USES THE CLIENT APP
GENERATES TRANSACTION PROPOSAL
SENDS PROPOSAL TO ENDORSING PEERS
THEY RETURN THE ENDORSED TRANSACTION
BACK TO THE CLIENT
CLIENT SENDS THE ENDORSED TRANSACTION
TO THE ORDERER
IT ORDERS THE TRANSACTION AND CREATE A BLOCK
THE BLOCK GETS DISTRIBUTED TO ALL THE PEER IN THE CHANNEL
EACH PEER VALIDATES THE BLOCK
AND ADDS THE BLOCK TO THEIR LEDGER

Invoke Transaction

Query Transactions

Endorsement Policy

- A Set of **Rules** specifies the set of peers on a channel that must **execute chaincode** and **endorse the execution** results for the transaction to be considered valid.
- The developers or administrators can define policies called the endorsement policies that are associated with the chaincode.
- At the time of transaction validation, the peers check for the appropriate number of endorsements from the endorsing peers.

Endorsement Policy

- The syntax of the language is: **EXPR(E[, E...])**, where EXPR is either AND, OR, or OutOf, and E is either a principal or another nested call to EXPR.

  For example:

- **AND('Org1.member', 'Org2.member', 'Org3.member')** requests one signature from each of the three.
- **OR('Org1.member', 'Org2.member')** requests one signature from either one of the two principals.
- **OR('Org1.member', AND('Org2.member', 'Org3.member'))**
- **OutOf(1, 'Org1.member', 'Org2.member')**, which resolves to the same thing as OR('Org1.member', 'Org2.member')
- **OutOf(2, 'Org1.member', 'Org2.member')** is equivalent to AND('Org1.member', 'Org2.member')

How to build a Chaincode

Chaincode SDK

- Go
- Java
- Node.js

Go packages

- contractapi
  - Available in fabric-contract-api-go module
  - Define a struct that embeds contractapi.Contract struct which defines a set of methods and functions to interact with the Hyperledger Fabric blockchain.

    eg:

    ```
    type CarContract struct {
        contractapi.Contract
    }
    ```

  - Here, CarContract inherits base smart contract functionalities from contractapi.Contract.

Transaction Context

- Every transaction function must take a **transaction context (ctx)** as the first parameter.
- It's used to interact with the ledger, access the current transaction's information, and perform various operations related to the smart contract.
- **ctx.GetStub** is used to access APIs that provide a broad range of transaction processing operations (GetSate, PutState, DelState etc)
- **ctx.GetClientIdentity** is used to get information about the identity of the user who submitted the transaction.

Commonly Used Stub Methods

Some of the commonly used methods

- **PutState**
  a. **PutState** is a commonly used method to register an asset in the Fabric ledger. This method helps you to store a state variable on the ledger as a key-value pair.
  b. **PutState** method will overwrite the state variable if it is already stored in the ledger.

- **GetState**
  a. This method helps you to retrieve an already stored state variable from the ledger.

- **DelState**
  a. DelState method will remove the state variable key from the world state store. But it will not delete it from the ledger history (transaction log).

Functions

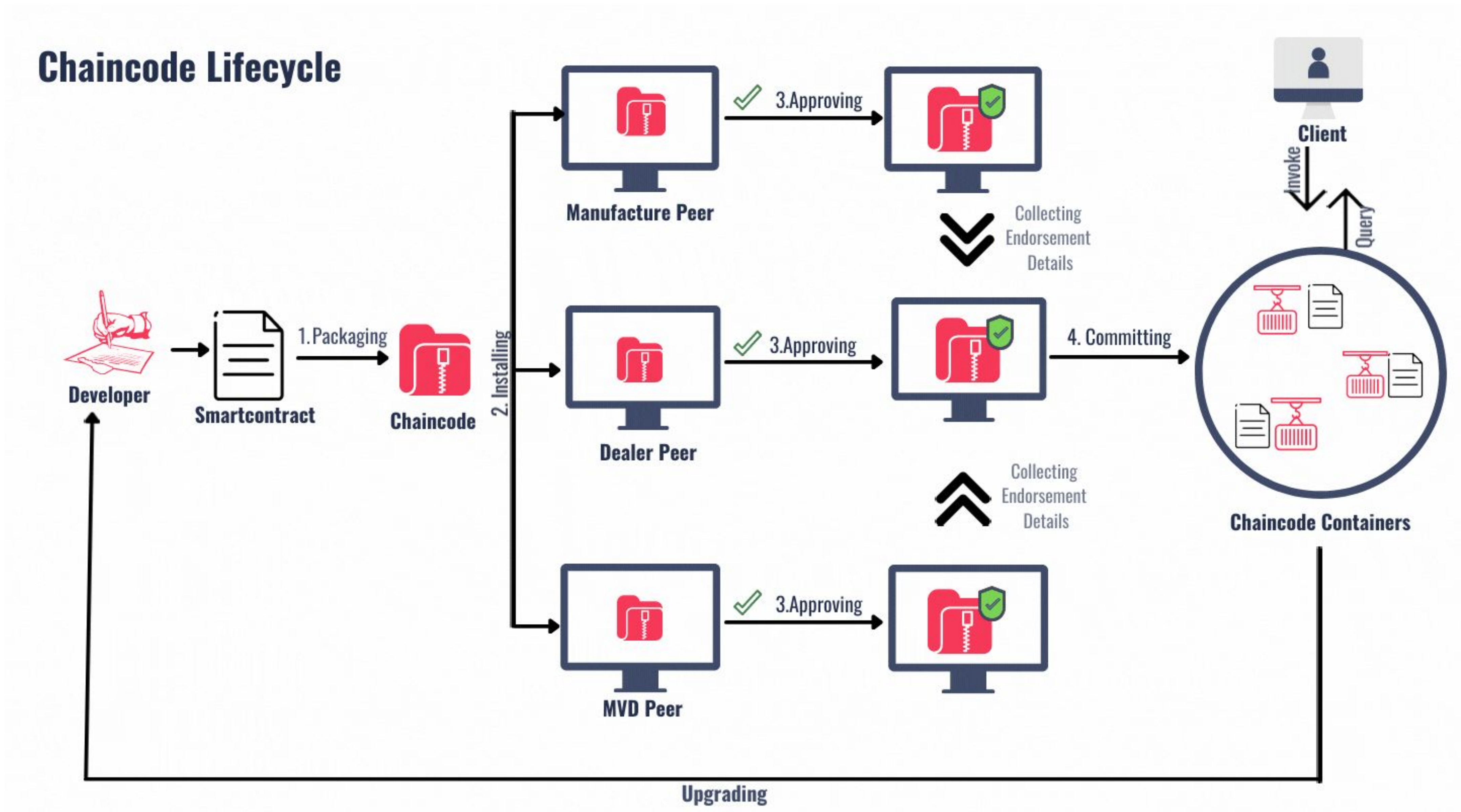
Some of the commonly used functions for chaincode development are:

- **ctx.GetStub().PutState(carID, bytes)**
- **ctx.GetStub().GetState(carID)**
- **ctx.GetStub().DelState(carID)**
- **ctx.GetClientIdentity().GetMSPID()**
- **contractapi.NewChaincode(carContract)**
- **chaincode.Start()**

Chaincode Lifecycle

- Packaging (TAR.gz)
- Installing
- Approving Chaincode Definition
- Committing in a Channel

Chaincode Lifecycle



System Chaincode

- **_lifecycle** runs in all peers and manages the installation, approval and committing of chaincodes.
- **Lifecycle system chaincode (LSCC)** manages the chaincode lifecycle for the 1.x releases of Fabric.
- **Configuration system chaincode (CSCC)** runs in all peers to handle changes to a channel configuration.
- **Query system chaincode (QSCC)** runs in all peers to provide ledger APIs which include block query, transaction query etc.
- **Endorsement system chaincode (ESCC)** runs in endorsing peers to cryptographically sign a transaction response.
- **Validation system chaincode (VSCC)** validates a transaction, including checking endorsement policy and read-write set versioning.

THANK YOU

K B A