HYPERLEDGER

Fabric V1.0 Proposal

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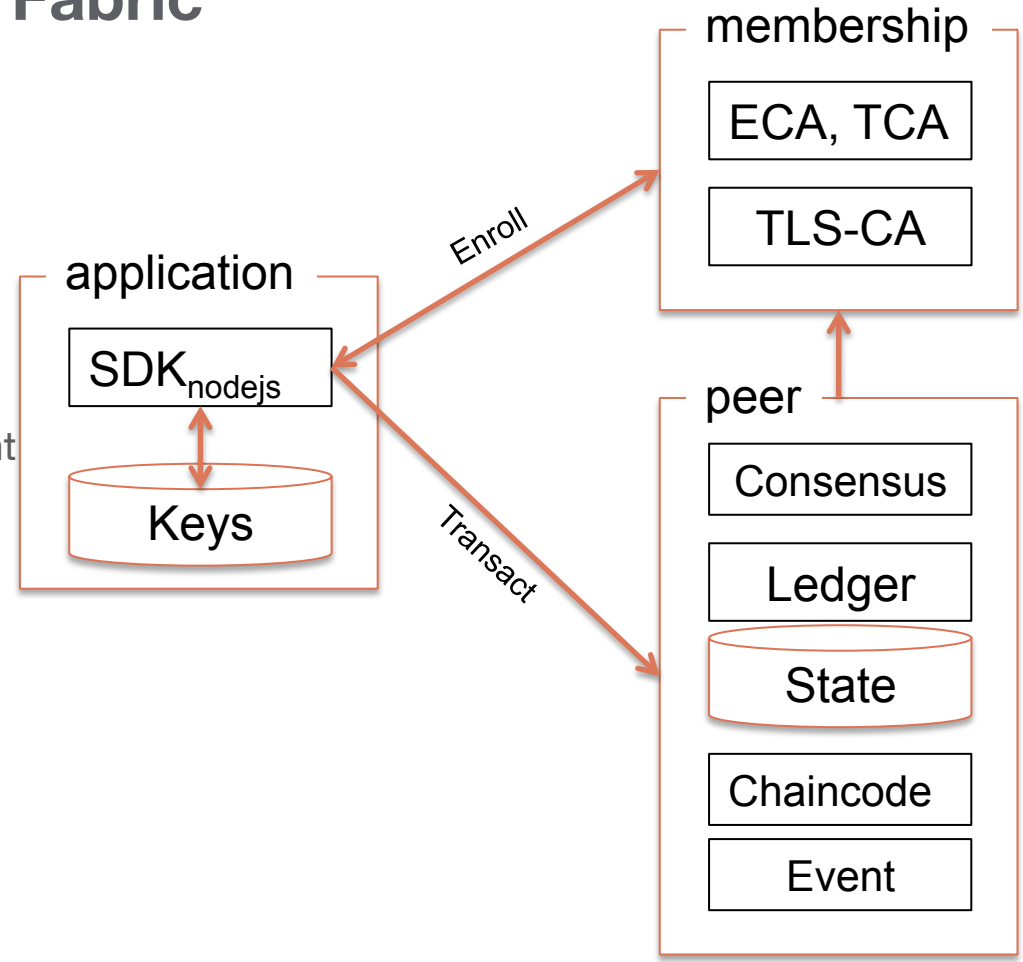
Overview

- Review the current Hyperledger Fabric implementation
- Motivation for the next proposal
- Hyperledger Fabric Next in detail
- Development and release roadmap

Current Hyperledger Fabric

- Permissioned blockchain with privacy, confidentiality, and auditability
- Pluggable consensus framework
  - PBFT, SIEVE (proto), NOOPS
- Chaincode execution environment (Go, Java WIP)
  - Docker container (user-cc)
  - In peer process (system-cc)
- Client Node.js SDK
- REST APIs
- Basic CLI



Motivations for Fabric Next

- Better support for confidentiality
- Scalable in number of participants and transaction throughput
- Eliminate none deterministic transactions
- Enable pluggable data store
- Ability to upgrade fabric and chaincode
- Remove SPF and enable multiple providers of Membership Services

Redefining Key Components

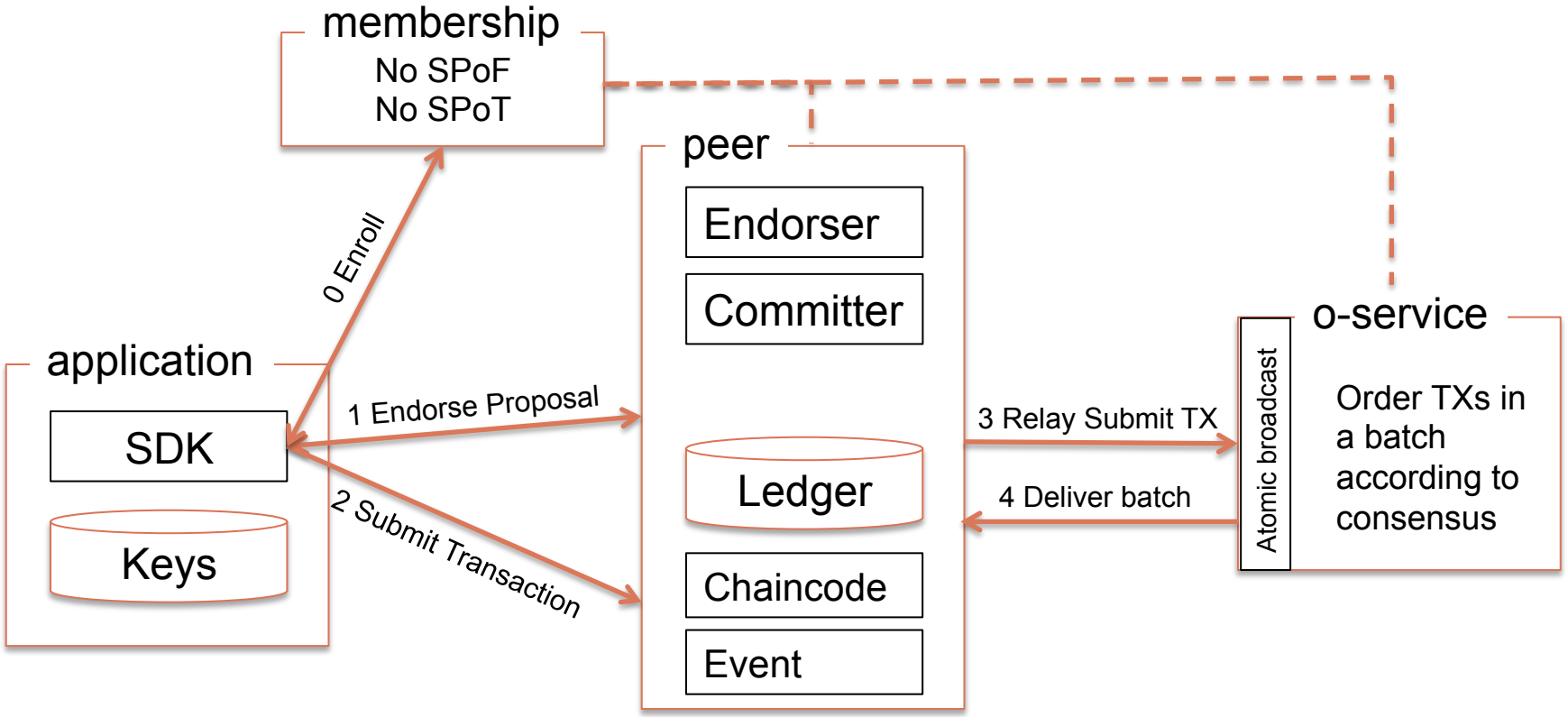
- Client SDK: Assists application security and transacting on blockchain
- Peer: Responsible for endorsing, validating, and committing transactions
  - Maintaining the ledger and aware of other peers via gossip network
  - Peer is stateless (no memory between transactions)
- Consenter: Runs consensus to provide atomic broadcast

- More detail: https://github.com/hyperledger/fabric/wiki/Next-Consensus-Architecture-Proposal

Assumptions

- No backward compatibility with v0.5 Developer-Preview
  - Protocol and blockchain structure changes
- Since Consenters are agnostic about the transaction content, application may use hash(transaction) for confidentiality and manage the transaction content

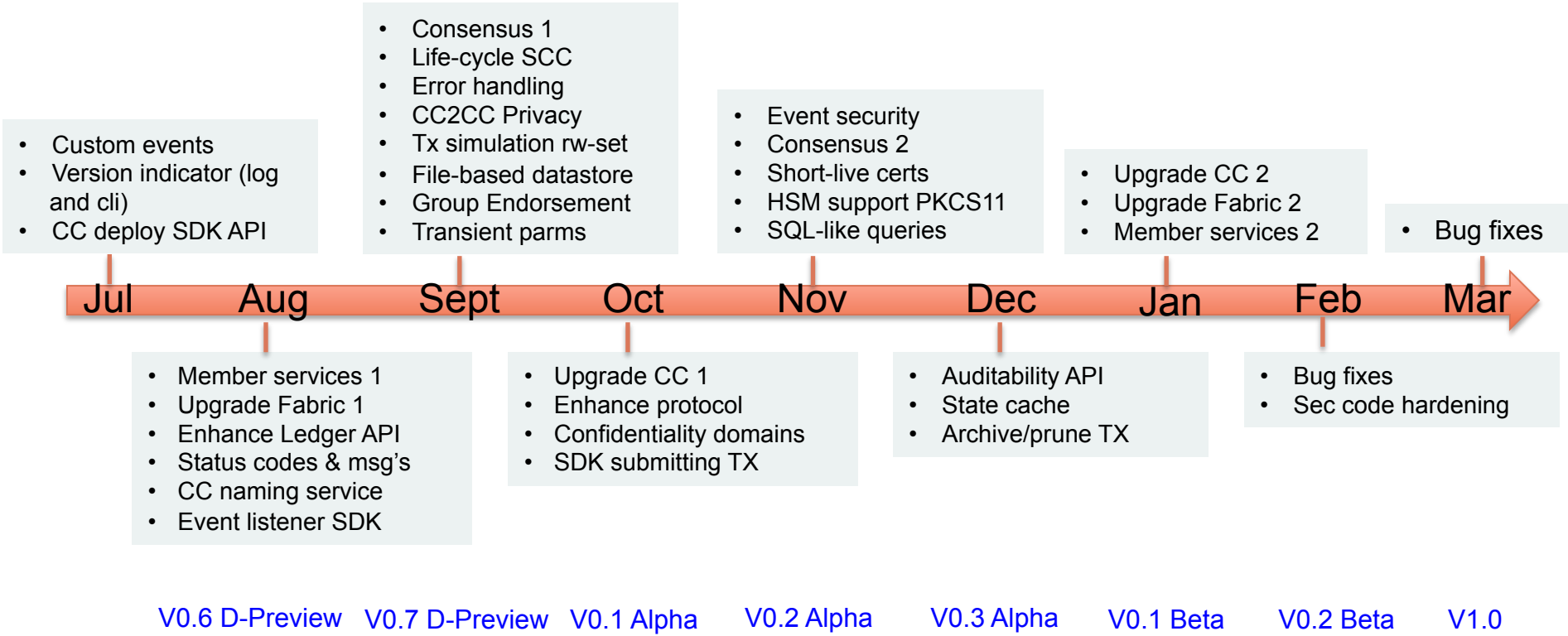
High Level Interaction



Key Development Items

- Consensus
- Multi confidential domains
- Security (ACL, HSM, CC2CC, event)
- Ledger abstraction API and data store
- SDK (submitting transaction)
- Transaction endorsement and validation system chaincode
- Membership services high availability with multiple providers
- Fabric upgrade
- Life-cycle system chaincode
- Naming system chaincode
- Enhance protocol (including status codes and messages)
- Error handling

Hyperledger-Fabric Proposed Roadmap & Releases



Technical Details

Transaction Defined

- Transaction is a chaincode function call
  - transaction : <proposal> <endorsements>
  - proposal : chaincode, <function-spec>
  - function-spec: function name, arguments
  - endorsements : proposal hash, simulation result

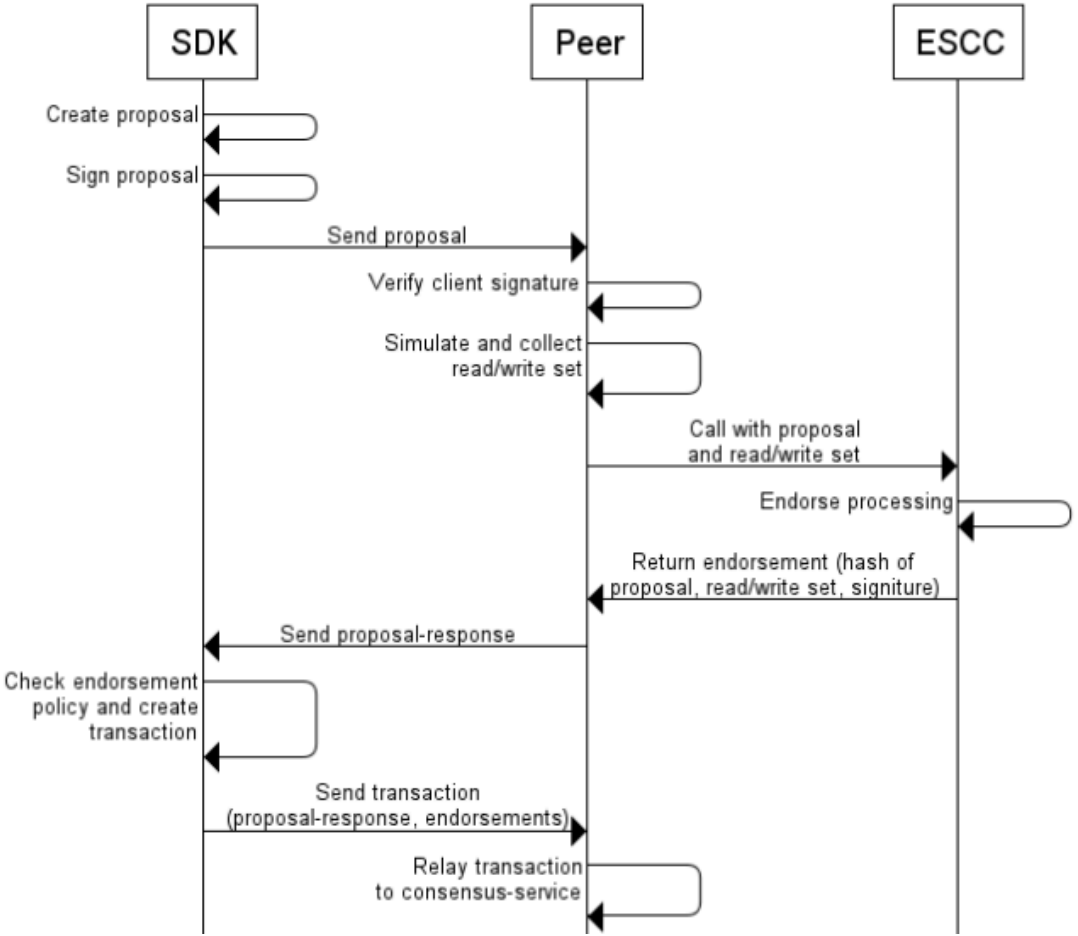
- Each chaincode may be associated with an endorsement and validation system chaincode (ESCC, VSCC)
  - ESCC decides how to endorse a proposal (including simulation and app specifics)
  - VSCC decides transaction validity (including correctness of endorsements)

Bootstrap

- Orderer bootstrap
  - Configuration contains 1 or more anchor nodes ip:port
  - Connect to anchors and start discovery protocol using ecert
- Peer bootstrap
  - Configuration contains 1 or more anchor Peers and an Orderer proxy address
  - Connect to the anchor Peers and start discovery protocol using ecert
  - Connect to the Orderer proxy to send/receive transactions

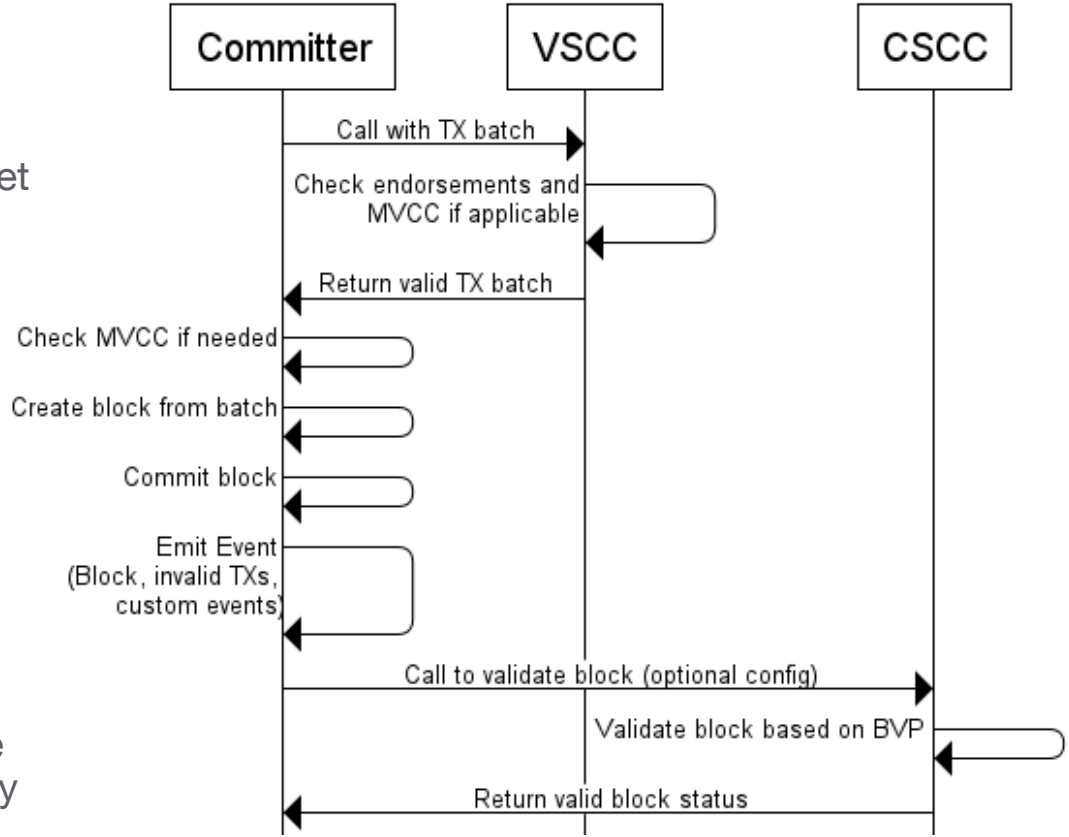
Endorse Transactions

- SDK sends Proposal to Peers based on the chaincode's endorsement policy
  - A peer may relay Proposal on client behalf
- Endorser system chaincode (ESCC) processes the endorsement
  - ESCC provides ability to customize endorsement
  - Default logic will just sign the Proposal Response
- Client/SDK decides transaction content if endorsement satisfied



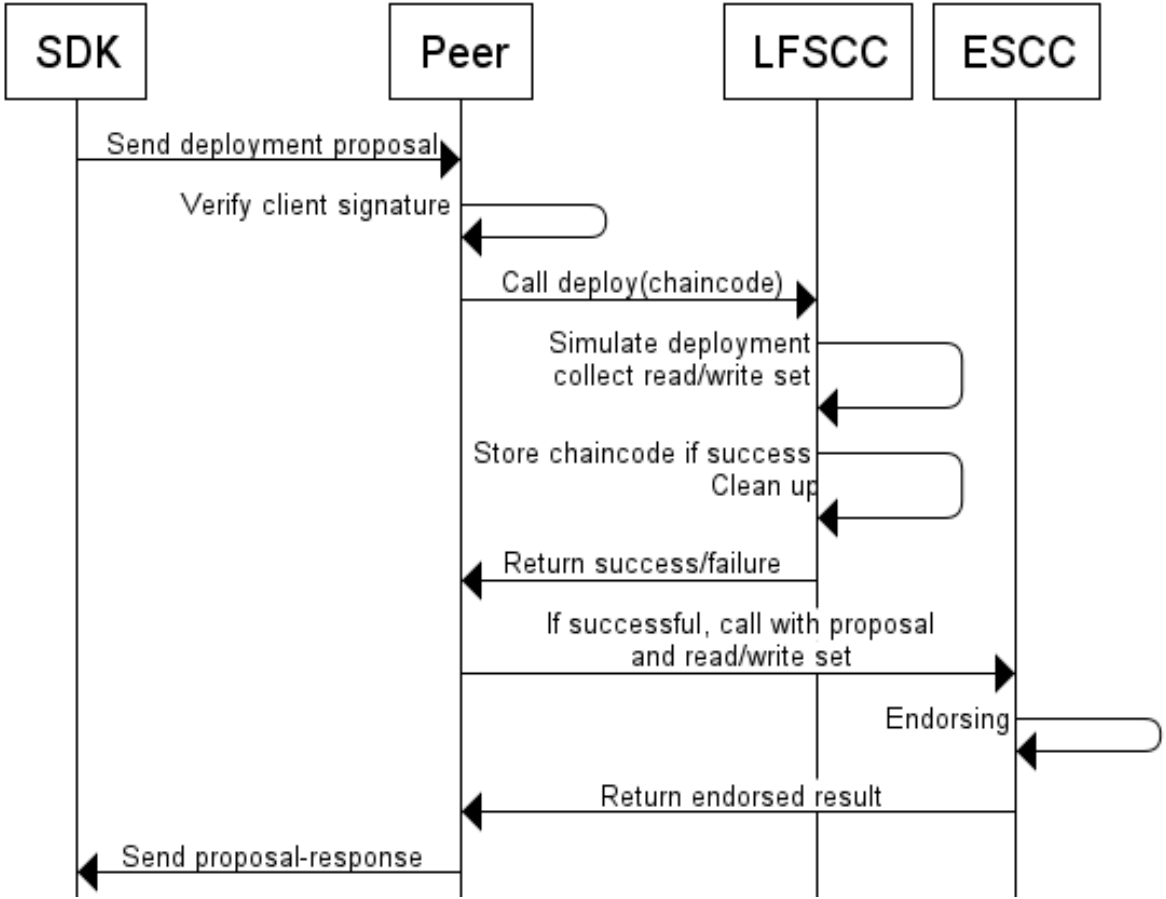
Commit Transactions

- Committing a transaction involves validating each transaction read/write-set and endorsements
- Committer calls Validator system chaincode (VSCC) to validate the batch and commit the block
  - VSCC may perform more sophisticated validation (eg executing script OP_CHECKSIG in Bitcoin)
- Emit events (block, invalid TXs, custom)
- Block may be optionally validated (ie checkpoint to detect faulty and prune ledger) by Committer system chaincode (CSCC) based on Block Validation Policy



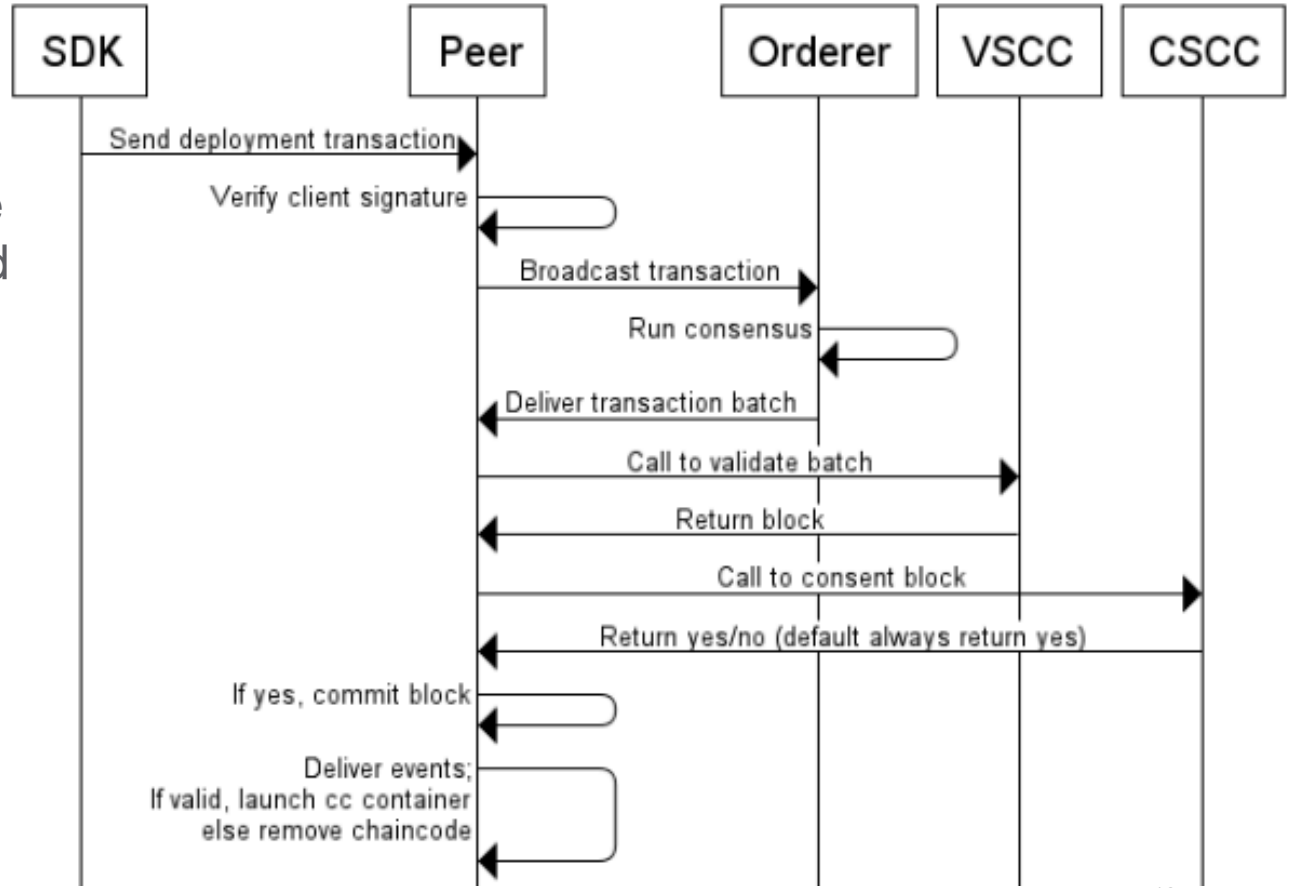
Chaincode Deployment Proposal

- Proposal is a call specification to the Life-Cycle System Chaincode LFSCC to deploy a user chaincode (UCC)
- LFSCC creates version record (version, ucc hash, name) in read-write set
- LFSCC removes container before returning



Chaincode Deployment Transaction

- Deployment transaction records the chaincode address and its initial values onto the ledger
- If the transaction has been successfully committed, launch the container



Upgrade Chaincode

- Upgrade is to deploy a new version of a chaincode with the same name, where version could be the hash of the chaincode source or a mapped name maintained by LCSCC
- Read-write set includes the version of the chaincode used in simulation
- Any transaction referencing the old version is invalid during commit

Query vs Proposal

- Committer provides GRPC interface for structure queries (block, transaction)
  - Transactions might be encrypted (eg, originally submitted form)
- Endorser enables client to “call” chaincode via endorsement proposal from which chaincode may return result
  - Application may call multiple endorsers to get “strong read”

Backup

Security & Privacy

- HSM
  - Support PKCS11 to access crypto functions (eg key generation, signature, encryption) on peer, consenter, membership services, and sdk
- Chaincode calling chaincode within a confidential domain
- Confidential event
- Chaincode upgrade with key update
- User-based confidentiality
- Peer-based confidentiality

Membership Services

- Phase 1
  - Cluster of membership service instances
- Phase 2
  - No single company or entity alone control access to the blockchain for all users
  - Guarantee the uniqueness of the enrollment ID globally for a chain

Upgrade Fabric

- Replace code
- Replace code with protocol changes
  - Backward compatibility
- Replace code with ledger migration

Upgrade User Chaincode

- Deploy and switch name
- Deploy, switch name and migrate data

Consensus

- Phase 1
  - Separation of consensus into a standalone process (SOLO)
  - Basic endorsing and committing peer with validation
- Phase 2
  - Batch to block with validation on multiple peers
  - Scalability and performance
  - Dynamic adding/removing members