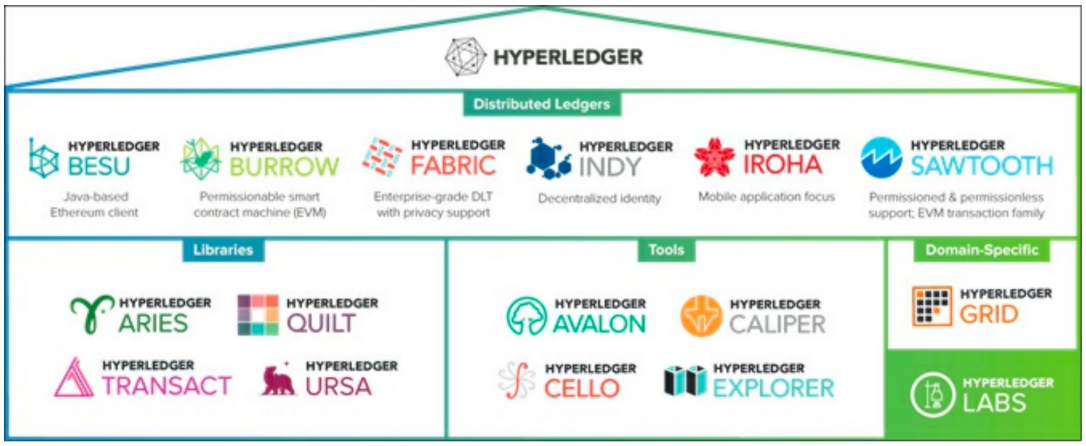
HYPERLEDGER

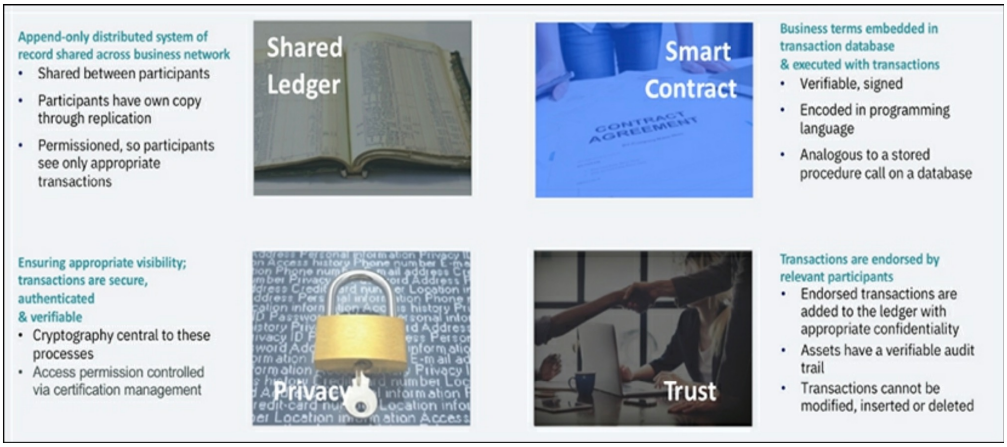
23

Hyperledger Framework



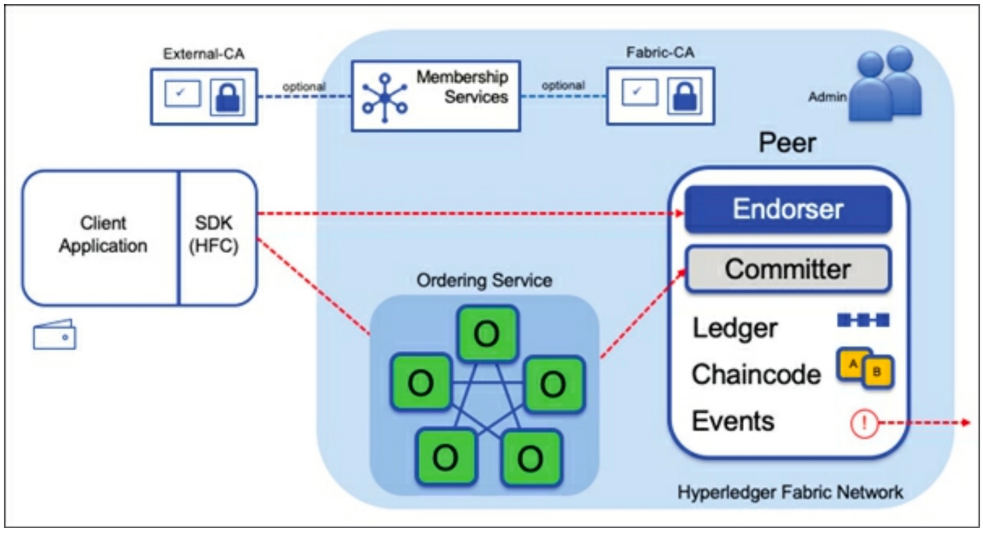
24

Blockchain Components



25

Hyperledger Fabric



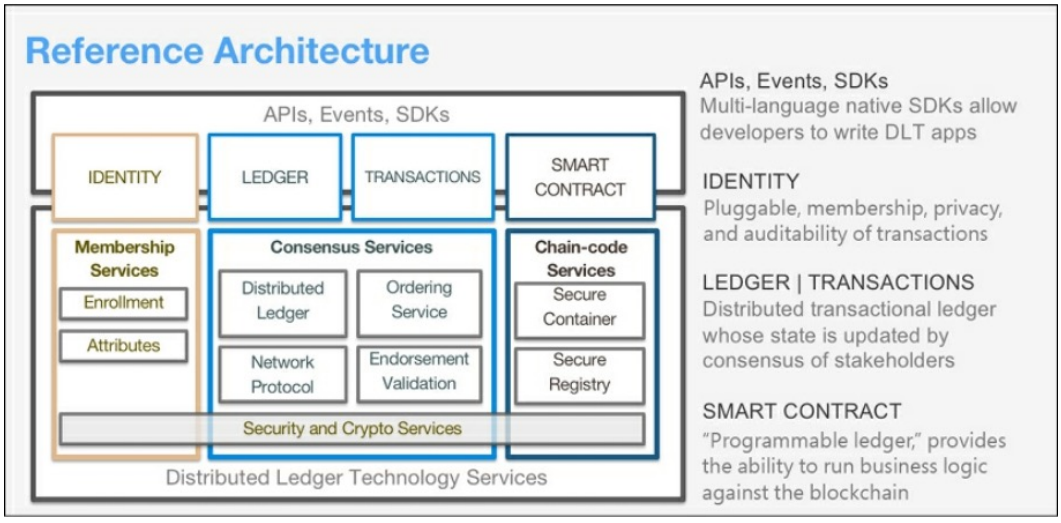
26

Hyperledger Fabric

- Membership Service
  - X509 Certificate Authority, PKI
  - Mixer network for anonymity
- Dedicated orderer nodes
  - Agreement on order of transactions
  - Ex: Raft, Kafka
- Peers
  - Endorsers: Execute smart contracts
  - Committers: Add transactions to blockchain

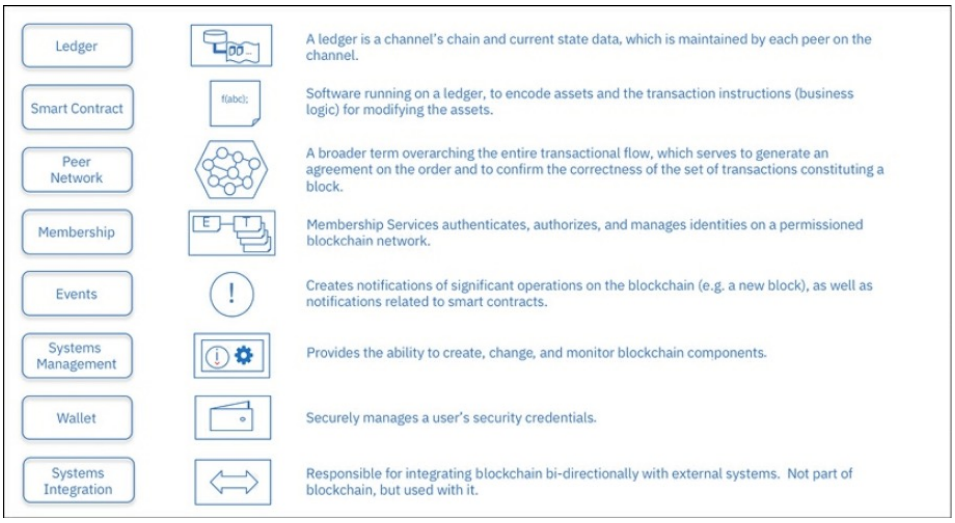
27

Reference Architecture



28

Blockchain Network Components



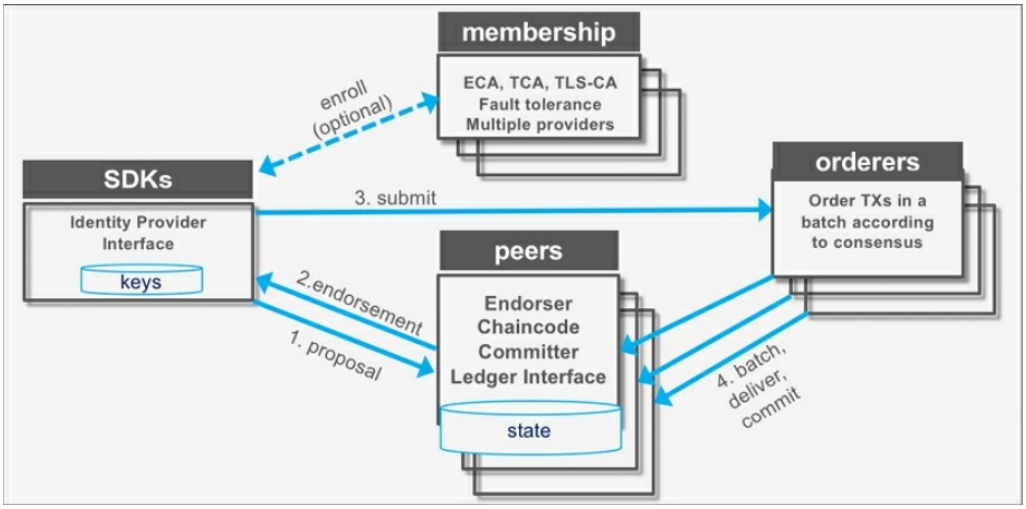
29

Hyperledger Concepts

- Transaction
  - Request to execute function on ledger
- Channel
  - Partition of ledger
- State database (world state)
- Contract service
  - Execute smart contract on world state
- Event
- Consensus

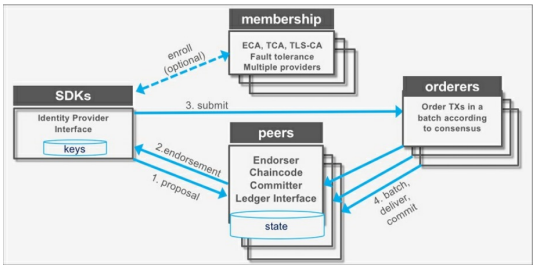
30

Runtime Architecture



31

Runtime Architecture



- Transaction proposal (client SDK):
  - Sent to multiple endorsing peers
- Transaction endorsement:
  - Endorsing peers execute the txn
- Transaction submitted to the ordering service:
  - Client SDK submits endorsed transaction proposals
  - Ordering service orders them into blocks
- Transaction validation:
  - Validate before committing to the ledger
  - Endorsement policy and state DB

32

Transaction Flow

- Endorsement of a transaction and checking its validity (validation step)
  - Gateway for correct transactions
- Ordering through an ordering service
  - Consensus
- Validation and transaction commitment
  - Application-specific trust assumptions

33

Types of Nodes

- Endorsing peer
  - Grant or deny
  - Execute smart contract
  - Transaction proposal
- Ordering nodes (service)
  - Approve addition to ledger
- Committing peer
  - Maintains the ledger and state

34

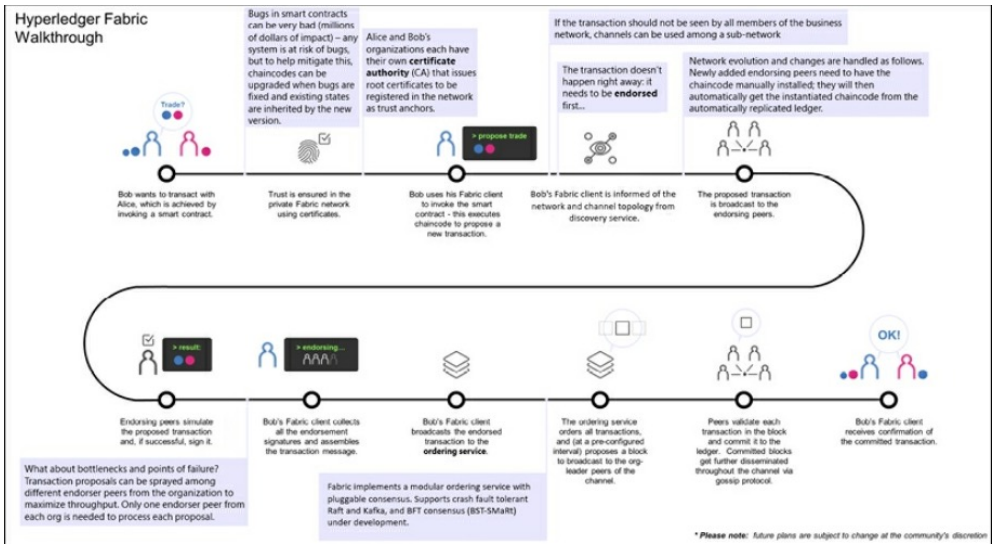
Types of Validation

- Endorsement
  - Smart contract
- Ordering
  - Consistency

- *Contract execution and block commit are separate!*

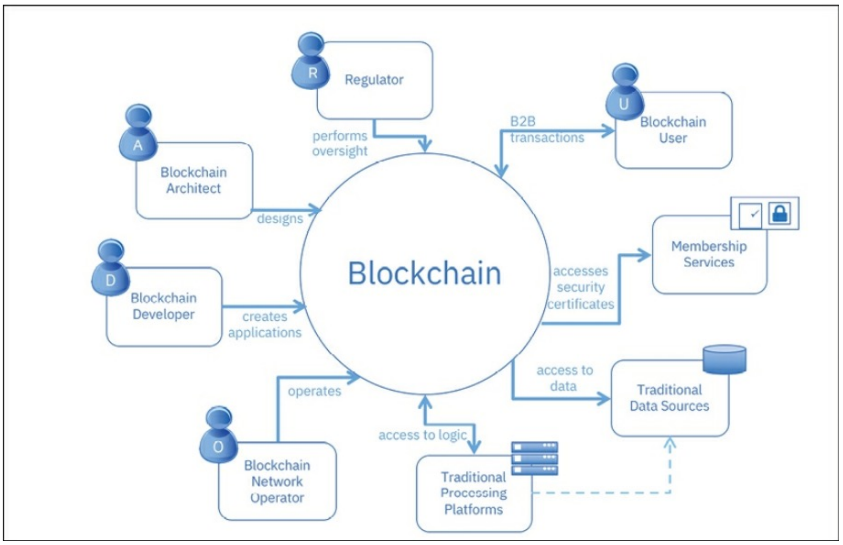
35

Flow of a Transaction



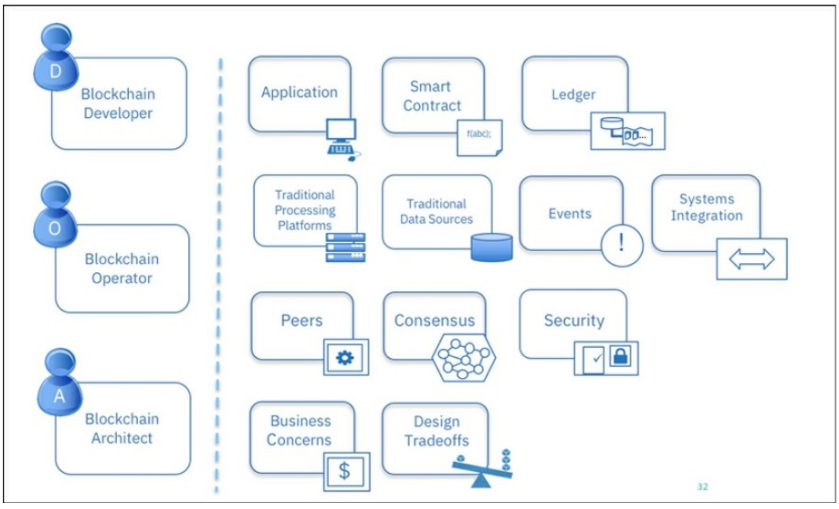
36

Actors in Blockchain Network



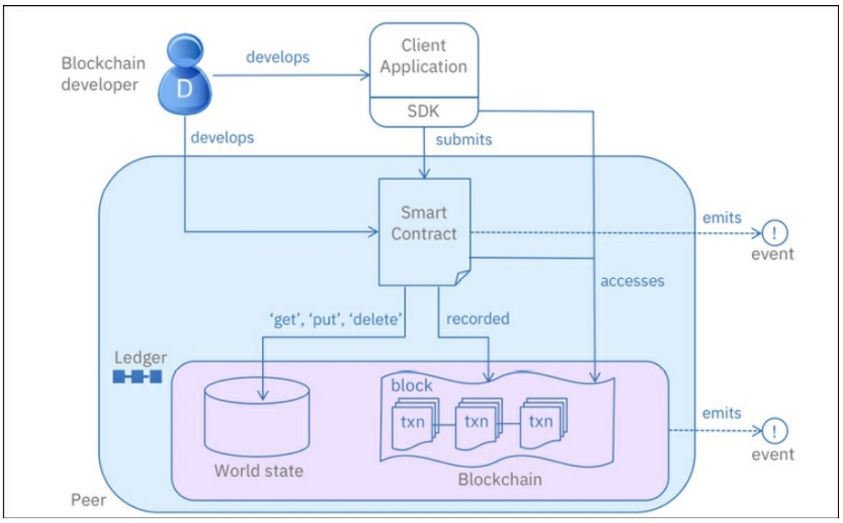
37

Roles in Blockchain Network



38

Developer Interaction



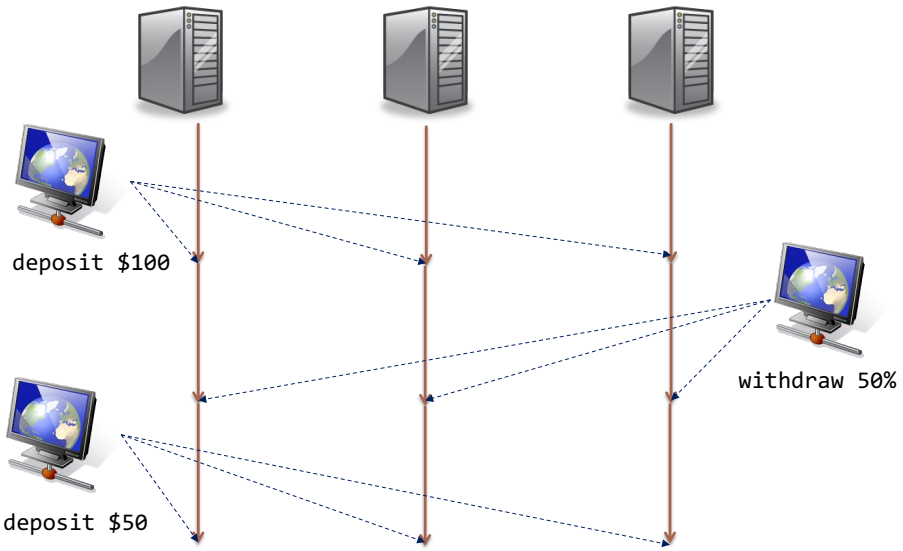
39

Consistency and Availability

- Blockchain is distributed database
- Consistency
  - All copies are "the same"
- Availability:
  - Can perform queries and updates

40

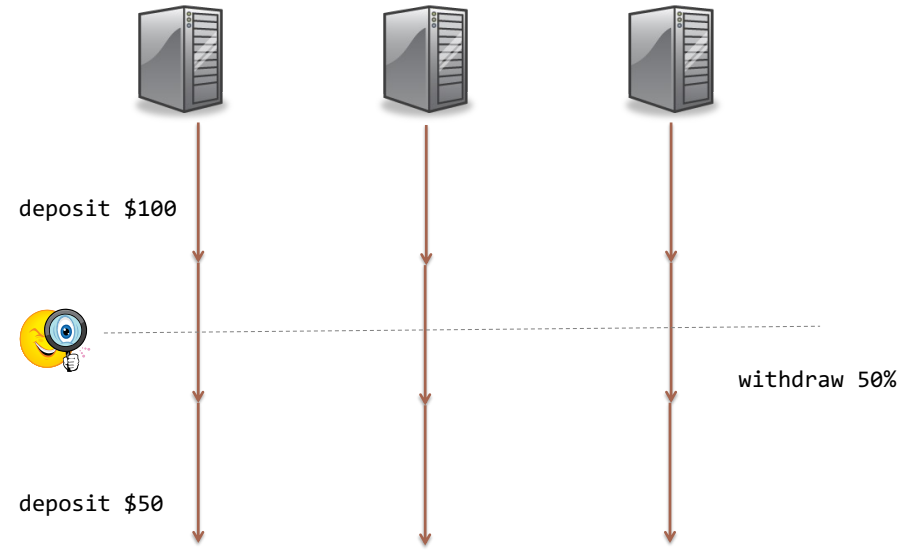
Strong Consistency



41

41

Strong Consistency

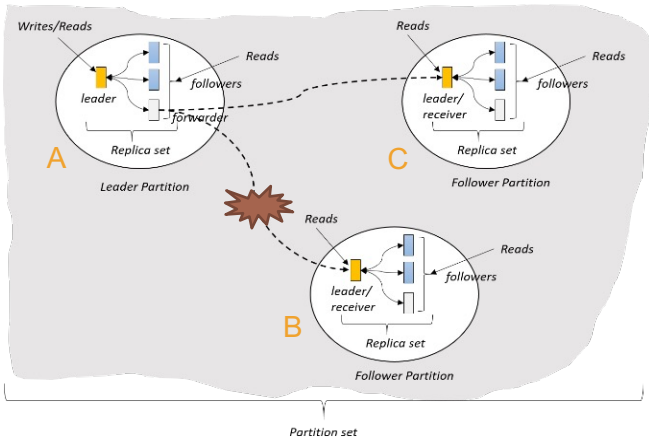


42

42

Consistency with Network Partition?

~~X=5~~
X=6



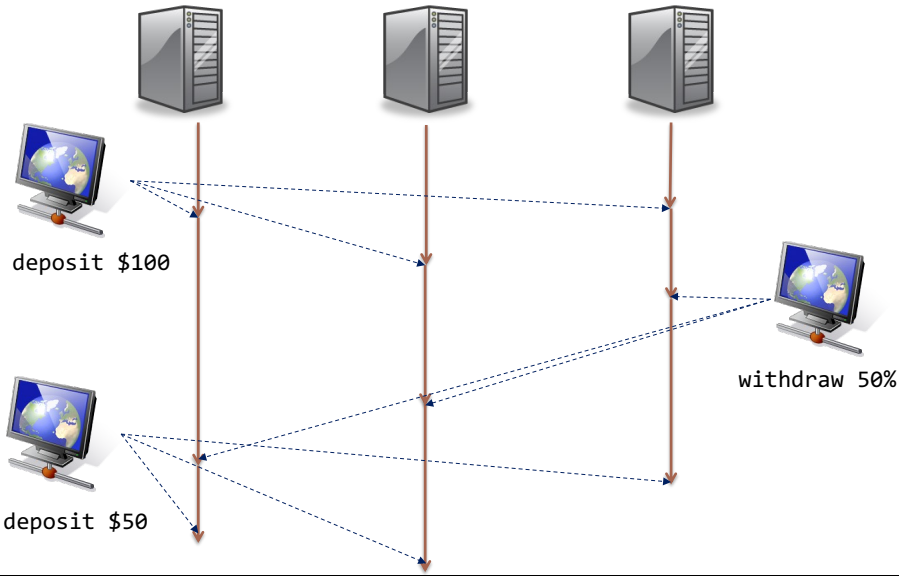
~~X=5~~
X=6

X=5

43

43

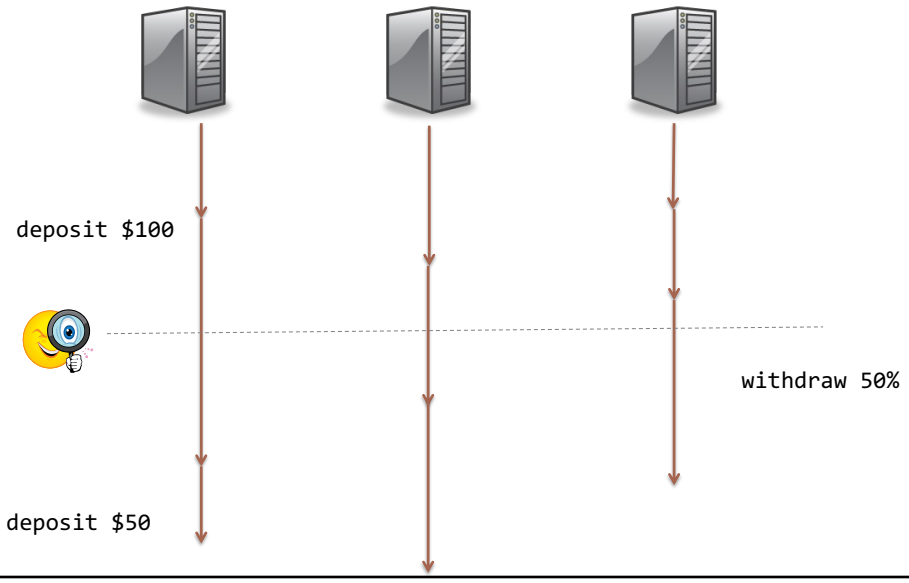
Eventual Consistency



44

44

Eventual Consistency

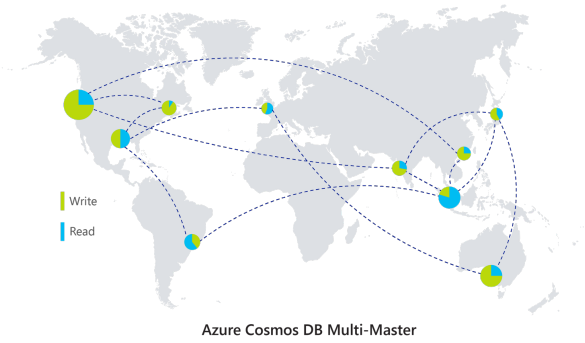


45

45

Consistency and Availability

- CAP Theorem: With network failures, cannot achieve both consistency and availability
- Bigger issue is consistency vs *latency*



46

Hyperledger Fabric Consistency

- Ordering nodes implement total broadcast
  - Agreement on global order
  - See Paxos protocol
- Transaction commit
  - Serializability part of final validation check
  - Multiversion concurrency control (MVCC)

47