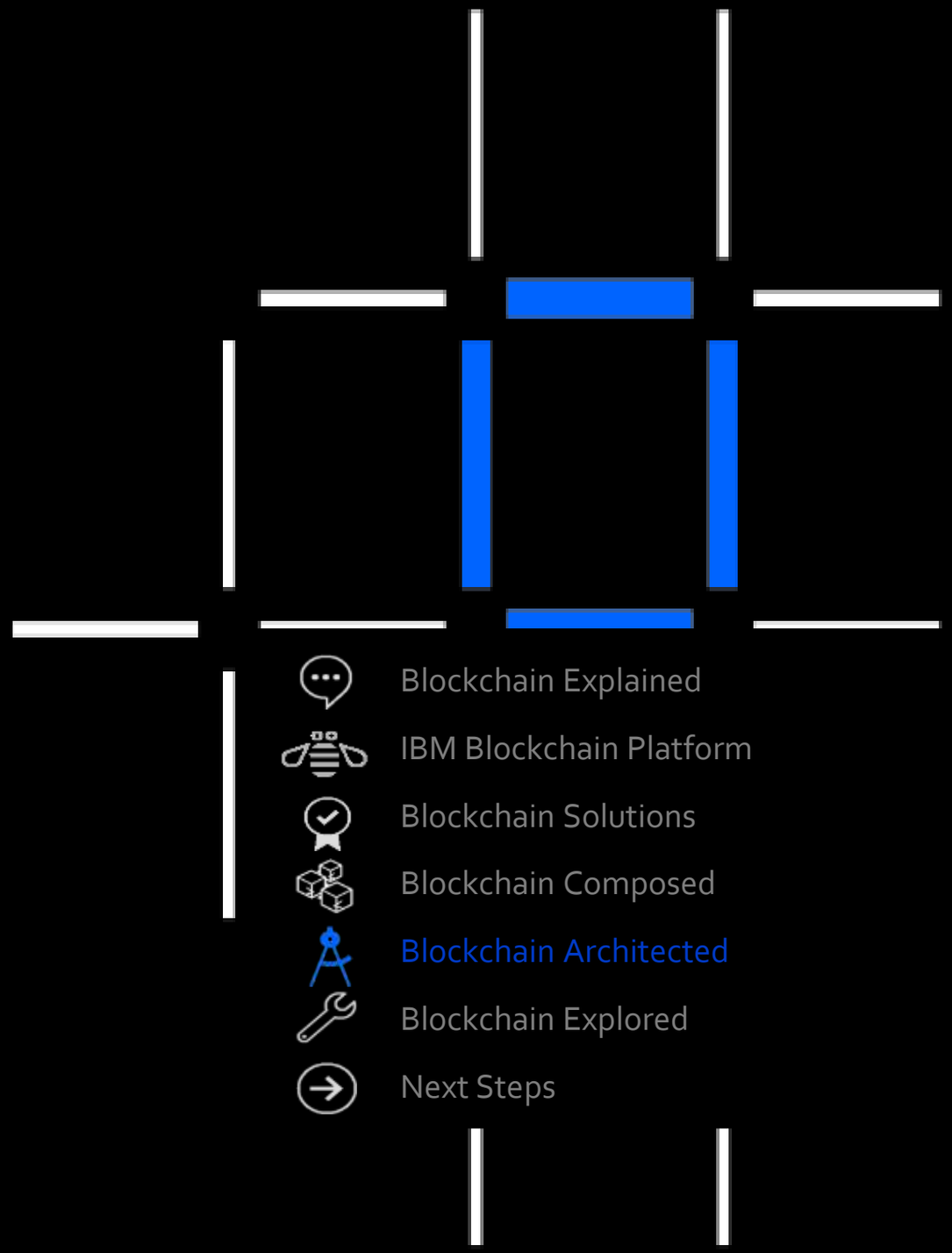
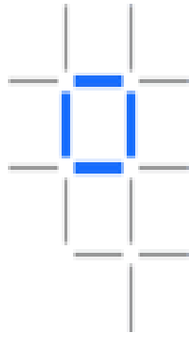
Deploy a blockchain web-app with Hyperledger Fabric

Horea Porutiu
Advisory Software Engineer, IBM
July 2019



IBM **Blockchain**

By a show of hands…



1. Understands how blockchains work?
2. Know what Hyperledger Fabric is?
3. Developed a smart contract?
4. Developed a dapp?
5. Deployed a network to production?

What you will learn

1. Blockchain vocabulary

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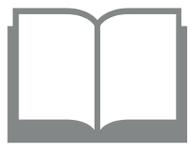
1. Blockchain vocabulary 
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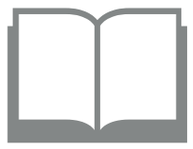
1. Blockchain vocabulary 
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What you will learn

1. Blockchain vocabulary
2. A use-case of blockchain
3. Architecture behind a Hyperledger Fabric solution
4. Difference between the world state and the ledger
5. Difference between public and private blockchains
6. How a client application invokes a smart contract

Security: Public vs. private blockchains

Public blockchains

- Bitcoin
- Users treated equally
- Identity is anonymous

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- Hyperledger Fabric, Quorum
- Network members known, transactions can be secret

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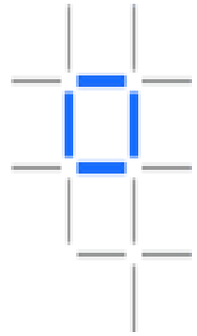

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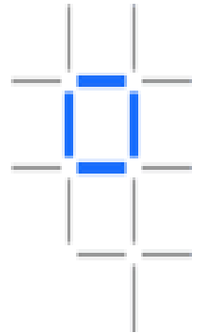

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Private blockchains

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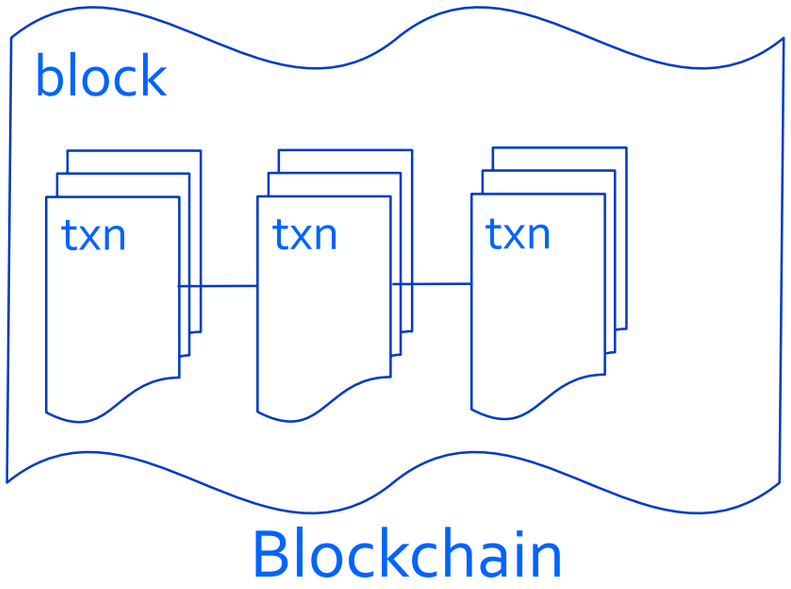
- Most business use-cases require private, permissioned blockchains
  - Network members know who they're dealing with (KYC)
  - Membership is controlled

A ledger often consists of two data structures



- Blockchain
  - A linked list of blocks
  - Each block describes a set of transactions

    (e.g. the inputs to a smart contract invocation)
  - Immutable – blocks cannot be tampered

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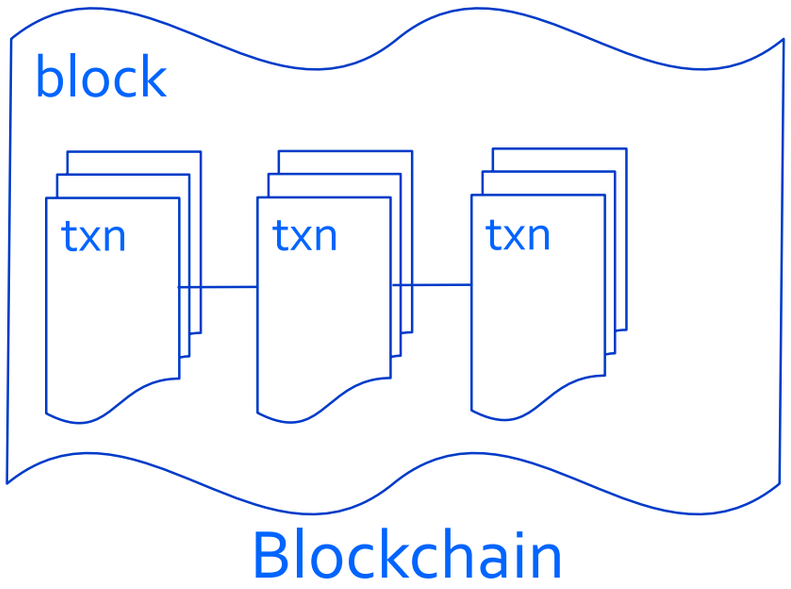

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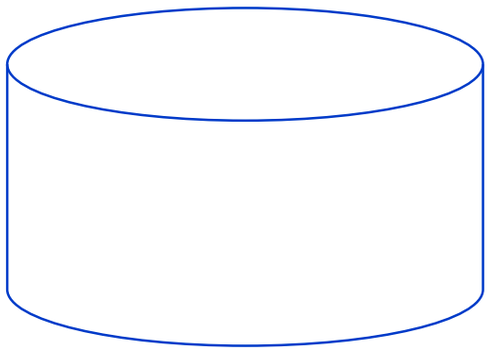
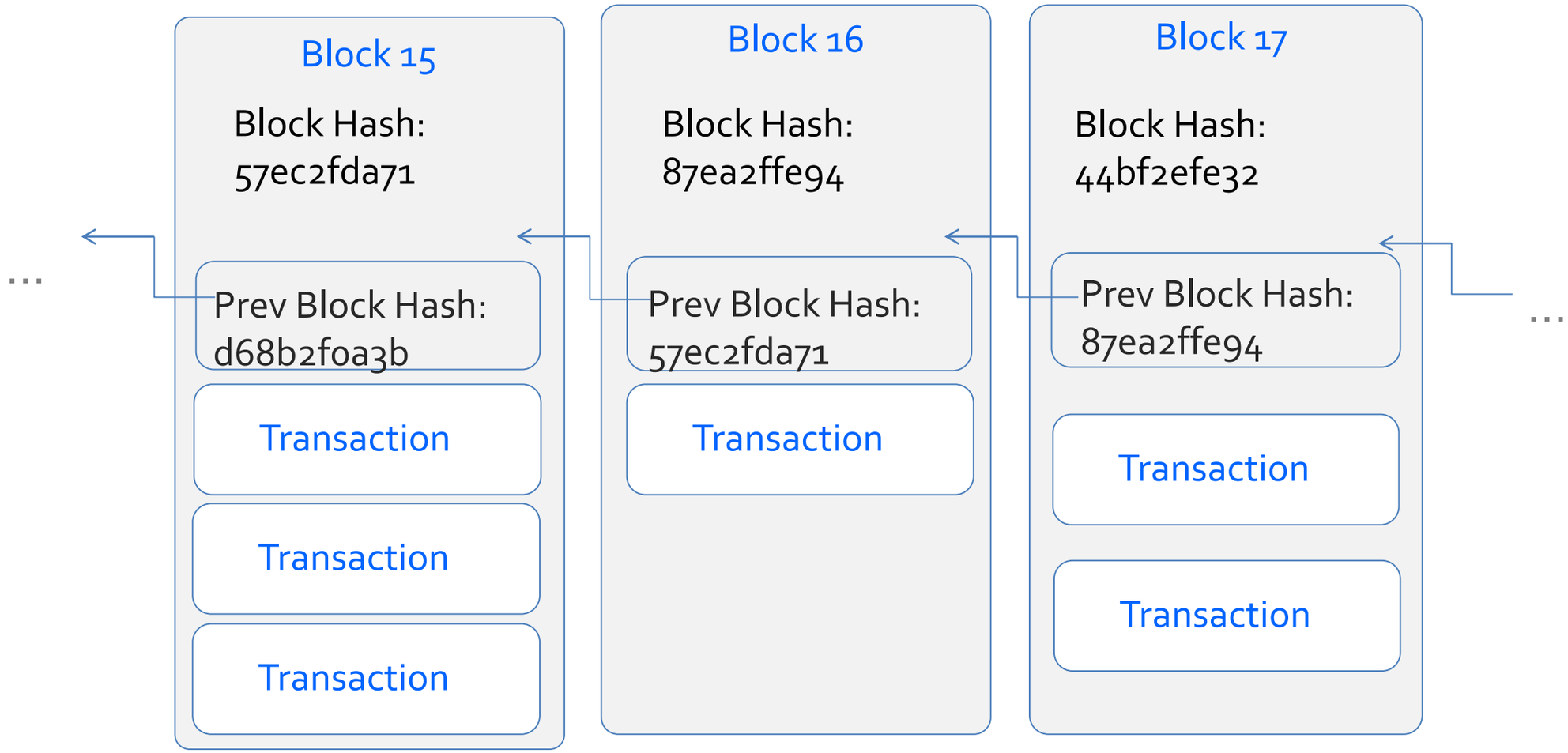


World state

- World State
  - An ordinary database (e.g. key/value store)
  - Stores the combined outputs of all transactions
  - CAN delete

Block detail (simplified)



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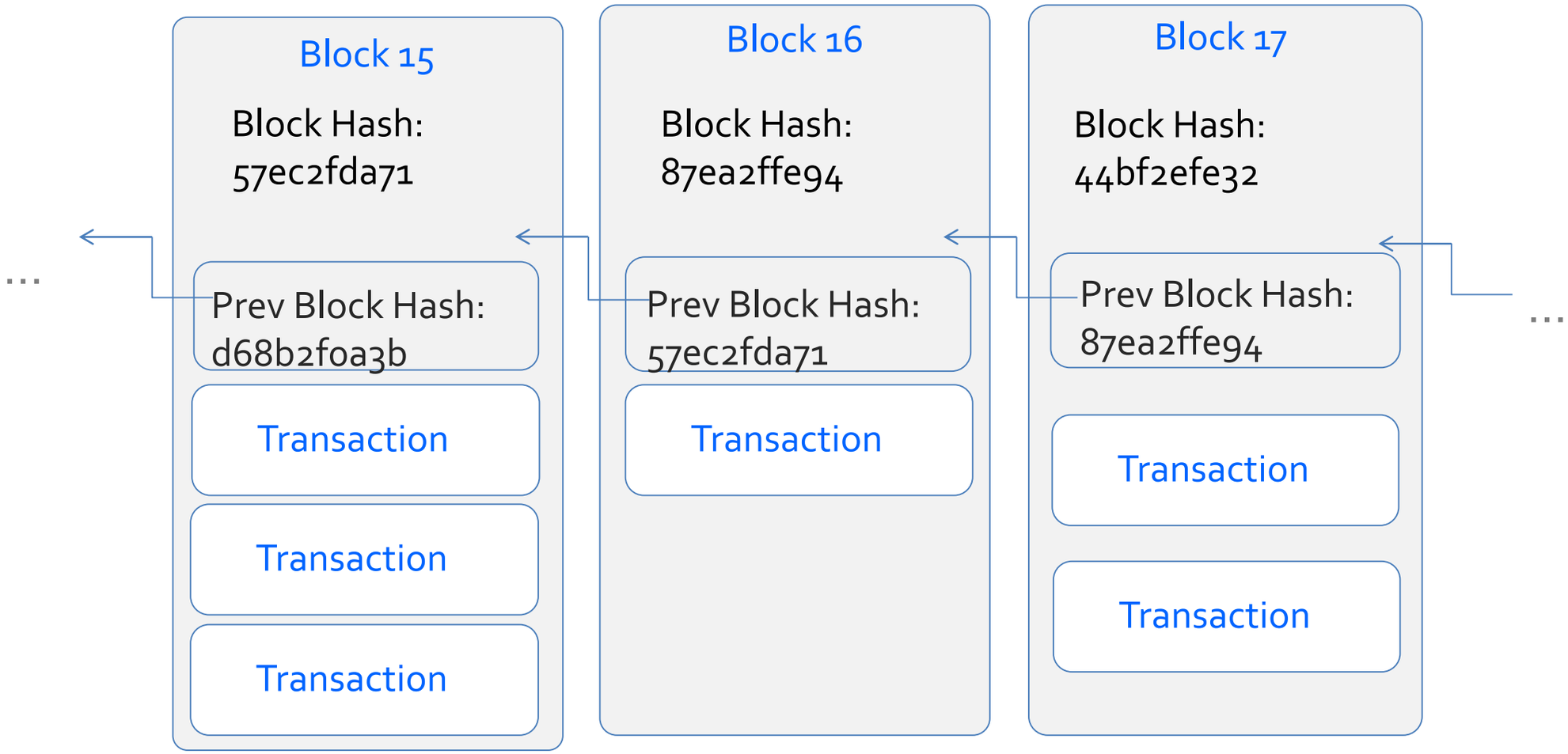
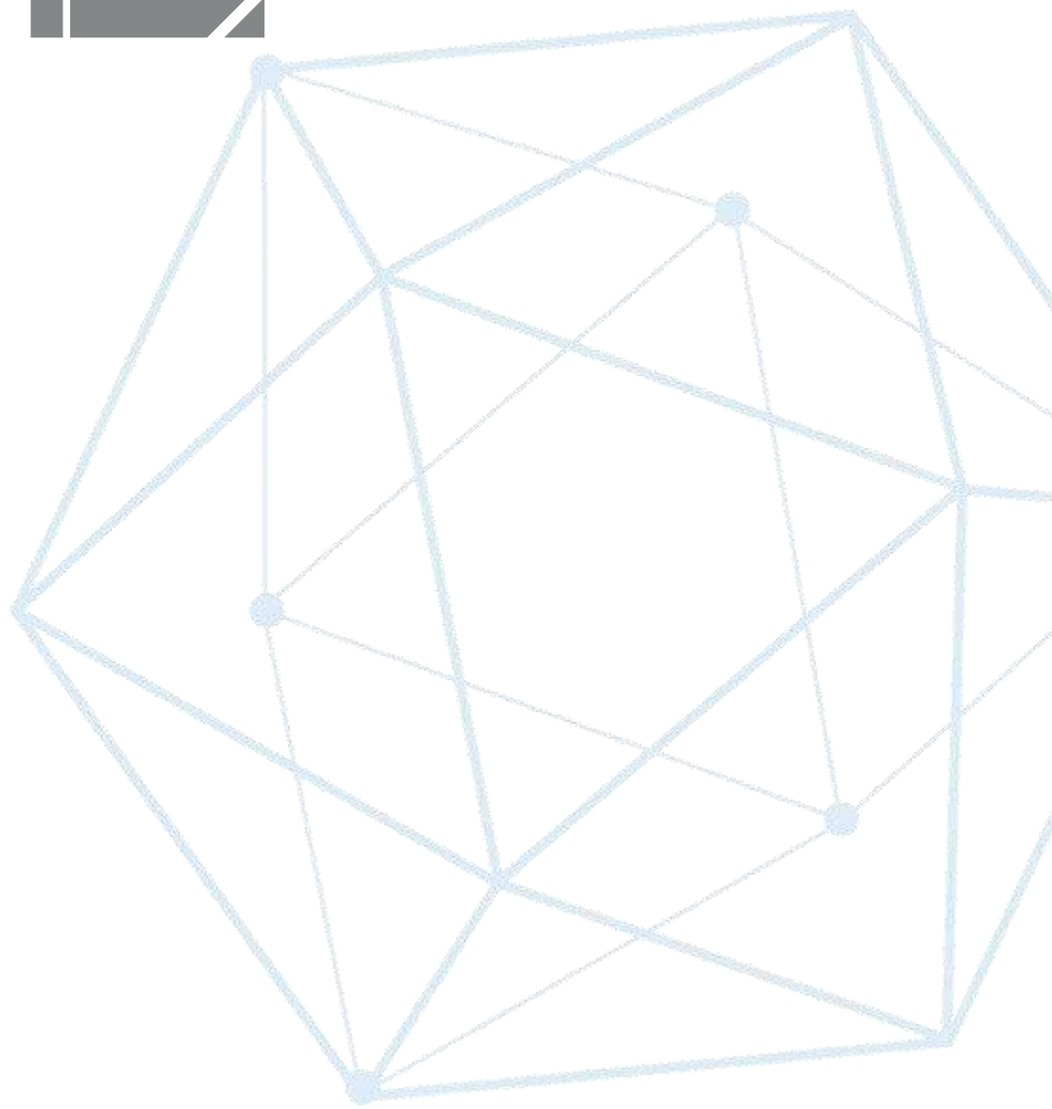


- New blocks always added to the end

- Each block header includes a hash of the current block transactions and the previous block's transactions

What is Hyperledger Fabric

- Platform for distributed ledger solutions



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  - Contributions by hundreds of engineers from tens of organizations

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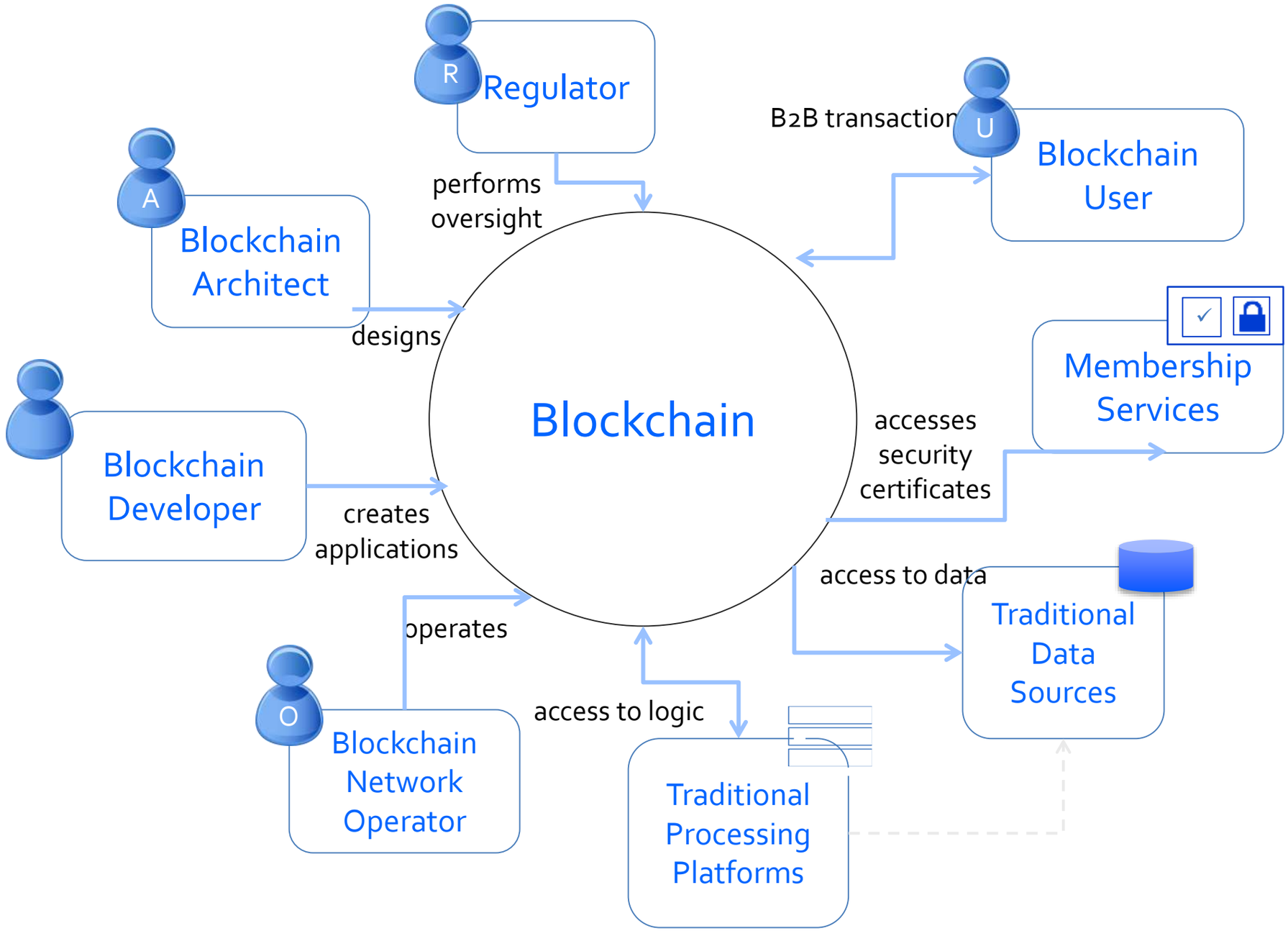
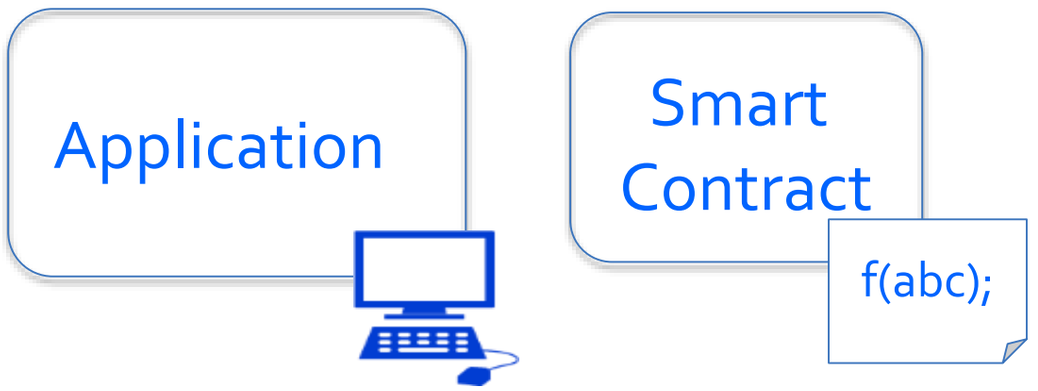
- Features
  - Smart Contracts (updates the ledger)
  - Consensus (synch ledger across network)
  - Privacy (channels)

Actors in a blockchain solution



The blockchain developer

Blockchain developers' primary interests are…



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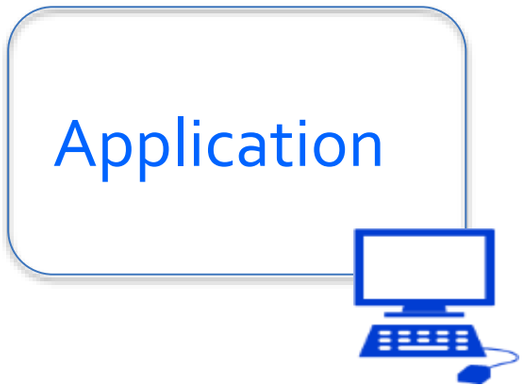
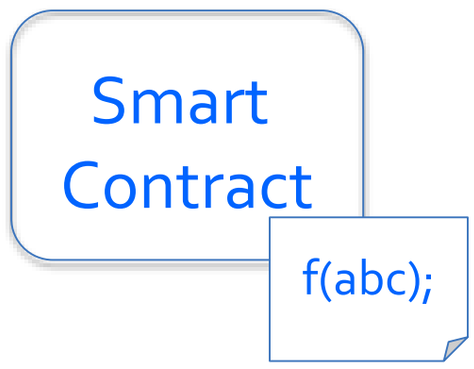
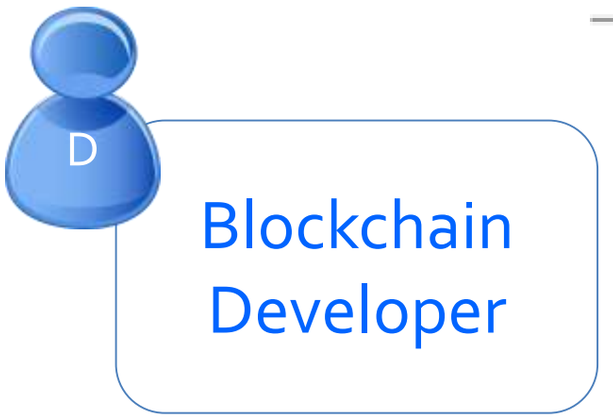
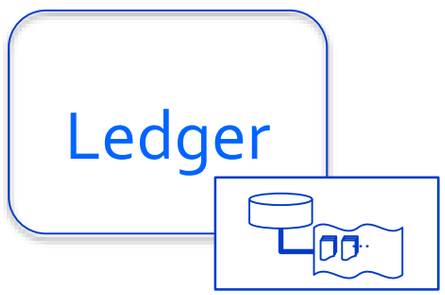
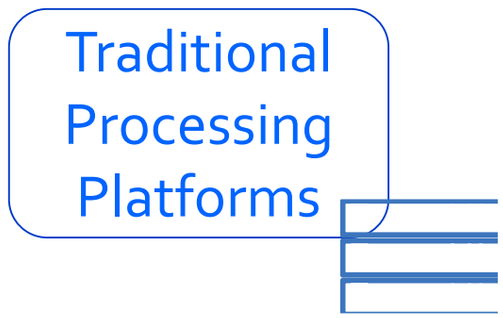


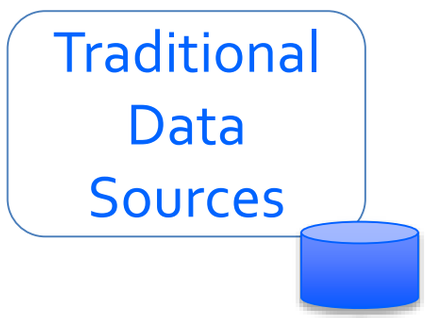


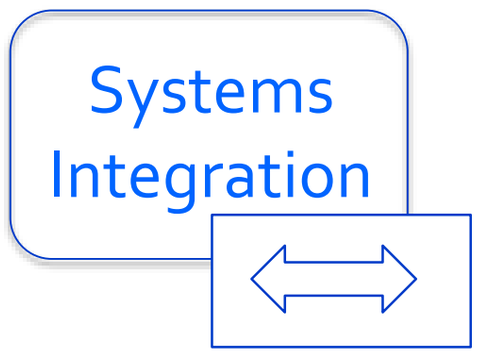


…and how they interact with the ledger and other systems of record:







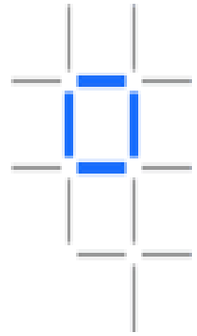


Components in a blockchain solution

Ledger

List of transactions maintained by peers

Components in a blockchain solution



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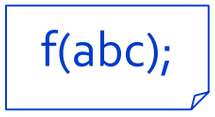

Software running on peer, updates the world state

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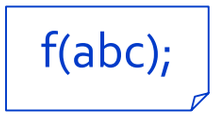
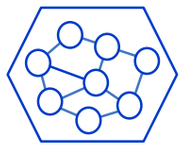
Smart Contract		Software running on peer, updates the world state
Peer Network		Network which reaches consensus to add blocks

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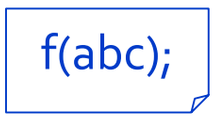
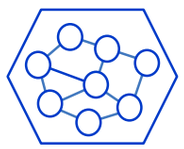
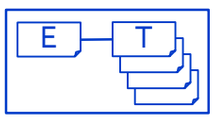
Smart Contract		Software running on peer, updates the world state
Peer Network		Network which reaches consensus to add blocks
Membership		Authenticates and manages identities on network

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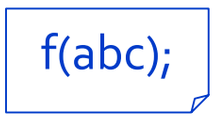
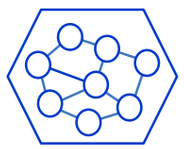
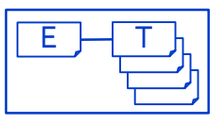
Smart Contract		Software running on peer, updates the world state
Peer Network		Network which reaches consensus to add blocks
Membership		Authenticates and manages identities on network
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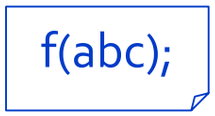
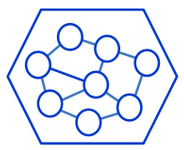
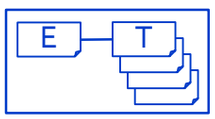
Smart Contract		Software running on peer, updates the world state
Peer Network		Network which reaches consensus to add blocks
Membership		Authenticates and manages identities on network
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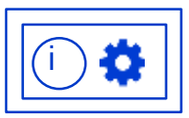
Systems Management		Enables us to create/monitor blockchain components

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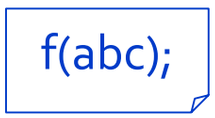
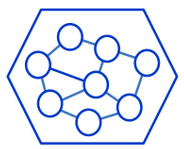
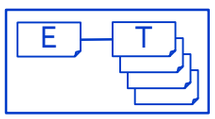
Smart Contract		Software running on peer, updates the world state
Peer Network		Network which reaches consensus to add blocks
Membership		Authenticates and manages identities on network
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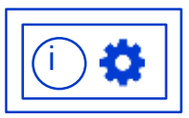
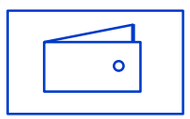
Systems Management		Enables us to create/monitor blockchain components
Wallet		Securely manages a user's credentials

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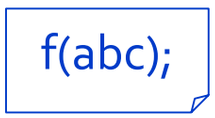
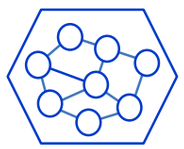
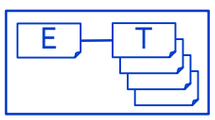
Smart Contract		Software running on peer, updates the world state
Peer Network		Network which reaches consensus to add blocks
Membership		Authenticates and manages identities on network
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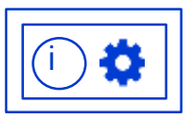
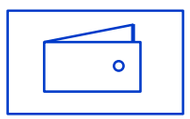
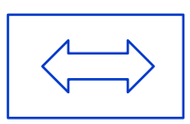
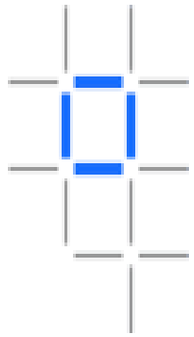
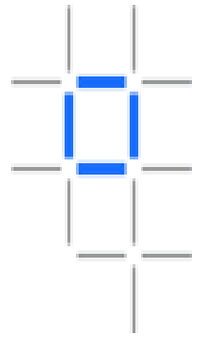
Systems Management		Enables us to create/monitor blockchain components
Wallet		Securely manages a user's credentials
Systems Integration		Integrate blockchain with eternal systems

Smart Contracts



Smart Contracts contain the business logic deployed to peers

Smart Contracts



Smart Contracts contain the business logic deployed to peers

- Interact with the world state through the Fabric shim interface

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- Language support for:
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  - Node.js
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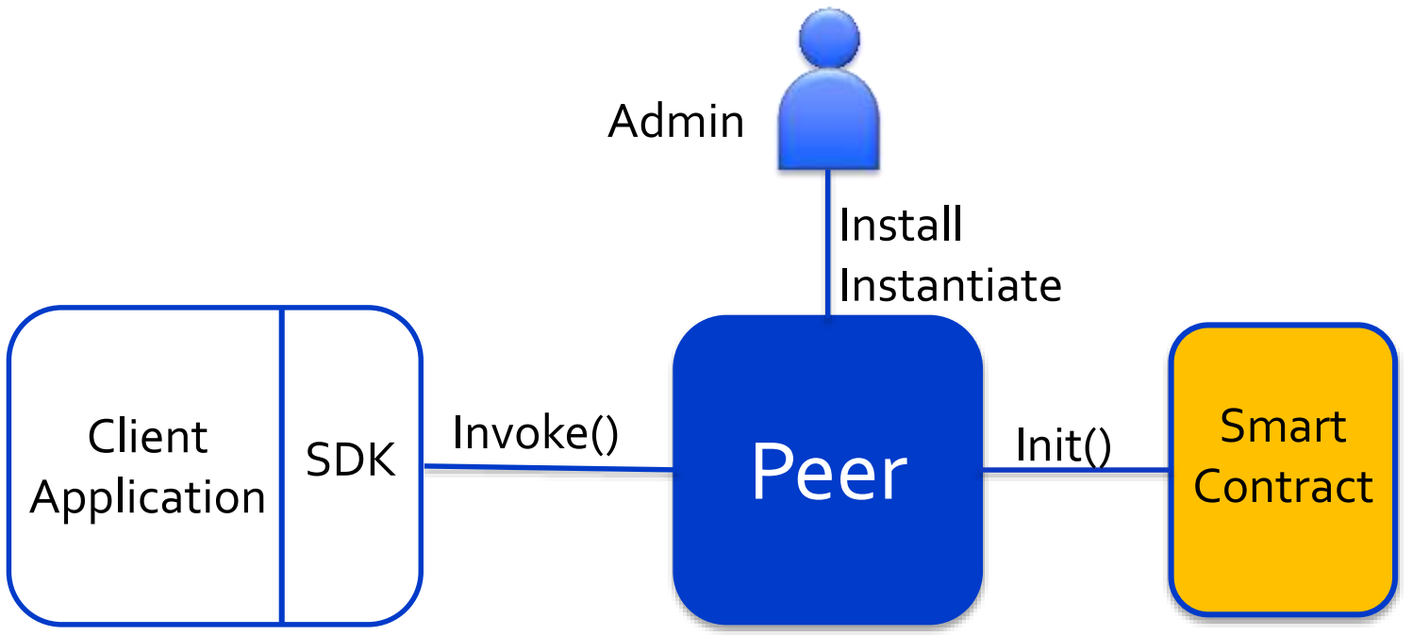
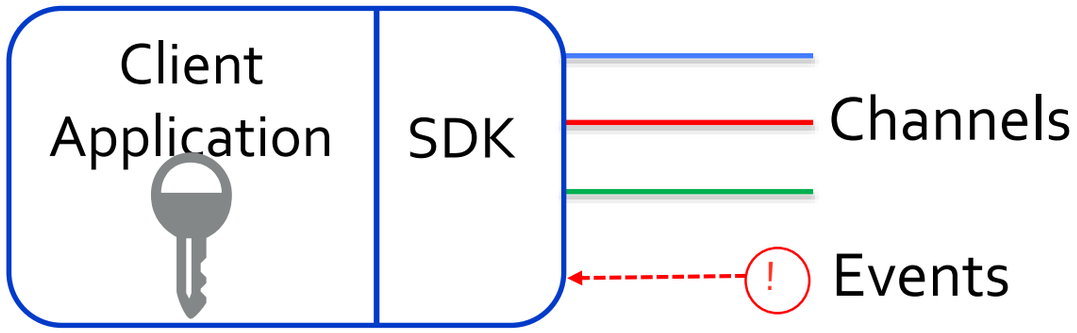


Client Application

Client applications use Fabric SDK to:

- Connects over channels to peer and orderer nodes
- Provide public / private keys



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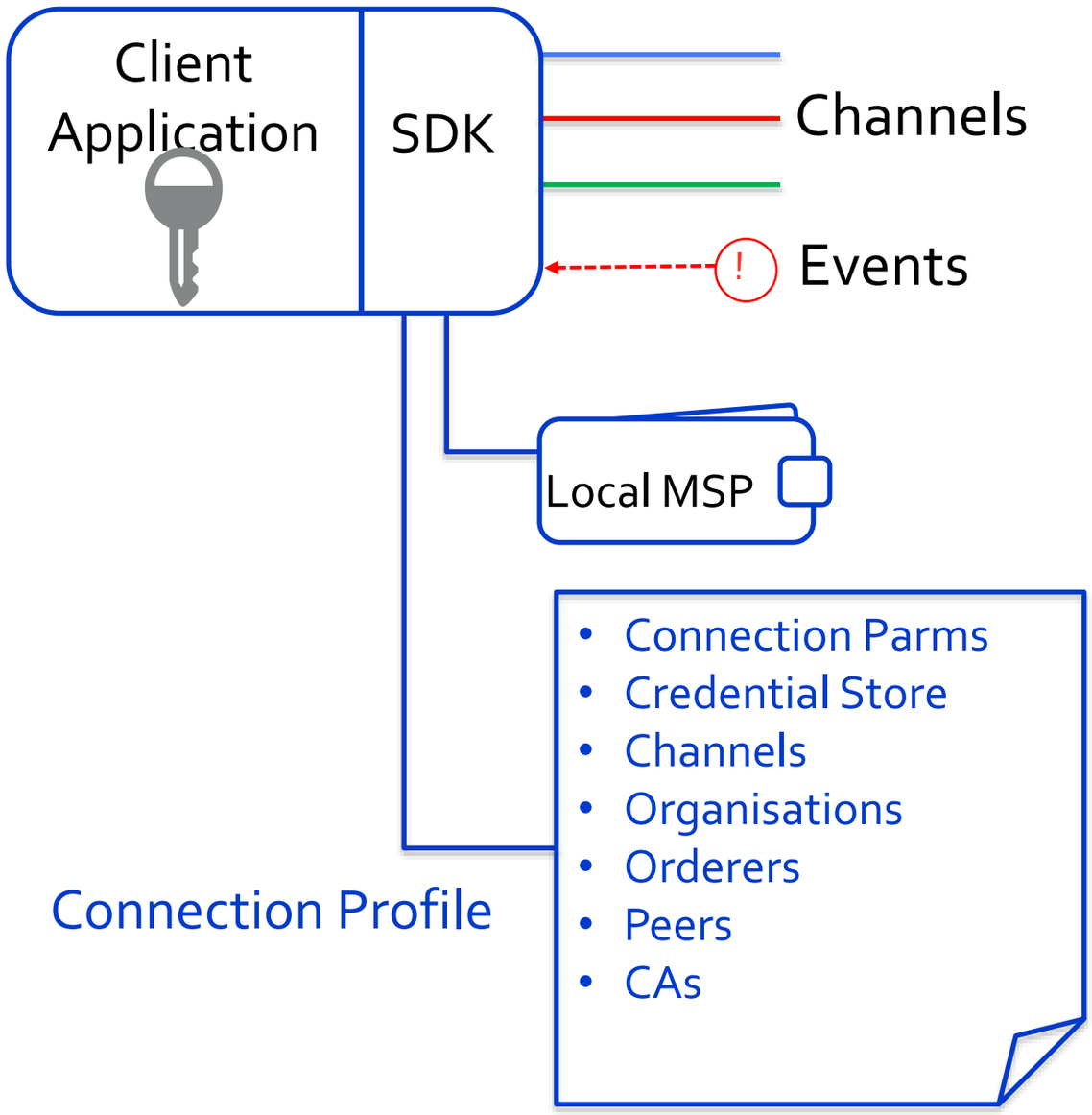
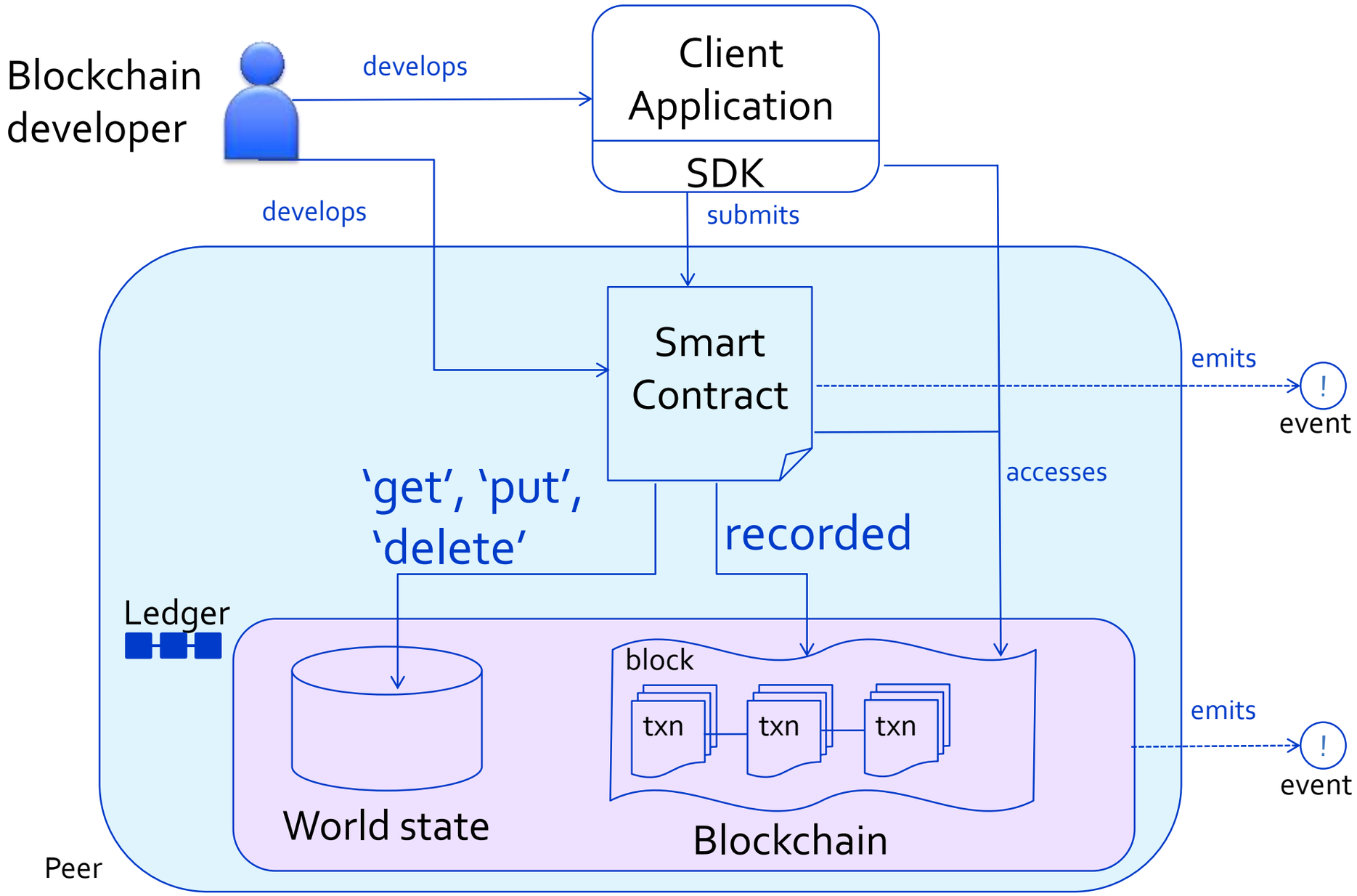
Connection Profile

- Network end-points and connection parameters
- The gateway to submit transactions to a Hyperledger Fabric network



How applications interact with the ledger



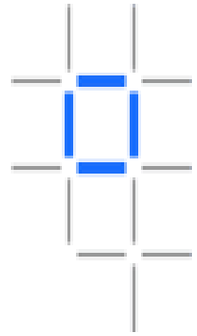
Sample blockchain use-case: e-voting

Components in an e-voting blockchain solution

Ledger

The ledger containing history of submitted votes

Components in an e-voting blockchain solution



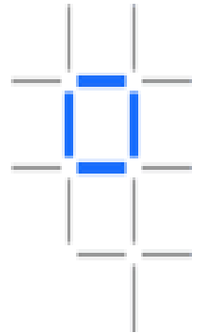
Ledger

The ledger containing history of submitted votes

Smart Contract

voterContract. Registers voters & submits votes

Components in an e-voting blockchain solution



Ledger		The ledger containing history of submitted votes
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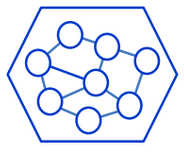
Peer Network		The peers which run the voterContract

Components in an e-voting blockchain solution

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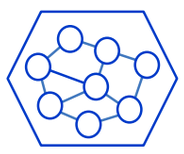
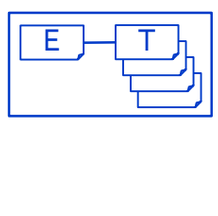
Peer Network		The peers which run the voterContract
Membership		Public and private key for each registered voter

Components in an e-voting blockchain solution

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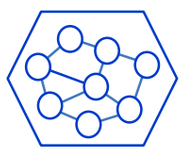
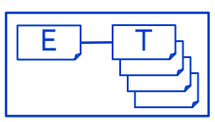
Peer Network		The peers which run the voterContract
Membership		Public and private key for each registered voter
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Components in an e-voting blockchain solution

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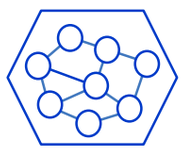
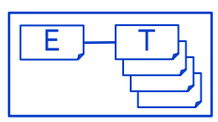
Peer Network		The peers which run the voterContract
Membership		Public and private key for each registered voter
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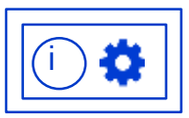
Systems Management		VSCode extension to manage nodes & network

Components in an e-voting blockchain solution

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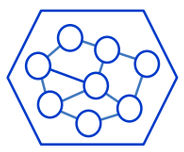
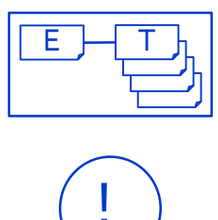
Peer Network		The peers which run the voterContract
Membership		Public and private key for each registered voter
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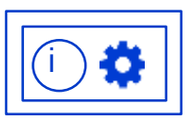
Systems Management		VSCode extension to manage nodes & network
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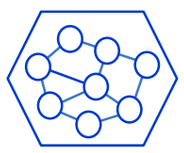
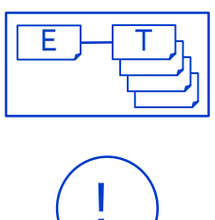
Peer Network		The peers which run the voterContract
Membership		Public and private key for each registered voter
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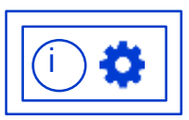
Systems Management		VSCode extension to manage nodes & network
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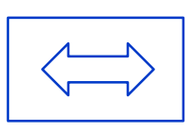
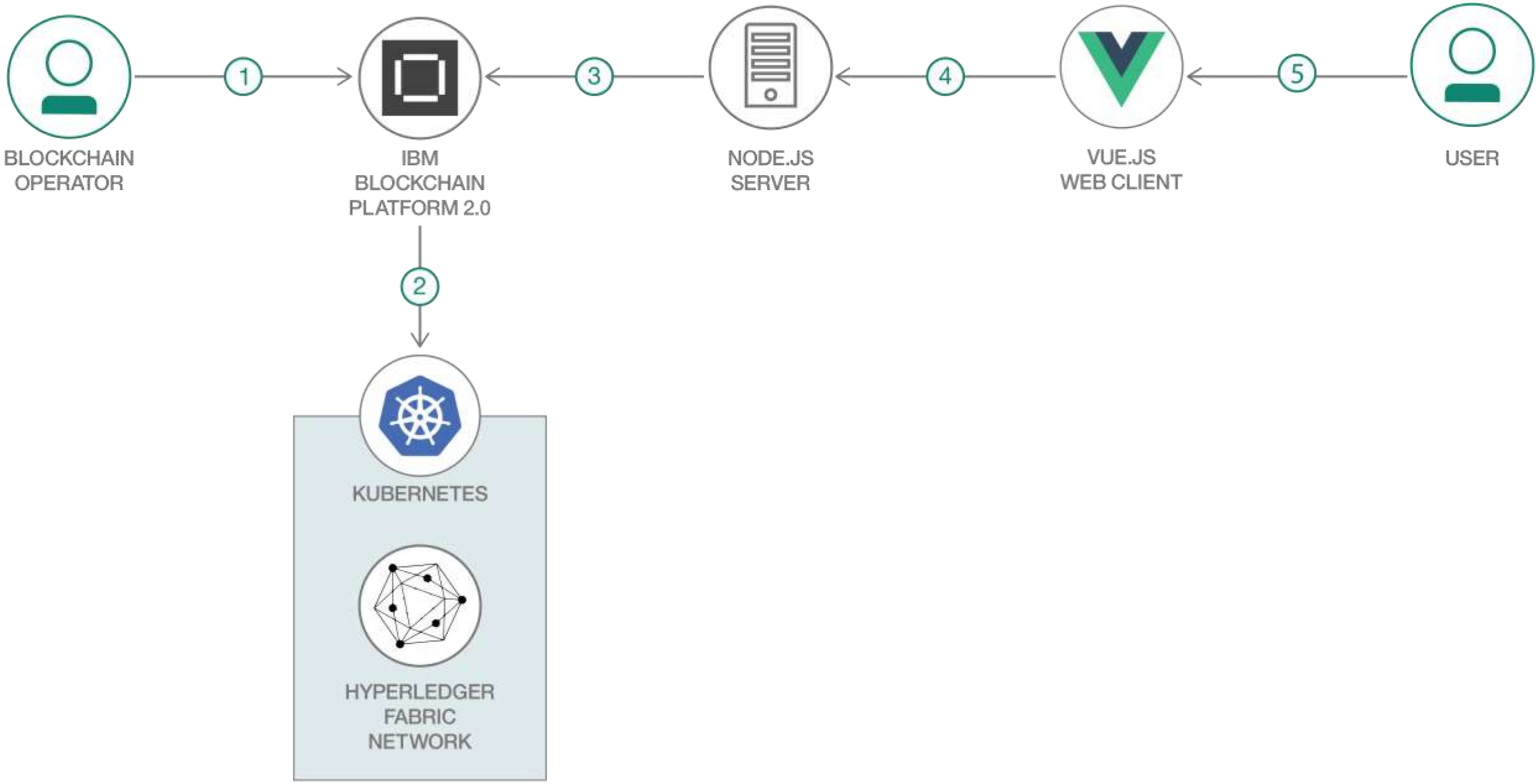
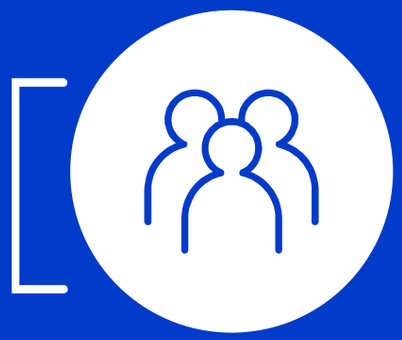
Systems Integration		An API to validate voter registration (DMV API)

App Architecture

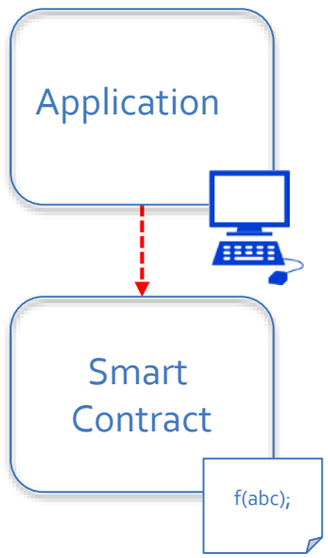


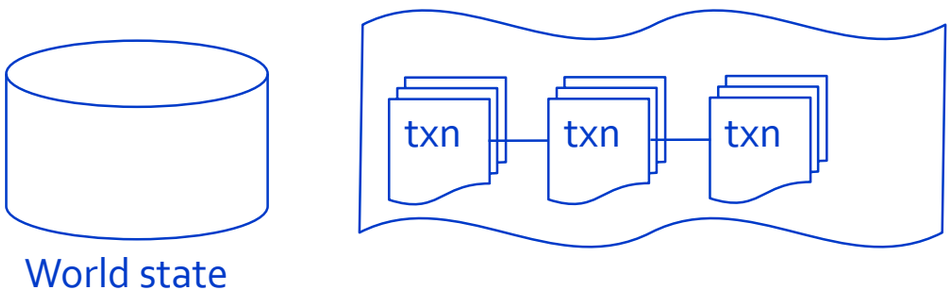
Concepts and Components



Considerations for the Developer,
Operator and Architect

Working with the ledger example: a change of ownership transaction





Transaction input - sent from application

invoke(voterContract, castVote, *2020election*, *123123123*, *democrat*)

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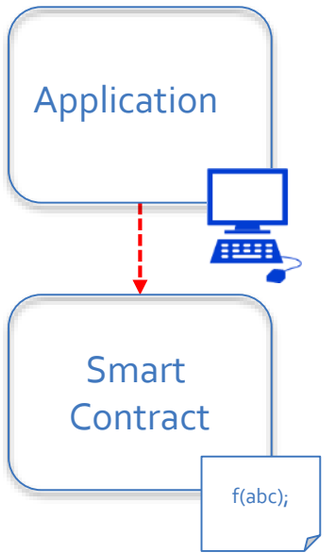

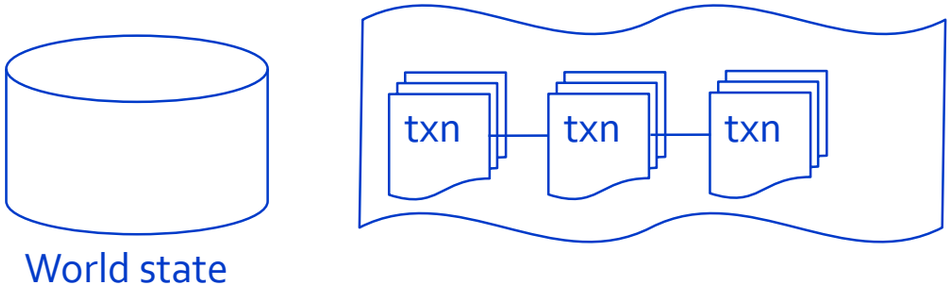

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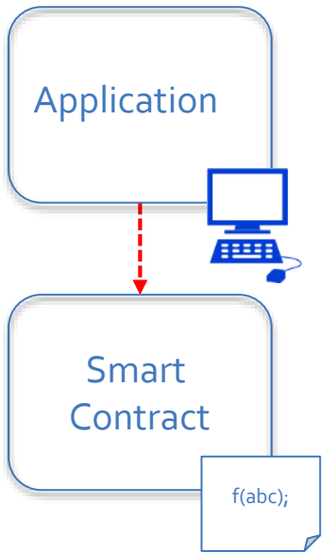

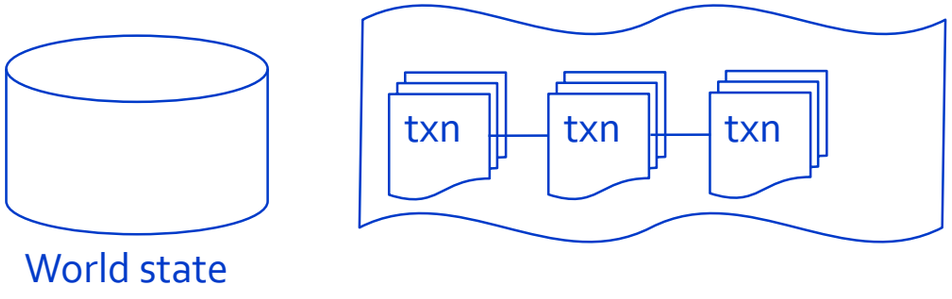

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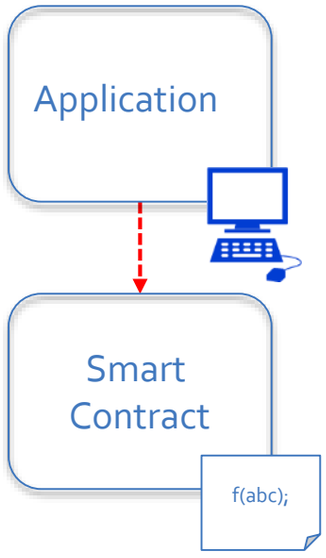
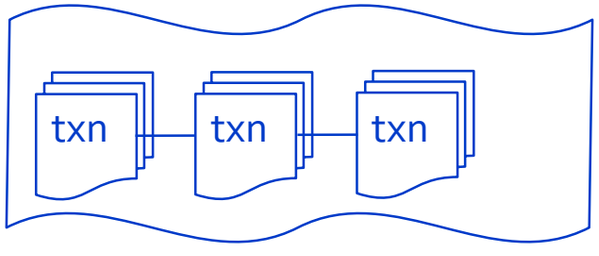


World state



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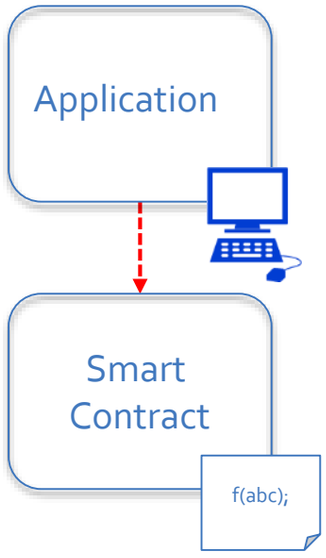

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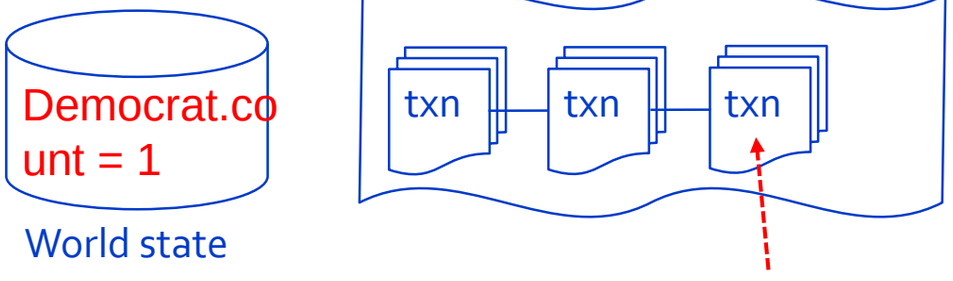

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"Invoke, voterContract, castVote, 2020election, 123123123, democrat"

E-voting Demo

What we learned

1. Blockchain vocabulary

2. A use-case of blockchain

3. Architecture behind a Hyperledger Fabric solution

4. Difference between the world state and the ledger

5. Difference between public and private blockchains

6. How a client application invokes a smart contract

Contact

Questions!?: horea.porutiu@ibm.com

Twitter: @horeaporutiu

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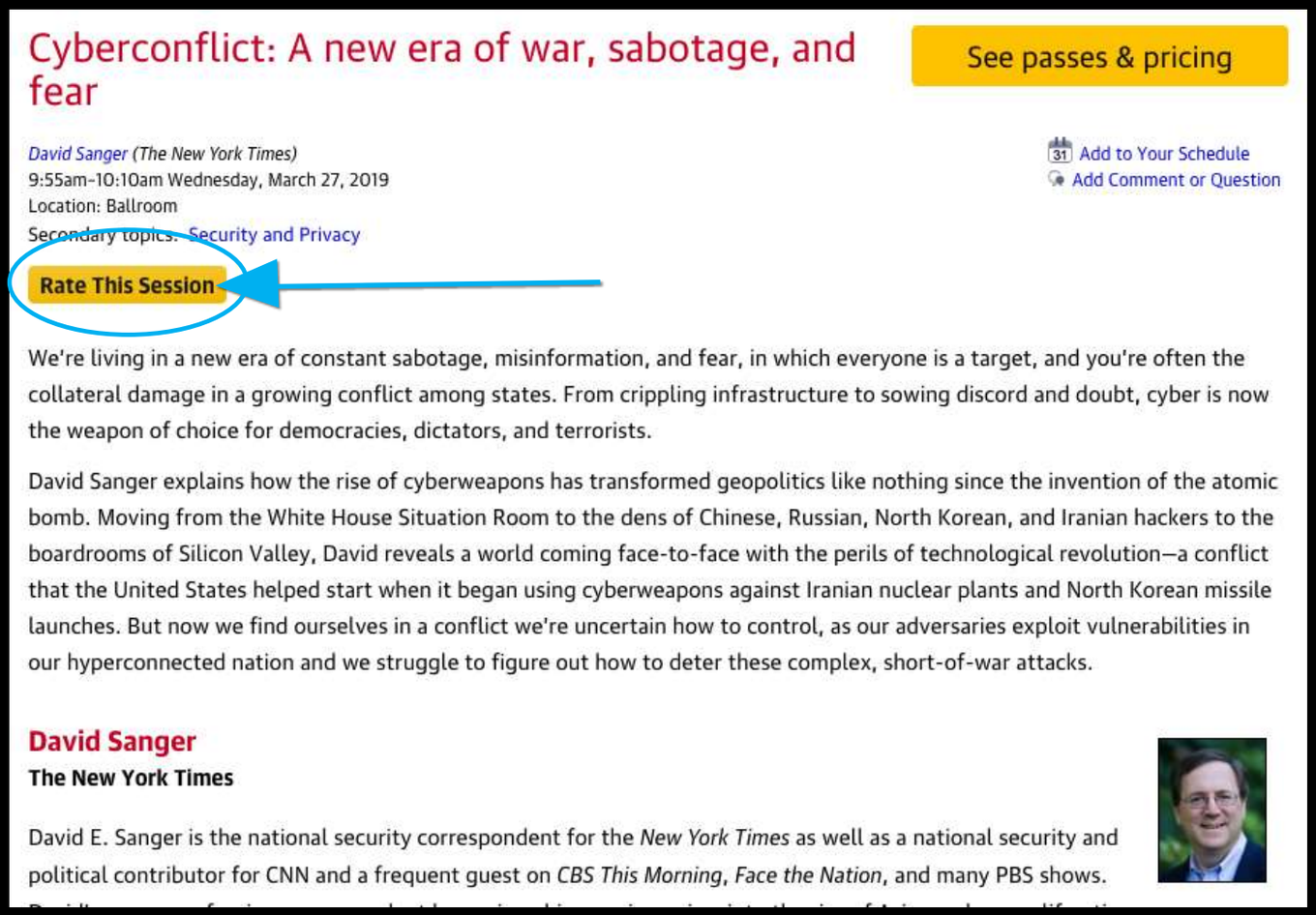
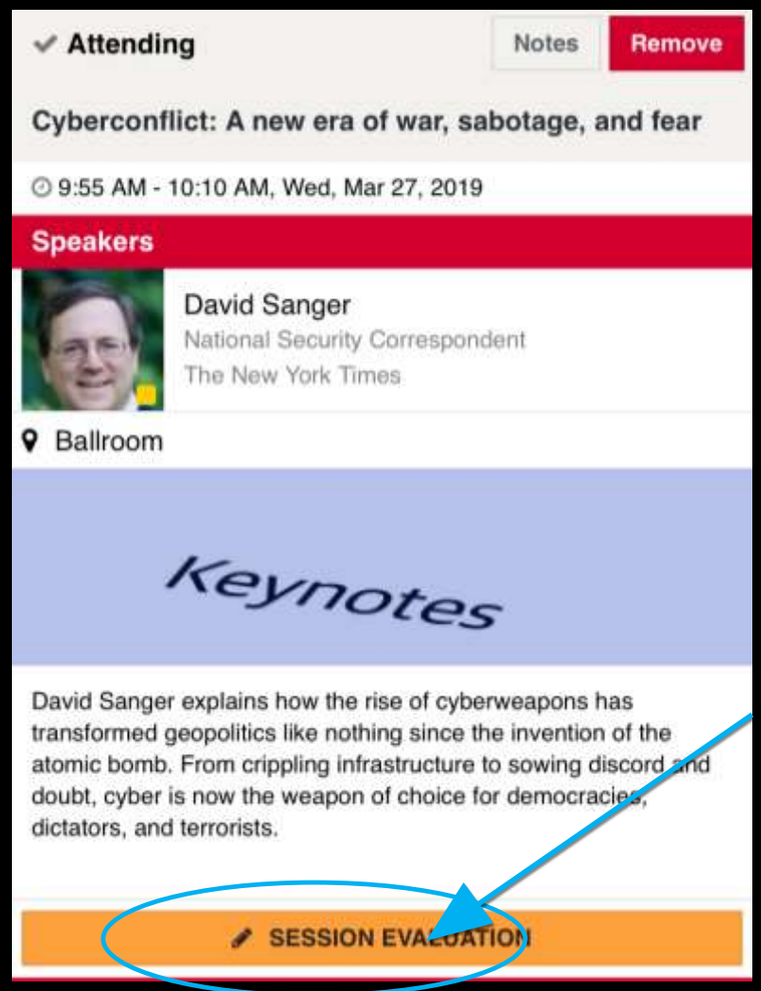


Session page on conference website



O’Reilly Events App