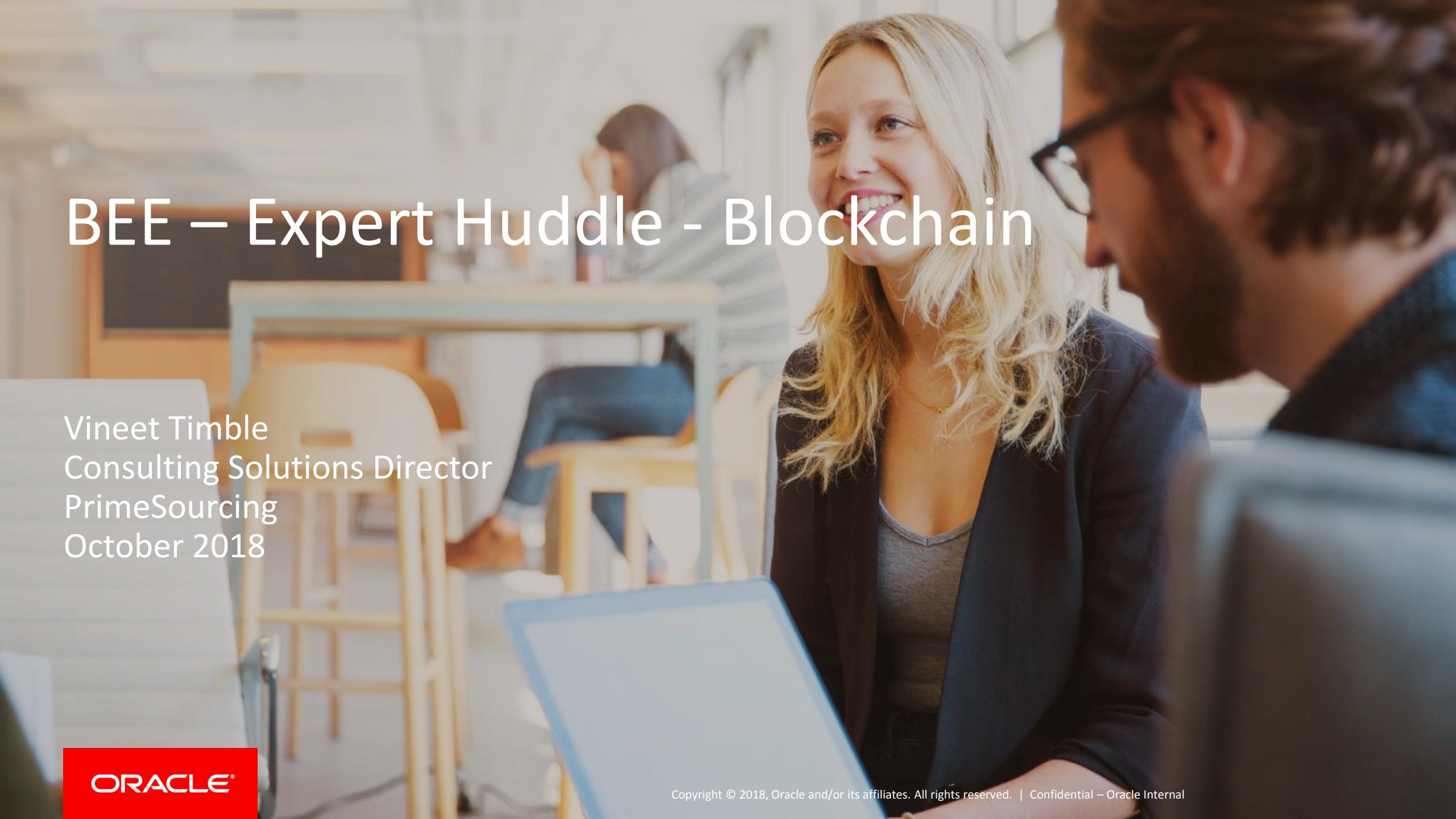


ORACLE®

BEE – Expert Huddle - Blockchain

A professional photograph of a woman with blonde hair, wearing a dark blazer over a grey top, smiling and looking towards the camera. A man with glasses and a dark shirt is visible behind her, looking down at a laptop screen. They appear to be in a modern office environment.

Vineet Timble
Consulting Solutions Director
PrimeSourcing
October 2018

Blockchain Technology- Introduction



“Though blockchain holds great promise, today's blockchain technology offerings are nascent and immature. It is crucial to experiment and explore. Often the technology is offered as a solution in search of a problem. To ensure a successful blockchain project, focus on the business problem, not the technology solution.”

- Gartner

Why Blockchain is revolutionary to Financial Industry

Financial Industry - Rife with Problems

- Friction through redundant and onerous paperwork
- Added cost through fees and delays
- Opening up opportunities for fraud and crime
- As a result regulatory costs continue to climb

What Blockchain has to offer

- Distributed Ledger capable of recording anything of a value
- Controlled by network consensus, cryptography, collaboration, and clever code...
- ...instead of Powerful Intermediators like banks and governments

“
Blockchain could reduce banks' infrastructure costs by US\$15 – 20 billion per annum by 2022.
”

For the first time in human history, two or more parties, be they businesses or individuals who may not even know each other, can forge agreements, make transactions, and build value without relying on intermediaries to verify their identities, establish trust, or perform the critical business logic — contracting, clearing, settling, and record-keeping tasks that are foundational to all forms of commerce

“
Blockchain has the potential to transform how business and government work in a wide variety of contexts.
”

A Blockchain

..... is a system that uses **cryptography** for maintaining **distributed ledgers** in a way that allows **organizations** who **do not fully trust** each other to **agree** on the **updates to the ledger** using **peer-to-peer protocols** **rather than a central 3rd party** or an offline reconciliation process.

A Blockchain

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Cryptography...

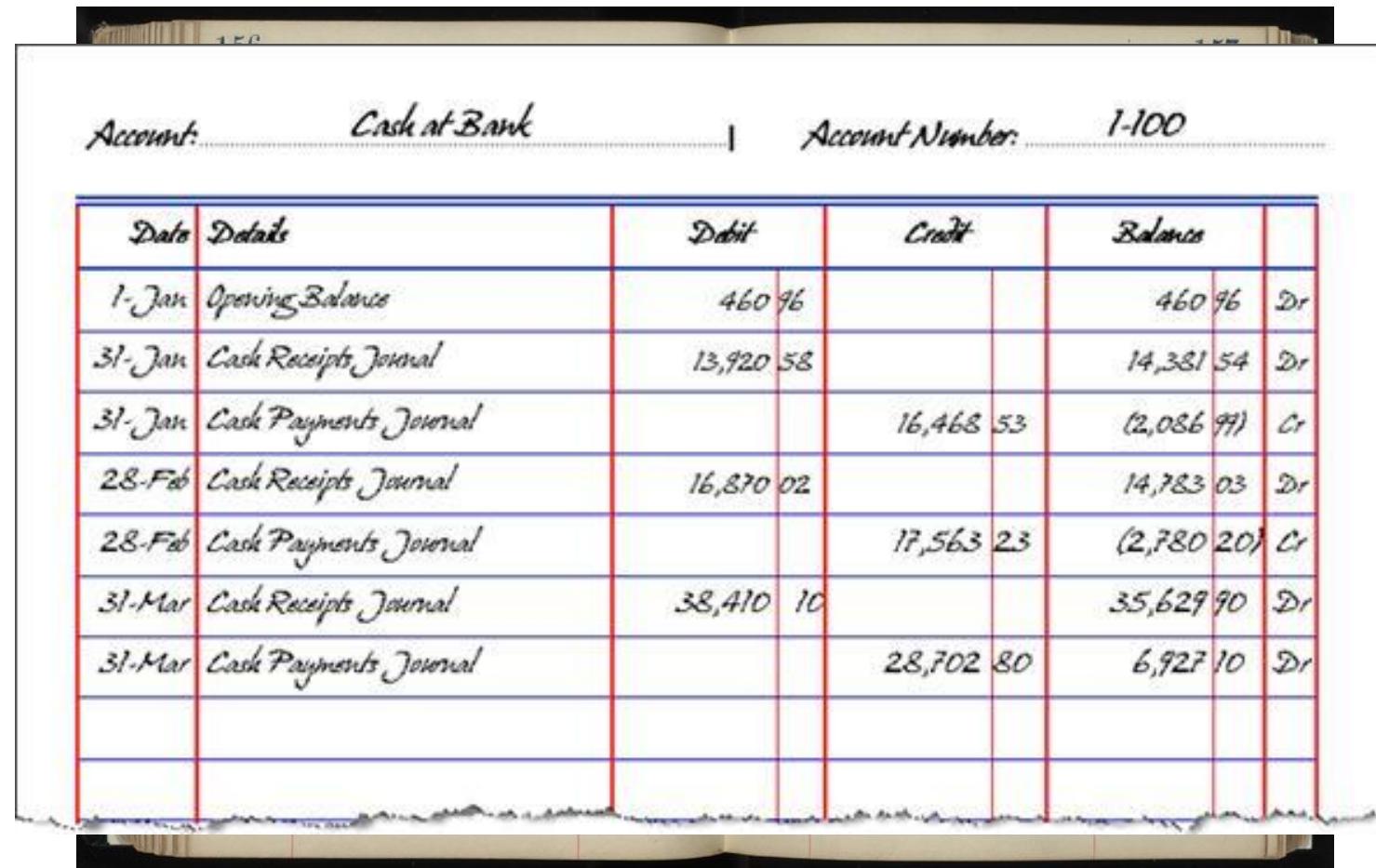


A Blockchain

..... is a system that uses **cryptography** for maintaining distributed **ledgers** in a way that allows **organizations** who do not fully trust each other to agree on the updates to the ledger using peer-to-peer protocols rather than a central 3rd party or an offline reconciliation process.

Ledger

Principal book for recording and totaling transactions

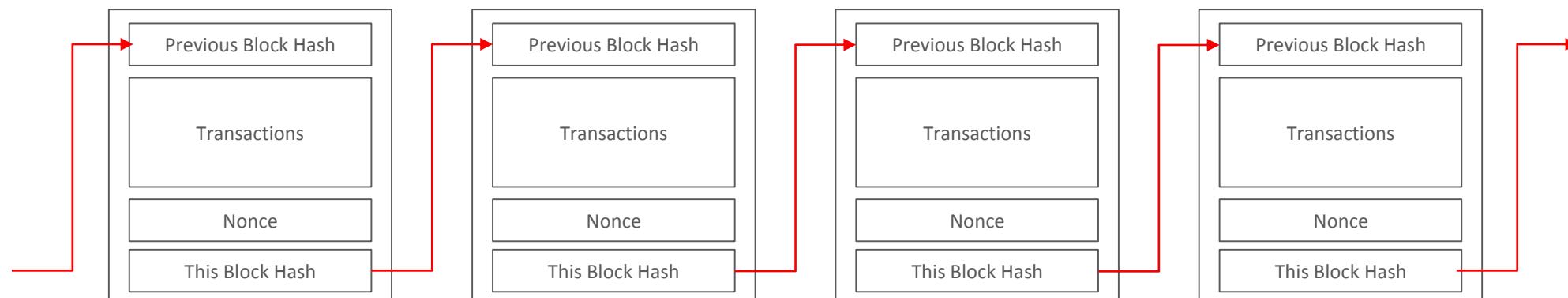
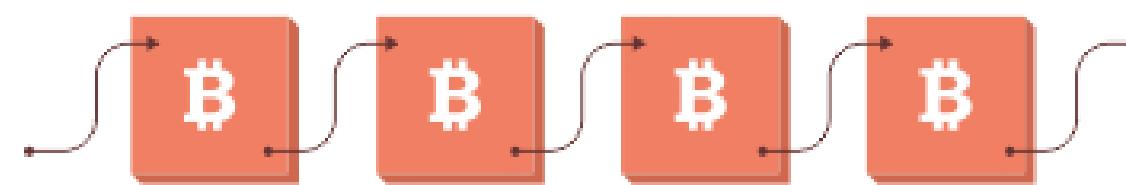
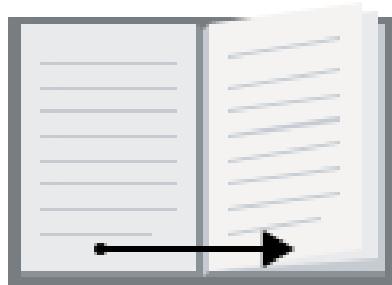


The image shows an open ledger book with two pages visible. The left page is titled "Account: Cash at Bank" and the right page is titled "Account Number: 1-100". Both pages have a header section with columns for Date, Details, Debit, Credit, and Balance. Below this header, there are seven rows of transaction data. The transactions are as follows:

Date	Details	Debit	Credit	Balance
1-Jan	Opening Balance	460 96		460 96 Dr
31-Jan	Cash Receipts Journal	13,920 58		14,381 54 Dr
31-Jan	Cash Payments Journal		16,468 53	(2,086 99) Cr
28-Feb	Cash Receipts Journal	16,870 02		14,783 03 Dr
28-Feb	Cash Payments Journal		17,563 23	(2,780 20) Cr
31-Mar	Cash Receipts Journal	38,410 10		35,629 90 Dr
31-Mar	Cash Payments Journal		28,702 80	6,927 10 Dr

Blockchain Ledger

Blocks in a chain refer to previous blocks, like page numbers in a book.

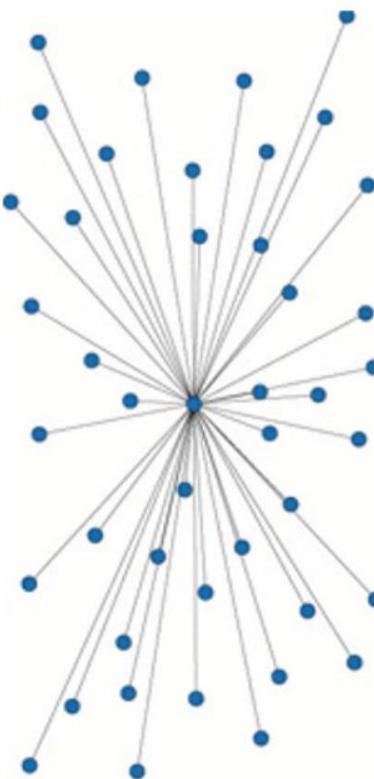


A Blockchain

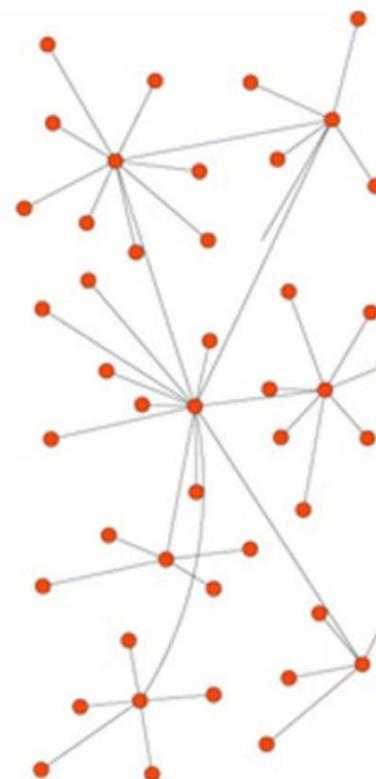
..... is a system that uses **cryptography** for maintaining **distributed ledgers** in a way that allows **organizations** who **do not fully trust** each other to **agree** on the **updates** to the ledger using **peer-to-peer** protocols **rather than a central 3rd party** or an offline reconciliation process.

Centralized, Decentralized, Distributed

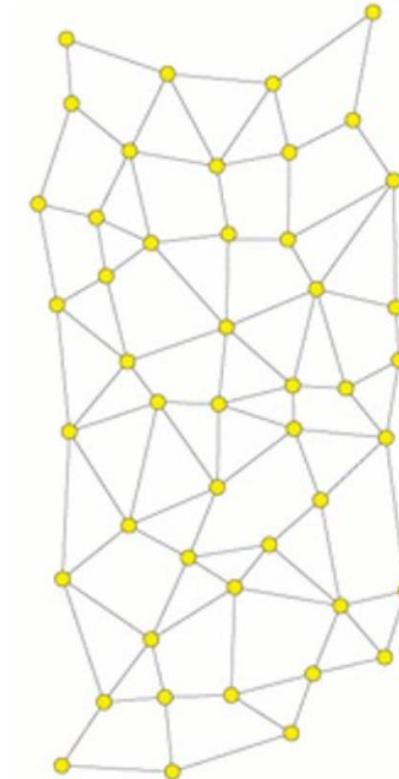
Centralized



Decentralized



Distributed



A Blockchain

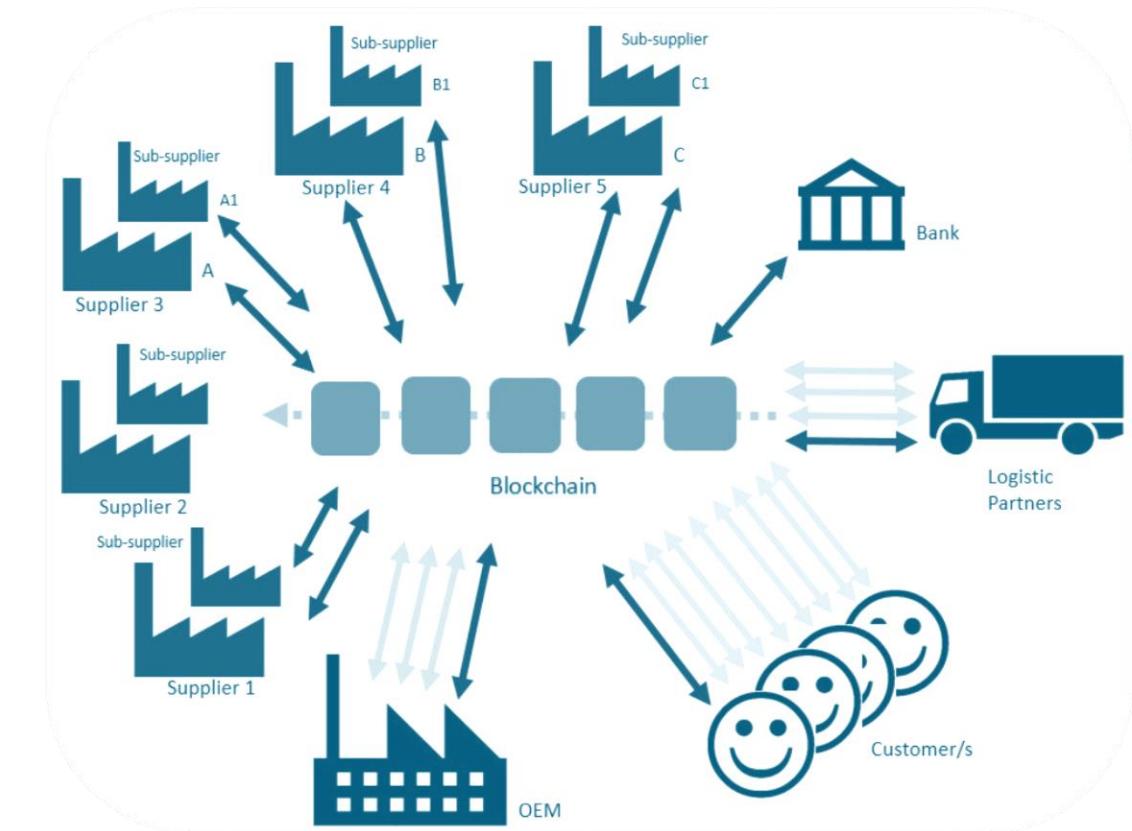
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How is Blockchain Different from a Secure Database/Cluster

- Data is directly shared across boundaries of trust, without requiring a centralized intermediary or complex data transfer and reconciliation processes.
 - Datastore can be directly shared by multiple organizations
 - Every node in a blockchain independently verifies and processes every transaction. A node can do this because it has full visibility into the current “state of the world” – the values in the data store, and the updates requested by proposed transactions, which are also digitally signed to prove their origin
- Replicated data controlled by multiple organizations
 - No single point of failure
 - No single point of control (no single SYSDBA) or potential for compromise
- Multiple writers whose transactions are ordered the same way across the nodes in near real-time
 - Blockchain-powered transactions and data are extremely fault tolerant due to built-in redundancy.
 - Avoiding intermediaries and reconciliation processes may result in faster updates as there is no need to wait for a central clearing house or overnight batch processing
- Records not just latest data, but maintains the history of all changes in tamper-evident manner

Key Properties of Blockchains

- Near real-time updates
- Cryptographic proof of trust replaces intermediaries
- Shared & transparent data access
- Validated/non-repudiable transactions
- Tamper-evident transaction history



The Promise of Blockchain

“ \$176 billion in added business value by 2025; that total reaches **\$3.1 trillion by 2030.**”

Gartner[®]

“ More than **2,500 patents** have been filed in the last 3 years.”



“The technology most likely to change the next decade of business is not the social web, big data, the cloud, robotics, or even artificial intelligence. It's the blockchain...“

—*Harvard Business Review*
“The Impact of Blockchain Goes Beyond Financial Services,”
May 2016

Blockchain Adoption Momentum

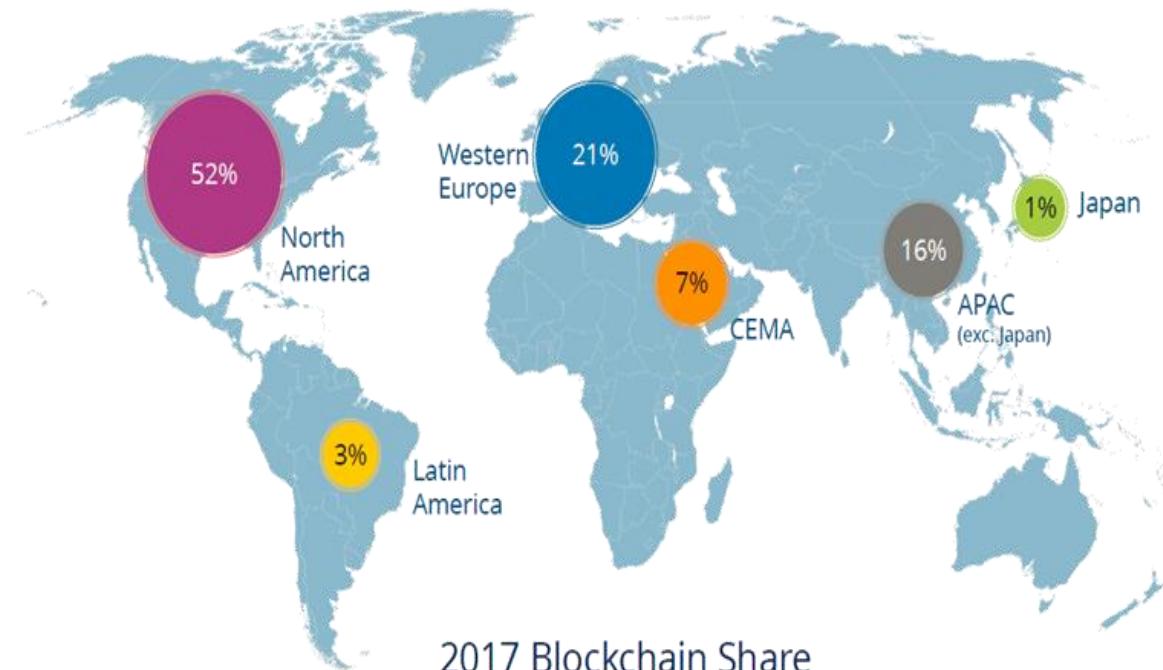
2x: Growth in projected spend from 2017 to 2018

3x: The number of blockchain-related LinkedIn job postings more than tripled over the last 12 months

22%: of industry CIOs are in a planning stage or experimenting with blockchain, and another

43% have it on their radar

\$945 Million spent in 2017 - Blockchain Technology Investments Will Reach \$9.7 Billion by 2021



Source: IDC's Worldwide Semiannual Blockchain Spending Guide, 2017H1 (January 2018)
Note: All numbers in the document may not be exact due to rounding.

© IDC



Two Types of Blockchain

- Public (a.k.a. “Permissionless”)
 - Anyone can join the network and have a copy of the ledger
 - E.g.,: Bitcoin, Ethereum
 - This involves the computer resource intensive mining process to add blocks cryptographically
 - Consensus models based on computationally expensive algorithms requiring the processing power of many nodes to ensure security.

- Permissioned

- Closed ecosystem: members are invited to join and keep a copy of the ledger
- Who members are in the real (legal) world is known (to at least the operators of the blockchain, but not necessarily all participants)
- E.g., Chain, R3 Corda, Hyperledger Fabric
- Consensus protocols depend on knowing who the members are, e.g., PBFT, for greater scalability
- Two subtypes:
 - Consortium: multiple organizations or departments
 - Private: single organization (prototypes, pilots)

Disruptive Characteristics/Benefits of Blockchain

- **Decentralized, peer-to-peer network –**

No central, controlling authority



Eliminating intermediaries means reduced transaction costs and near real-time transaction execution

- **Distributed ledger -** All participants

maintain a copy of the ledger



Eliminates manual efforts and delays due to reconciliation needs since data consistency is a key attribute of the distributed ledger

- **Immutable transaction history –**

Impossible to make changes to existing transactions in a blockchain without detection



Increased confidence in the information and reduced fraud opportunities

- **Smart contracts –** Business logic

deployed on a blockchain and shared and validated by participants.



Automated business processes in a trusted way. Represent any asset digitally.

- **Transparent –** Transactions on a blockchain

are visible to the authorized participants.



Increased auditability and trust, reduce cost of fraud and audits

Blockchain Terminology

Block	Blocks are packages of data that carry permanently recorded data on the blockchain network.
Blockchain	A blockchain is a shared ledger where transactions are permanently recorded by appending blocks. The blockchain serves as a historical record of all transactions that ever occurred, from the genesis block to the latest block, hence the name blockchain.
Block Height	The number of blocks connected on the blockchain.
Consensus	Consensus is achieved when all participants of the network agree on the validity of the transactions, ensuring that the ledgers are exact copies of each other.
Dapp	A decentralized application (Dapp) is an application that is open source, operates autonomously, has its data stored on a blockchain, incentivized in the form of cryptographic tokens and operates on a protocol that shows proof of value.
Mining	Mining is the act of validating blockchain transactions. The necessity of validation warrants an incentive for the miners, usually in the form of coins. By choosing the most efficient and suitable hardware and mining target, mining can produce a stable form of passive income.
Node	A copy of the ledger operated by a participant of the blockchain network.
Proof of Stake	A consensus distribution algorithm that rewards earnings based on the number of coins you own or hold. The more you invest in the coin, the more you gain by mining with this protocol.
Proof of Work	A consensus distribution algorithm that requires an active role in mining data blocks, often consuming resources, such as electricity. The more 'work' you do or the more computational power you provide, the more coins you are rewarded with.
Wallet	A file that houses private keys. It usually contains a software client which allows access to view and create transactions on a specific blockchain that the wallet is designed for.

A photograph of two people in a professional setting. A man with glasses and a denim jacket is gesturing with his hands while speaking. A woman in a yellow sweater is listening attentively. They are seated at a desk covered with papers, a smartphone, and a tablet displaying charts.

But What About Bitcoin? Cryptocurrencies?

Bitcoin & The Satoshi Whitepaper

Released 2009

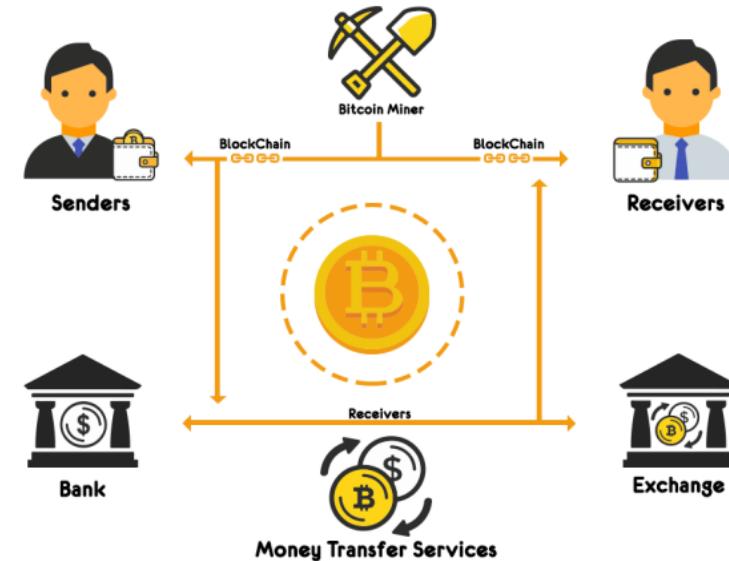
- Anonymous Author
 - Under Pseudo name, Satoshi Nakamoto
- Paper described a decentralized timestamping network used by a digital currency called bitcoin.
 - <https://bitcoin.org/bitcoin.pdf>
- PoW (proof of work provides consensus via process called “mining”)
- Network protected by incentives.

How to make Bitcoins?

Bitcoin Mining Reward...

- The block reward started at 50 BTC in block #1
 - halves every 210,000 blocks
 - This means every block up until block #210,000 rewards 50 BTC, while block 210,001 rewards 25
- Blocks are mined on average every 10 minutes
 - 144 blocks are mined per day on average
 - 210,000 blocks take on average four years to mine.

HOW DOES BITCOIN WORK?



Ethereum

Ethereum was announced in the North American Bitcoin Conference in early 2014 by Vitalik Buterin. Launched in 2015, Ethereum is the largest and most well-established, open-ended decentralized software platform that enables SmartContracts and Distributed Applications (DApps) to be built and run without any downtime, fraud, control or interference from a third party. Ethereum is not just a platform but also a programming language (Turing complete) running on a blockchain, helping developers to build and publish distributed applications.



Bitcoin

- Invented by Satoshi Nakamoto
- Went live in January 2009
- A new currency created to compete against the gold standard and fiat currencies



Ethereum

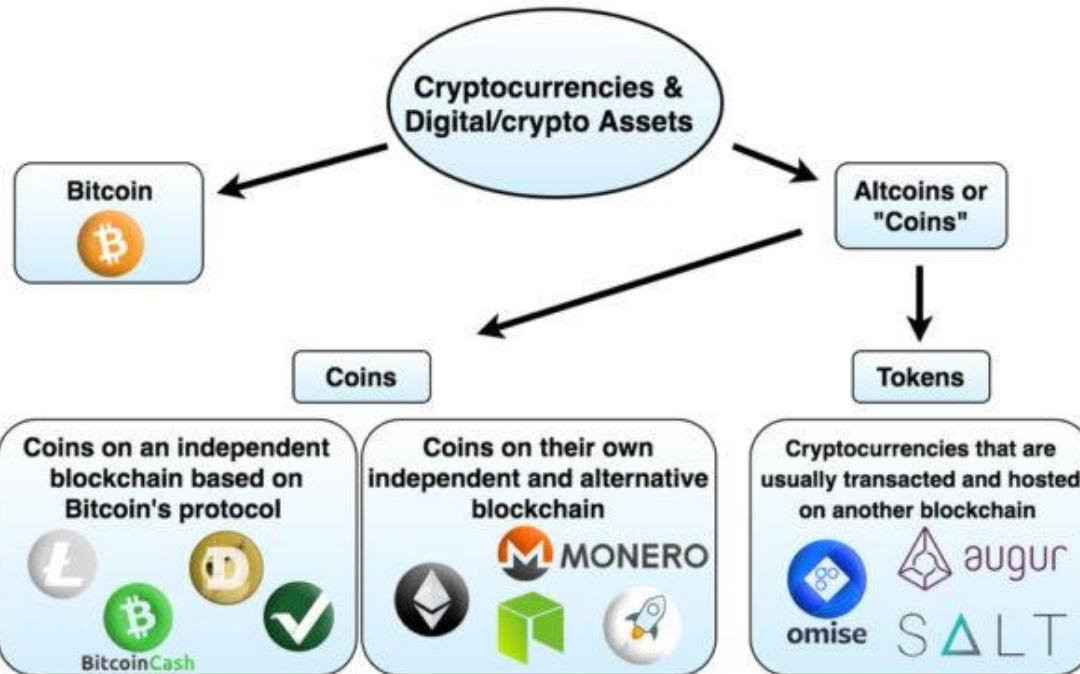
- Invented by Vitalik Buterin and others
- Went live in July 2015
- A software platform capable of facilitating Smart Contracts

Power of Ethereum lies in its Ethereum Virtual machine and Smart contracts language Solidity which is JavaScript based. Using Solidity developers can code business logic in smart contracts which can be run on decentralized blockchain based Ethereum network.

Examples of Smart Contract...

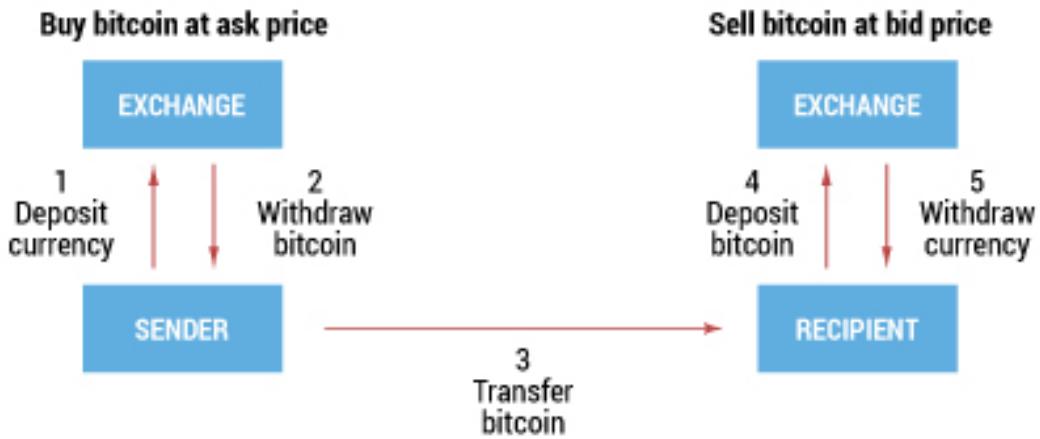
- A smart contract can be created to pay a worker for every hour they work, they log their hours on the blockchain and then after verification the funds are instantly transferred to them
- Buying goods internationally can be tracked and verified – reducing fraud.
- Property buying can be facilitated through the contract

Cryptocurrencies and Crypto exchanges



Anybody can create a digital token on Ethereum with ERC-20 standard and can list it on crypto exchanges

Bitcoin as a Value Transfer System with Exchanges



Note: "Exchange" here can also refer to a dealer such as a company running a "Bitcoin ATM."

Three Major Blockchain Technology Implementations

(Apart from Bitcoin)

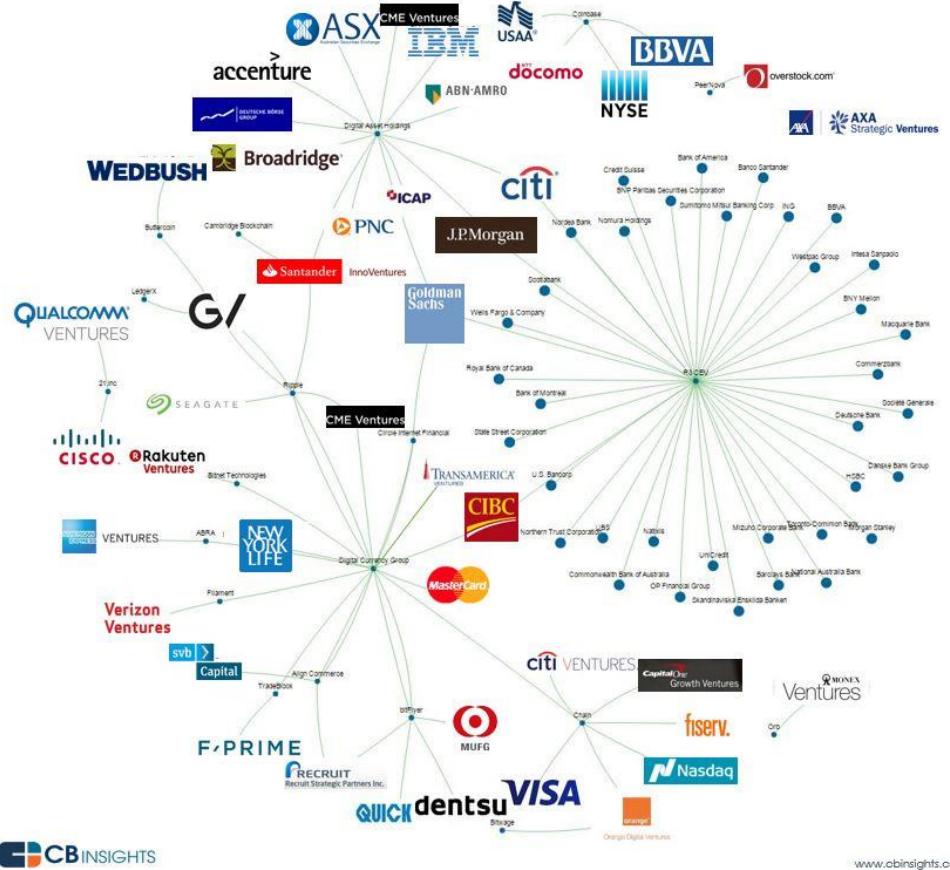
Characteristic	Ethereum	Hyperledger Fabric	R3 Corda
Description	Generic blockchain platform	Modular blockchain platform	Specialized for banking
Governance	Ethereum developer and banks via the EEA (Enterprise Ethereum Alliance)	Linux Foundation	R3 Membership
Mode of Operation	Permissionless (Public) or Permissioned (EEA)	Permissioned	Permissioned
Consensus	Mining PoW (Proof of Work) and others POS (Proof of Stake) Ledger Level	Multiple approaches (e.g., Kafka-based ordering service)	Specific understanding of consensus based on notary nodes
Privacy	No	Yes, confidentiality domains allow members to conduct private transactions over confidential channels	Mandatory, all transactions are visible only to participants
Smart Contract Languages	Solidity	GO, Java	Kotlin, Java
Currency	Ether or Tokens via SC	None built-in; Currency and tokens via smart contracts	None
Who is Using	Fintechs, Banks, Enterprises	Enterprises, Banks	Banking only
Frothy ICOs (Initial Coin Offerings)	Yes	No	No

Permissioned Blockchains



Financial Industry Players and Use Cases

The Financial Services and Strategic Investors in Blockchain and Bitcoin Startups



Payments

- Clearing and Settlement
 - Digital Identity
 - Smart Assets

Wealth Management

- Buying/selling securities
 - Smart securities
 - Security ownership registry
 - Real-time portfolio of FX swaps

**Capital
Markets**

- Pre-Trade Checks
 - Transaction Processing
 - Asset Servicing
 - Collateral Management

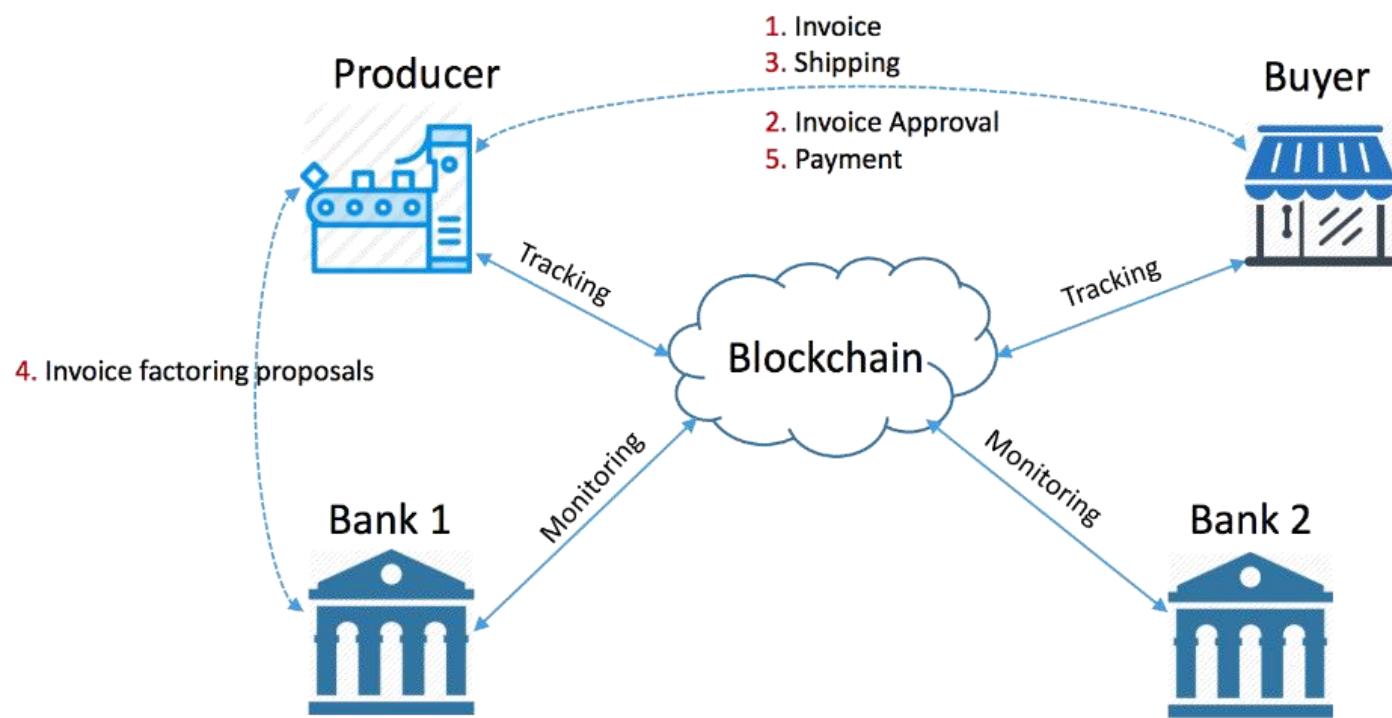
Insurance

- Claims handling & Fraud
 - Healthcare –insurance paid for
 - Accident/health records
 - Insurance Payouts

Trade Finance

- One Trade, One Contract
 - Supply chain Finance

Use case: Invoice discounting



Abstract:

A vendor that can receive money in advance from the Bank by sharing his accounts receivables (issued invoice).

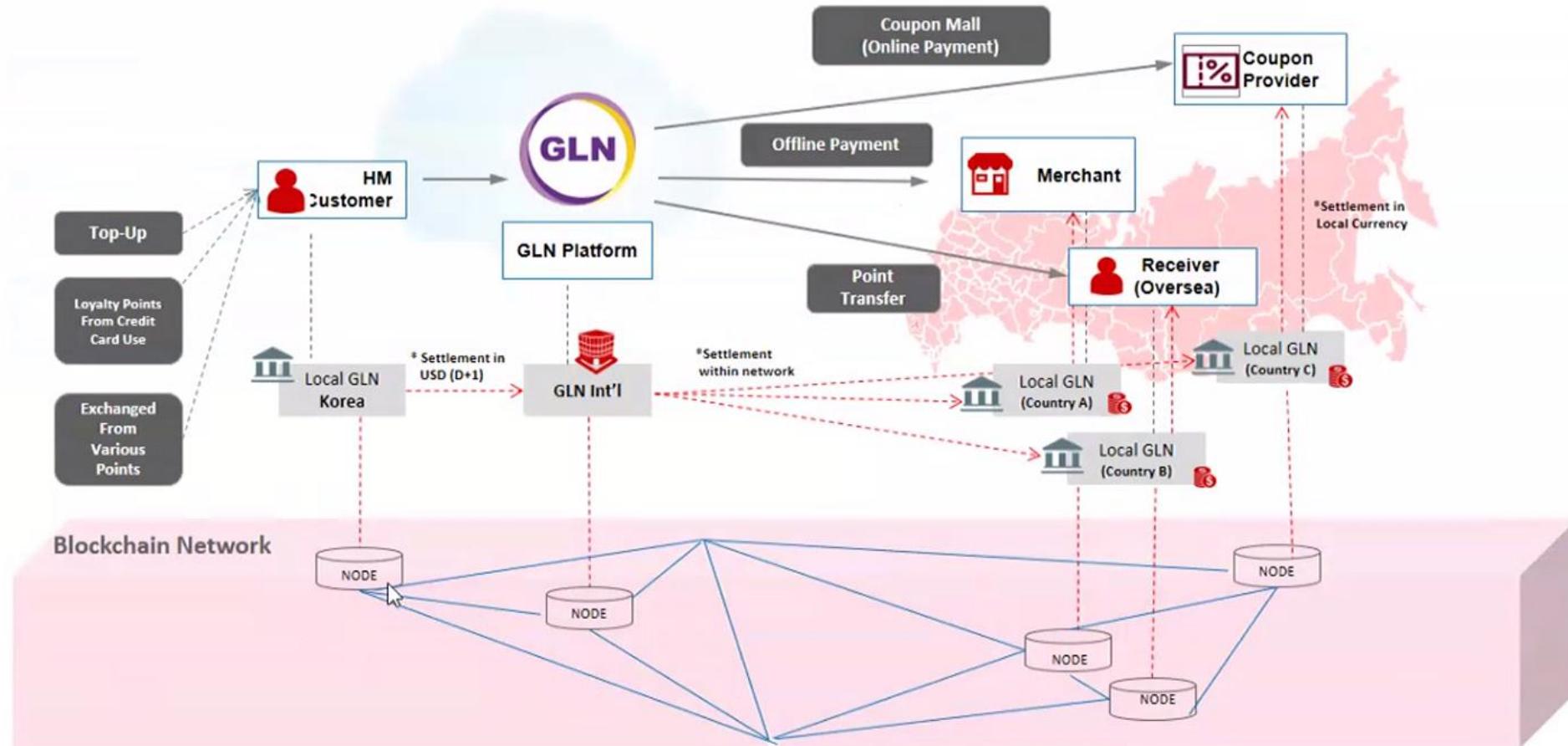
At the same time, the solution gives visibility by tracking the products, which means less risk to the Bank.

Benefits

- Liquidity for the vendor
- Risk Management for the Banks

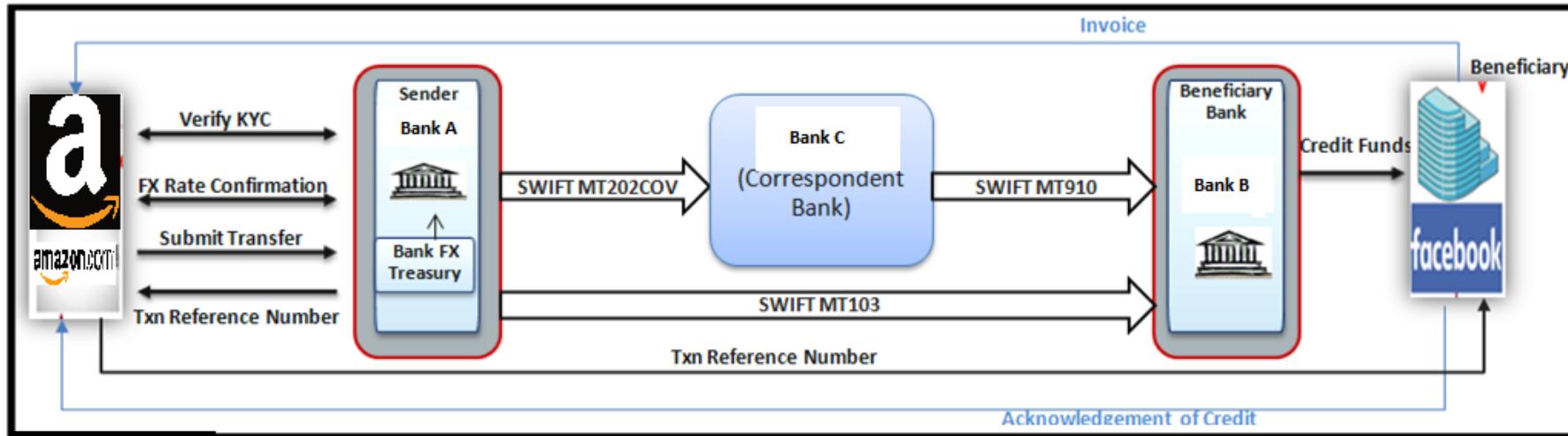
Presented by IntellectEU
at OOW 2017

Use case: Global Loyalty Network (GLN)



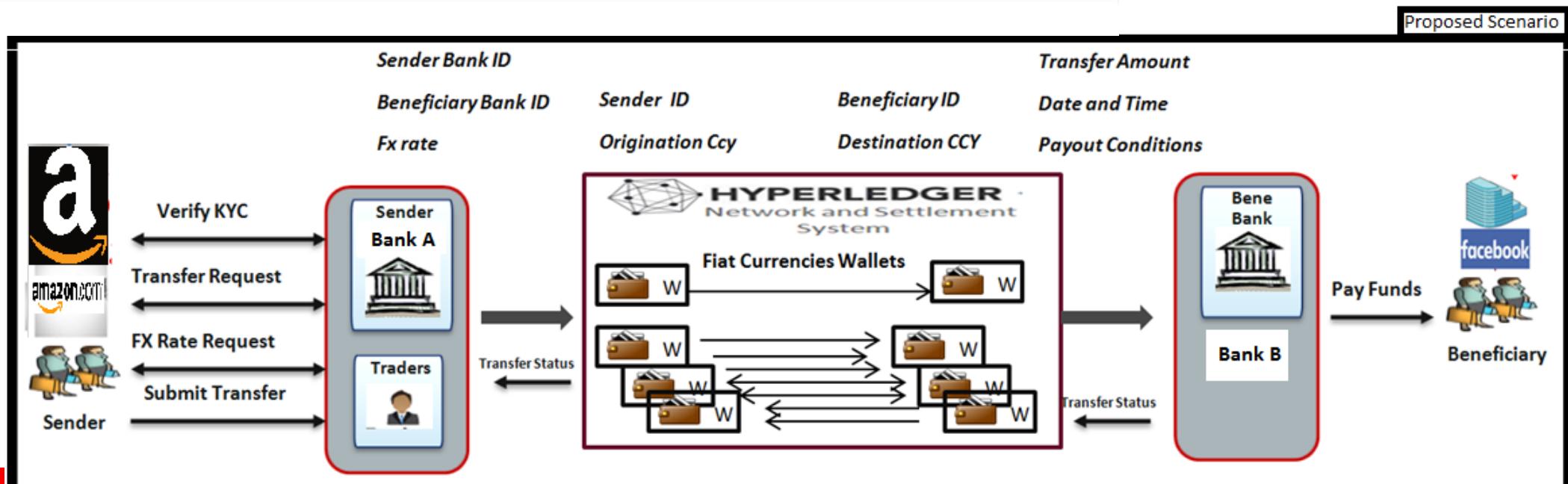
Cross-border Funds Transfers

Existing vs. Blockchain Scenario

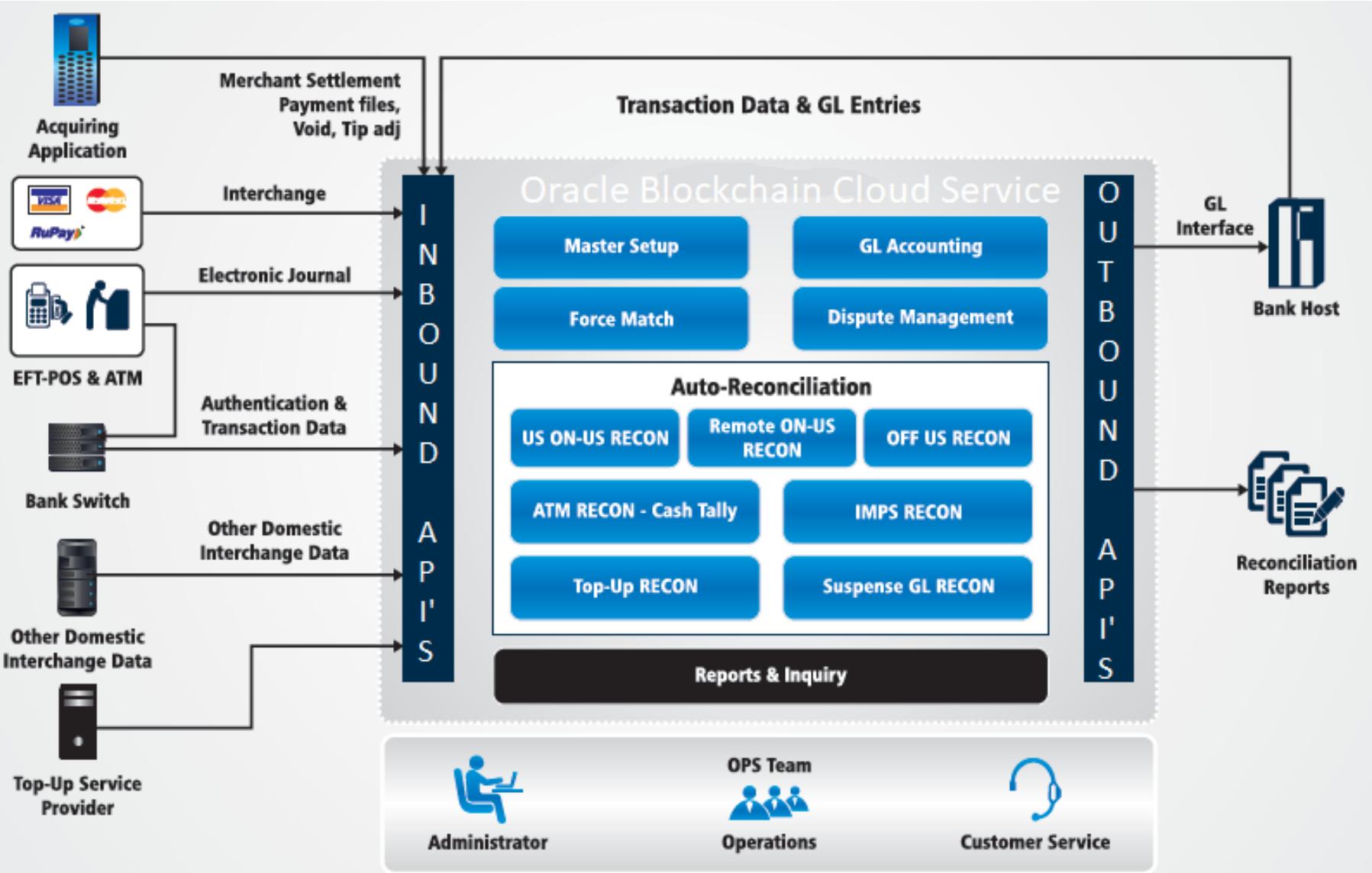


Current Scenario

Proposed Scenario



Reconciliation as A Service



Key Features

- Multi way Real-time Reconciliation
- Smart Contracts triggered at request and response, Smart contract defined alerts
- Support for multiple delivery channels
- Rule based and Force Match Options for settling entries
- Exception Reporting

Benefits for Industry



Challenges in adaptation of Blockchain

Immature Technology

Under development technology still resolving challenges of transaction speeds, data and network throughput limits and cryptography.

Uncertain Regulatory Status

Being emerging and disruptive technology, regulations and laws are yet to be adapted

Control, Security and Privacy

Security and Privacy concerns need to be addressed before large scale enterprise and general public can trust blockchain technology

Integration Concerns

Blockchain applications will require massive changes or complete replacements of existing systems

Cultural Adaptation

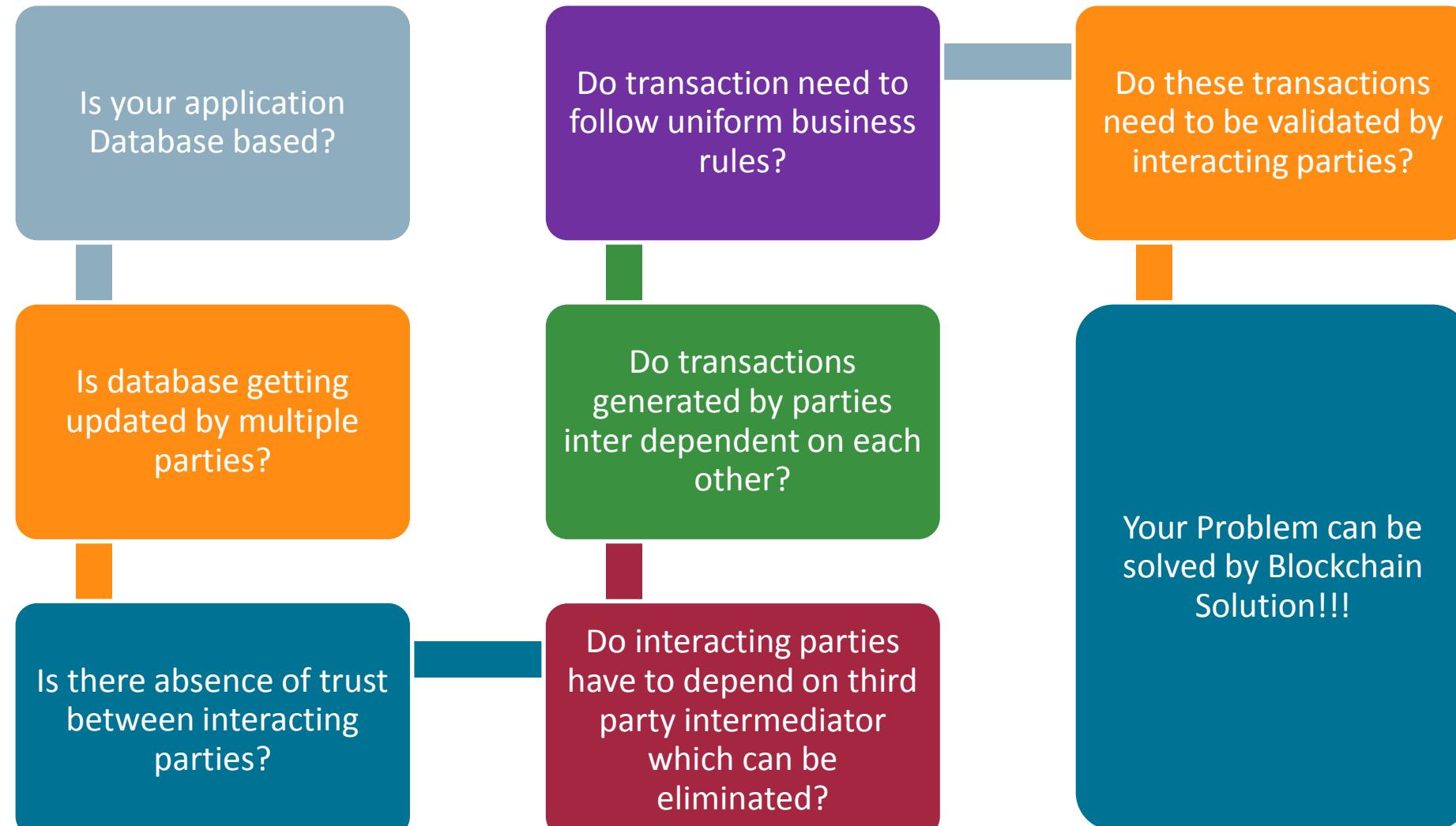
Blockchain will threaten existing market players and give opportunity to new market players. Buy-ins across the board will require significant efforts

High Initial Costs

Although cost saving in long term, initial investments in infrastructure, implementations and trainings will be significant

Does your business problem require blockchain as a solution?

Blockchain is not a solution to all problems!



Key Components of a Blockchain System

Applications

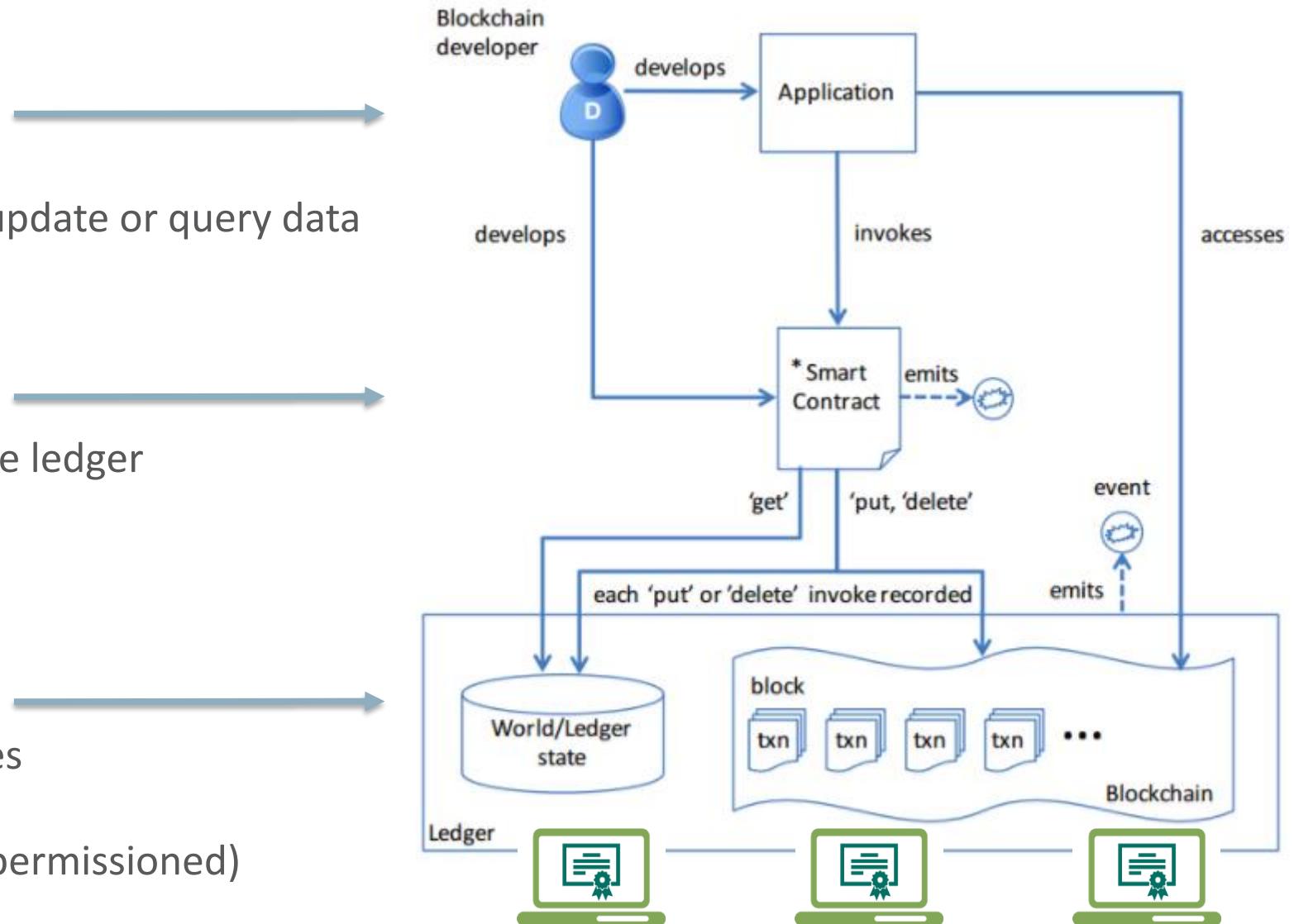
- Register users
- Invoke smart contracts to update or query data
- Consume events

Smart Contracts

- Business logic to update the ledger
- Query data
- Publish events

Blockchain Infrastructure

- Network of validating nodes
- Distributed Ledger
- Membership services (for permissioned)

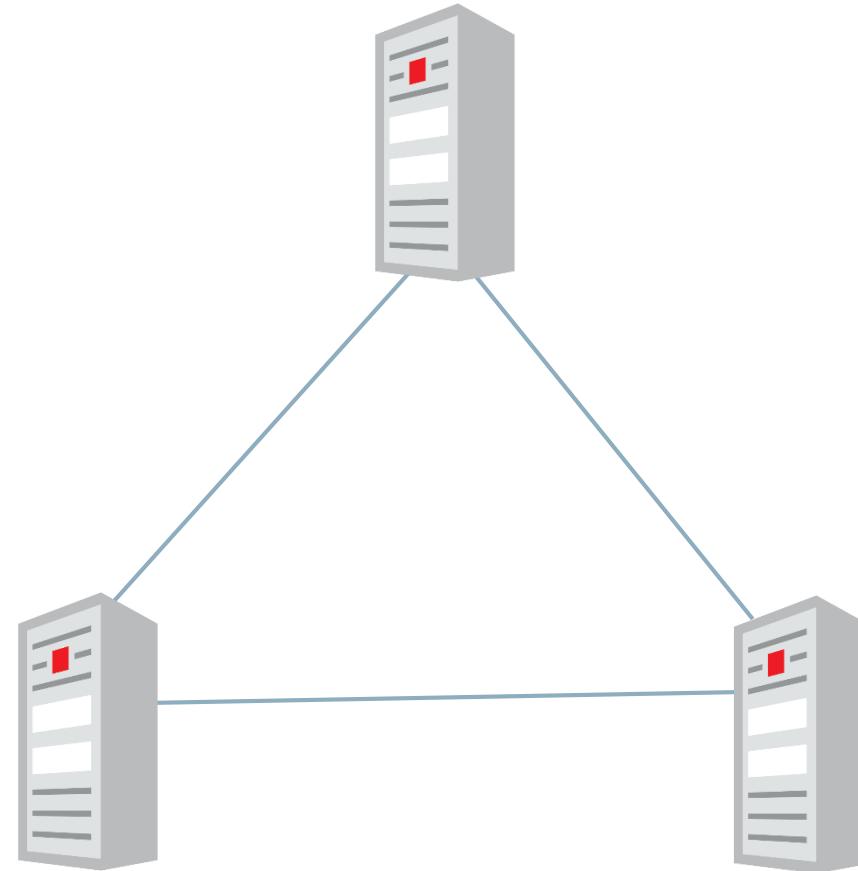


Components of a HyperLedger Fabric Blockchain

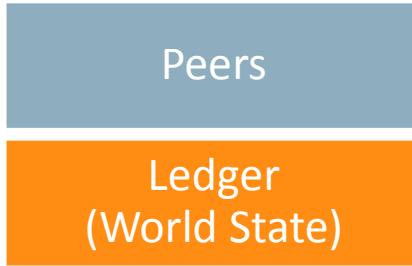
Peers

Maintain the state of the network and a copy of the ledger

- **Endorsers:** simulate and endorse transactions
- **Committers:** verify endorsements and validate transaction results, prior to committing transactions to the blockchain.

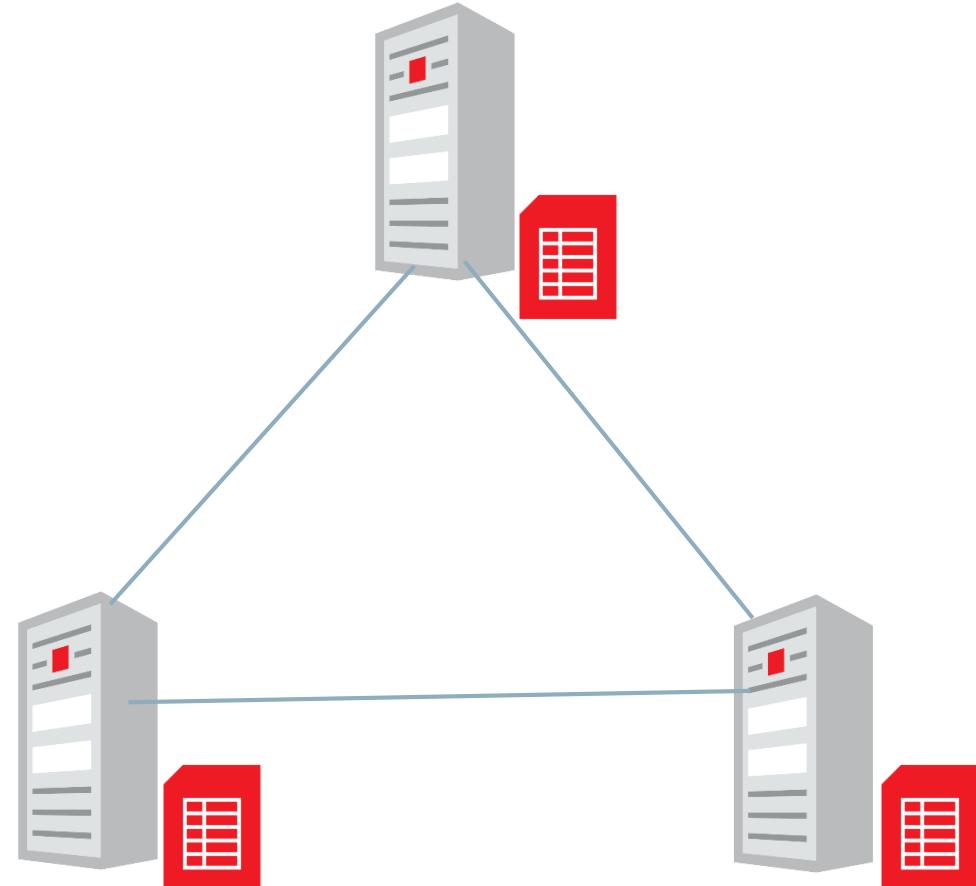


Components of a HyperLedger Fabric Blockchain



A shared, permissioned ledger that is an append-only system of records and serves as a single source of truth.

- **Chain:** transaction log, structured as **hash-linked blocks**, where each block contains a sequence of N transactions. The block header includes a hash of the block's transactions, as well as a hash of the prior block's header.
- **State DB:** ‘World State’ is modeled as a versioned key/value store (KVS). It reflects the current data about all the assets in the network. This data is stored in a database for efficient access. (LevelDB and/or CouchDB).
 - ✓ Keys are simple names or composite, i.e., constructed keys.
 - ✓ Values are arbitrary blobs, JSON often used.
- **History DB:** Maintains a history of the values of a key. Currently in Fabric just a pointer into ledger.

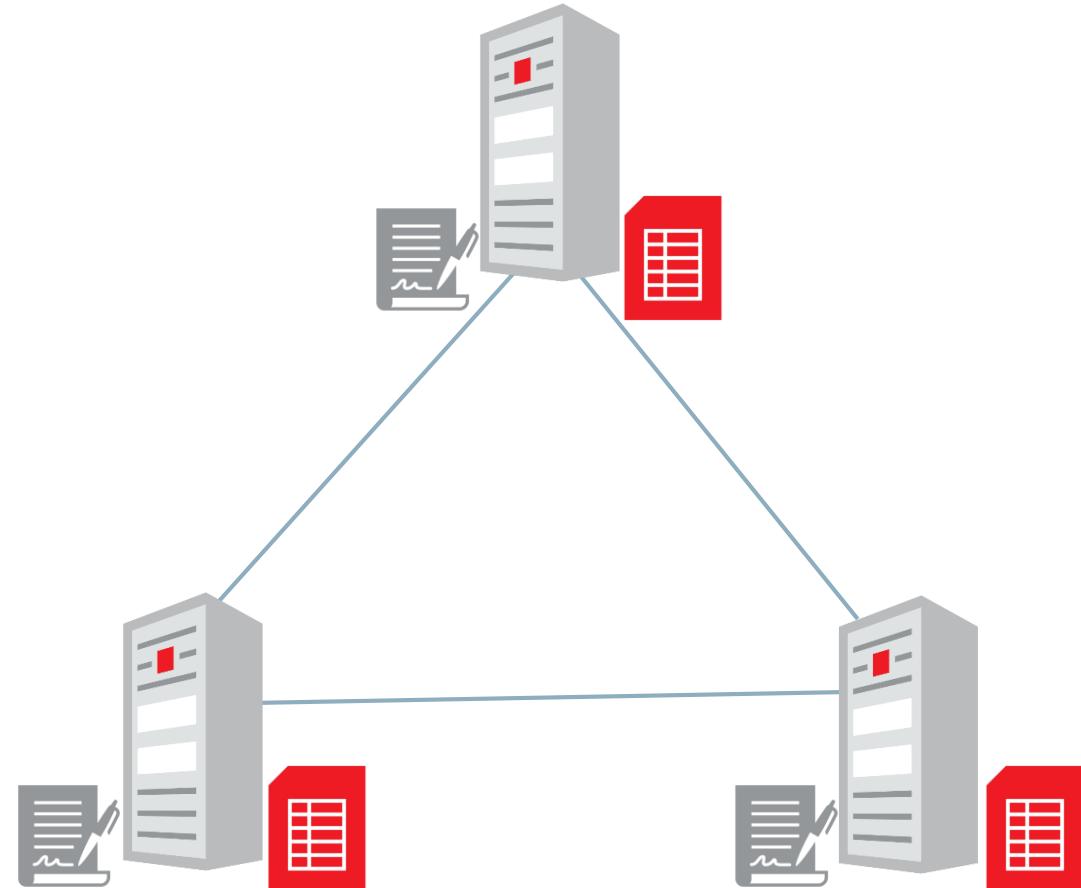


Components of a HyperLedger Fabric Blockchain



Business Logic to execute a transaction. A Transaction could be either (Add, Edit, Read, Delete) assets. Written in:

- Go
- NodeJS
- Java (beta)

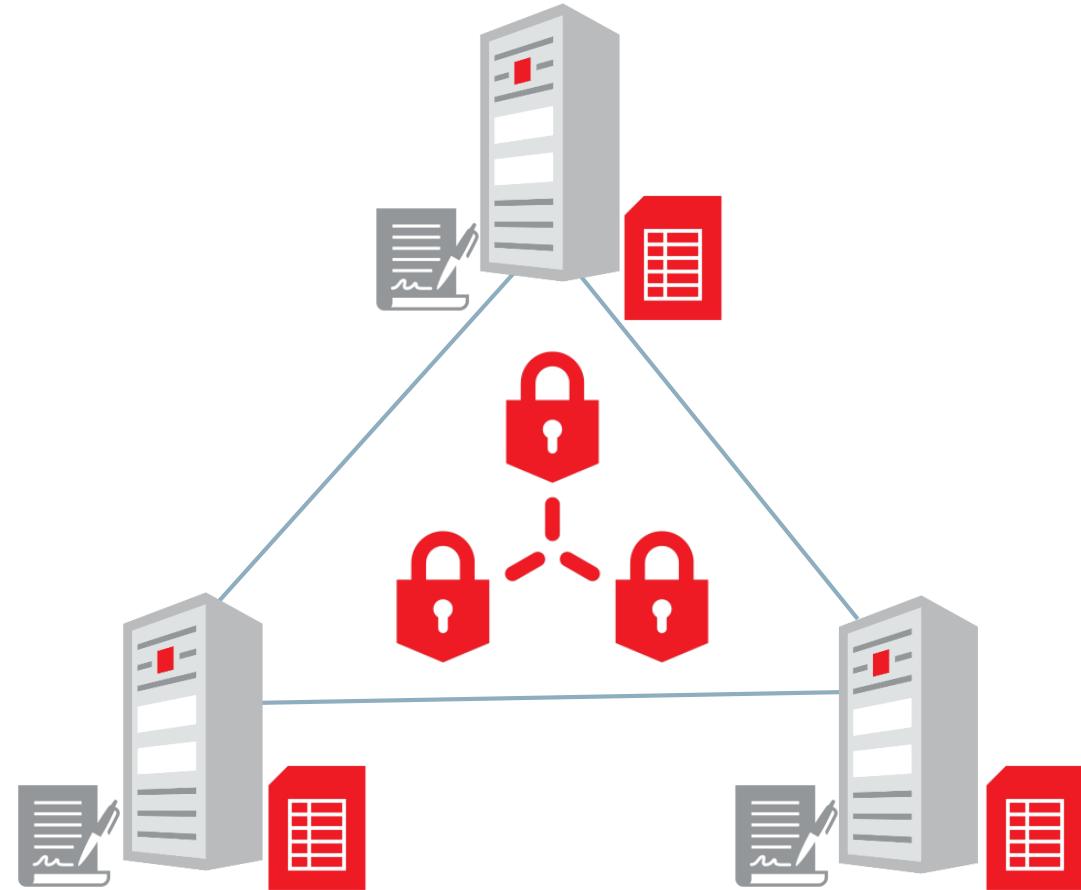


Components of a HyperLedger Fabric Blockchain

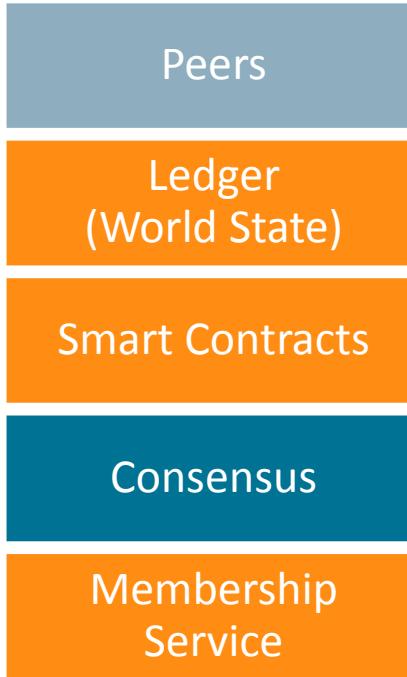


The process of reaching agreement on the next set of transactions to be added to the ledger:

- Transaction endorsement
- Ordering
- Validation and commitment



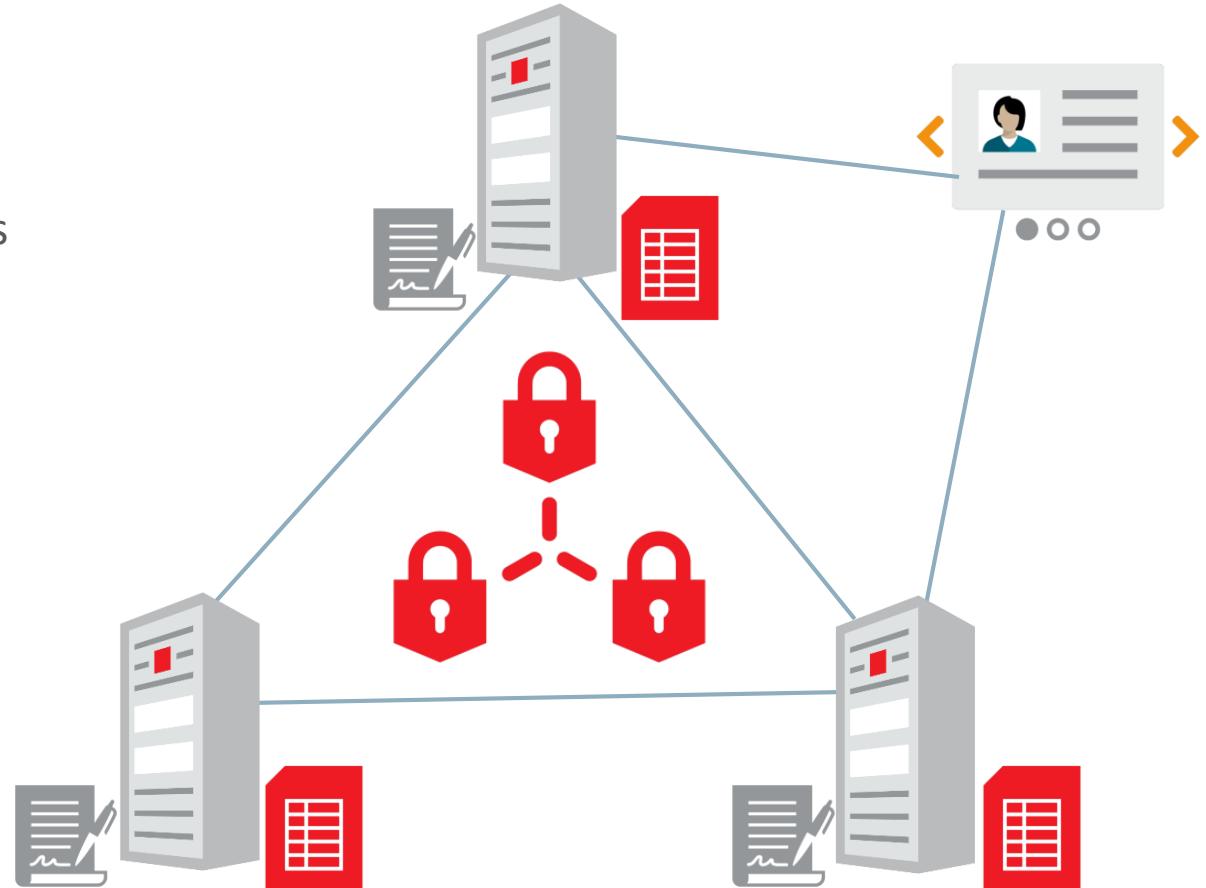
Components of a HyperLedger Fabric Blockchain



Controls enrollment of network members (organizations) and provides related cryptographic services.

Implements a CA architecture with Root CA and intermediate CAs

- Enrollment (ECerts).
- TLS (TCerts).

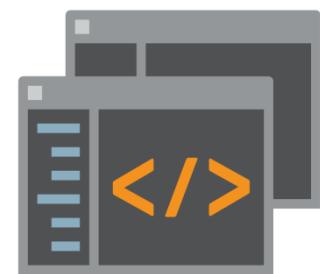


Components of a HyperLedger Fabric Blockchain

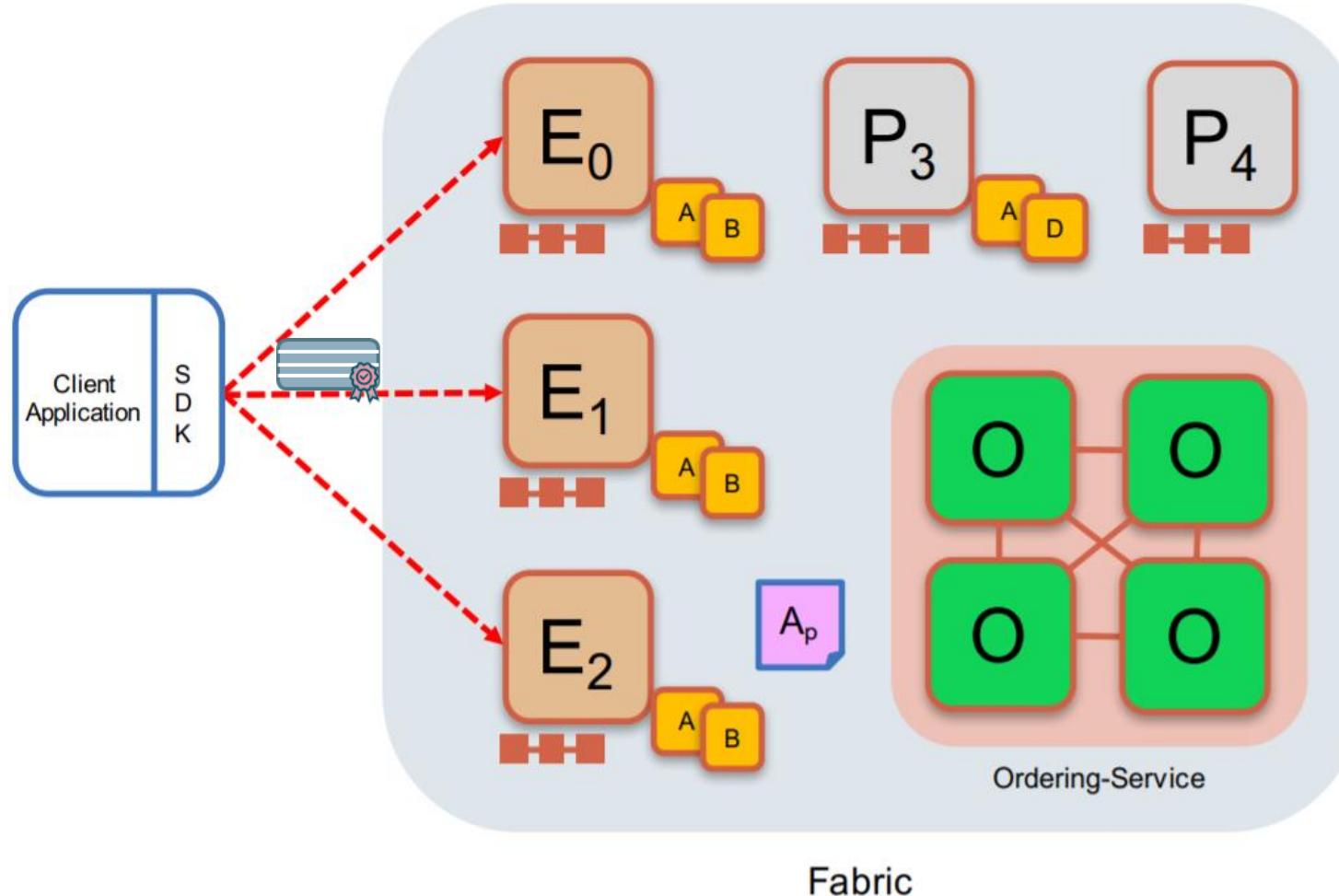


Clients are applications that act on behalf of a person to propose transactions on the network:

- Java SDK
- NodeJS SDK
- Python (under development)



Propose Transaction



Application proposes transaction

Endorsement policy:

- “E₀, E₁ and E₂ must sign”
- (P₃, P₄ are not part of the policy)

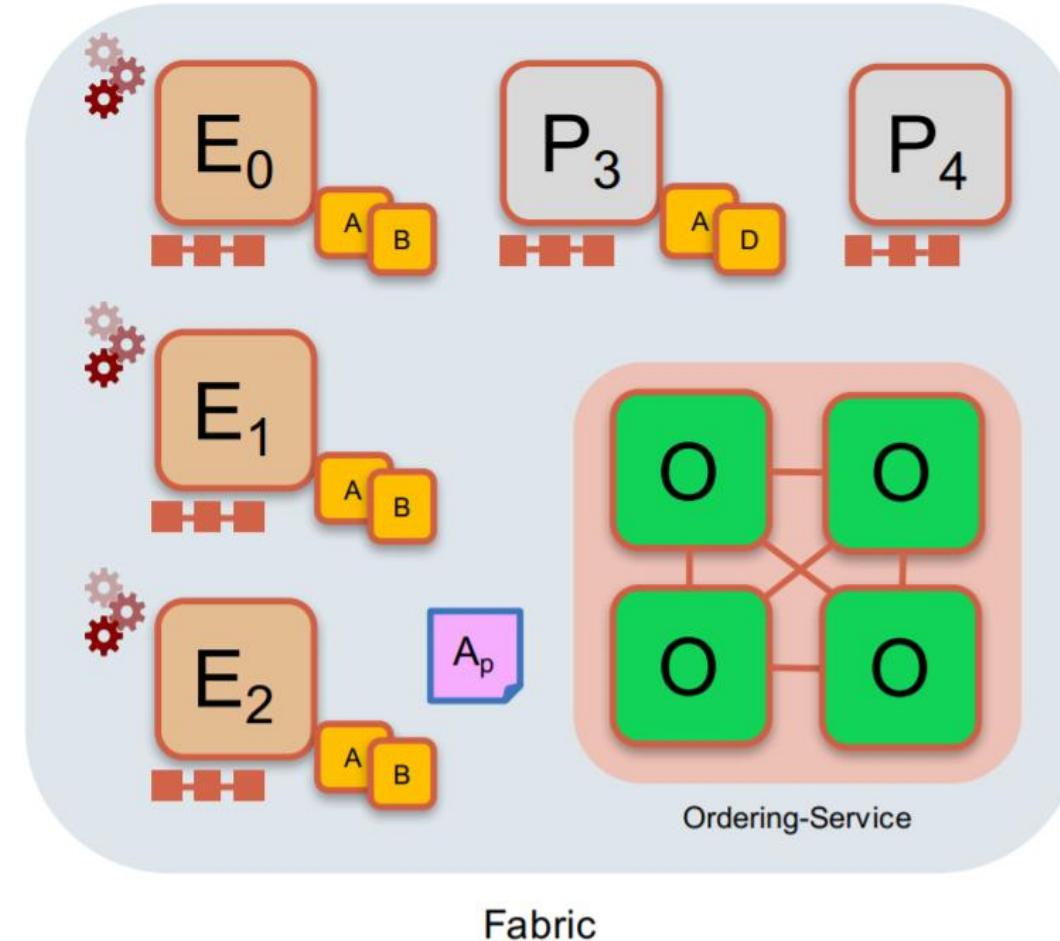
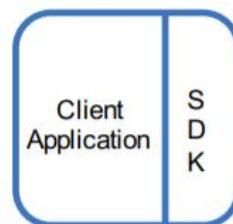
Client application submits a transaction proposal for **chaincode A**. It must target the required peers {E₀, E₁, E₂}

Key:

Endorser		Ledger
Committer		Application
Orderer		
Smart Contract (Chain code)		Endorsement Policy

20

Execute Proposal



Endorsers Execute Proposals

E₀, E₁ & E₂ will each execute the *proposed* transaction. None of these executions will update the ledger

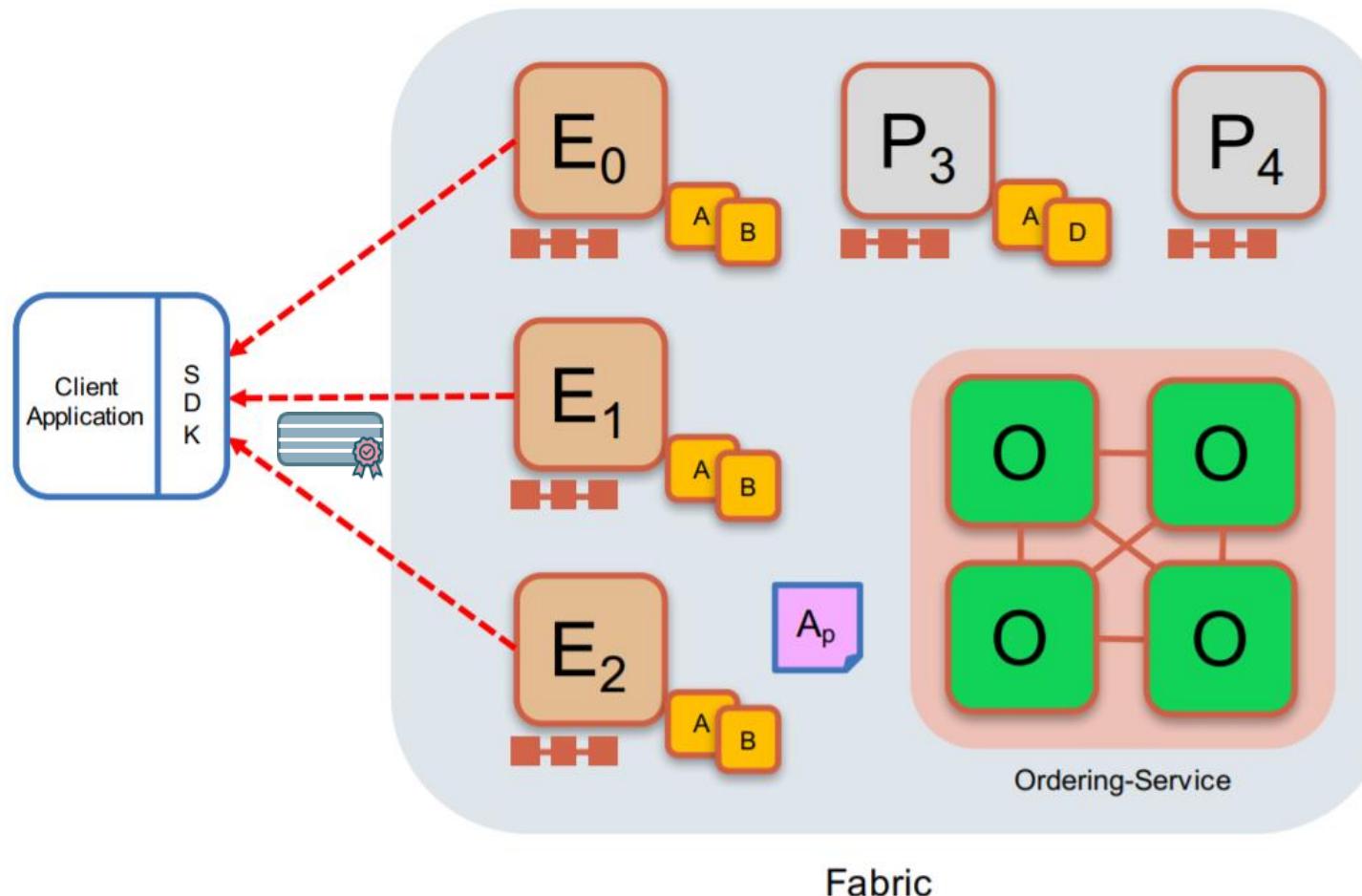
Each execution will capture the set of **R**ead and **W**ritten data, called **RW sets**, which will now flow in the fabric.

Key:

Endorser			Ledger
Committer			Application
Orderer			
Smart Contract (Chain code)			Endorsement Policy

21

Proposal Response



Application receives responses

The RW sets are signed by each endorser and returned to the application

Key:

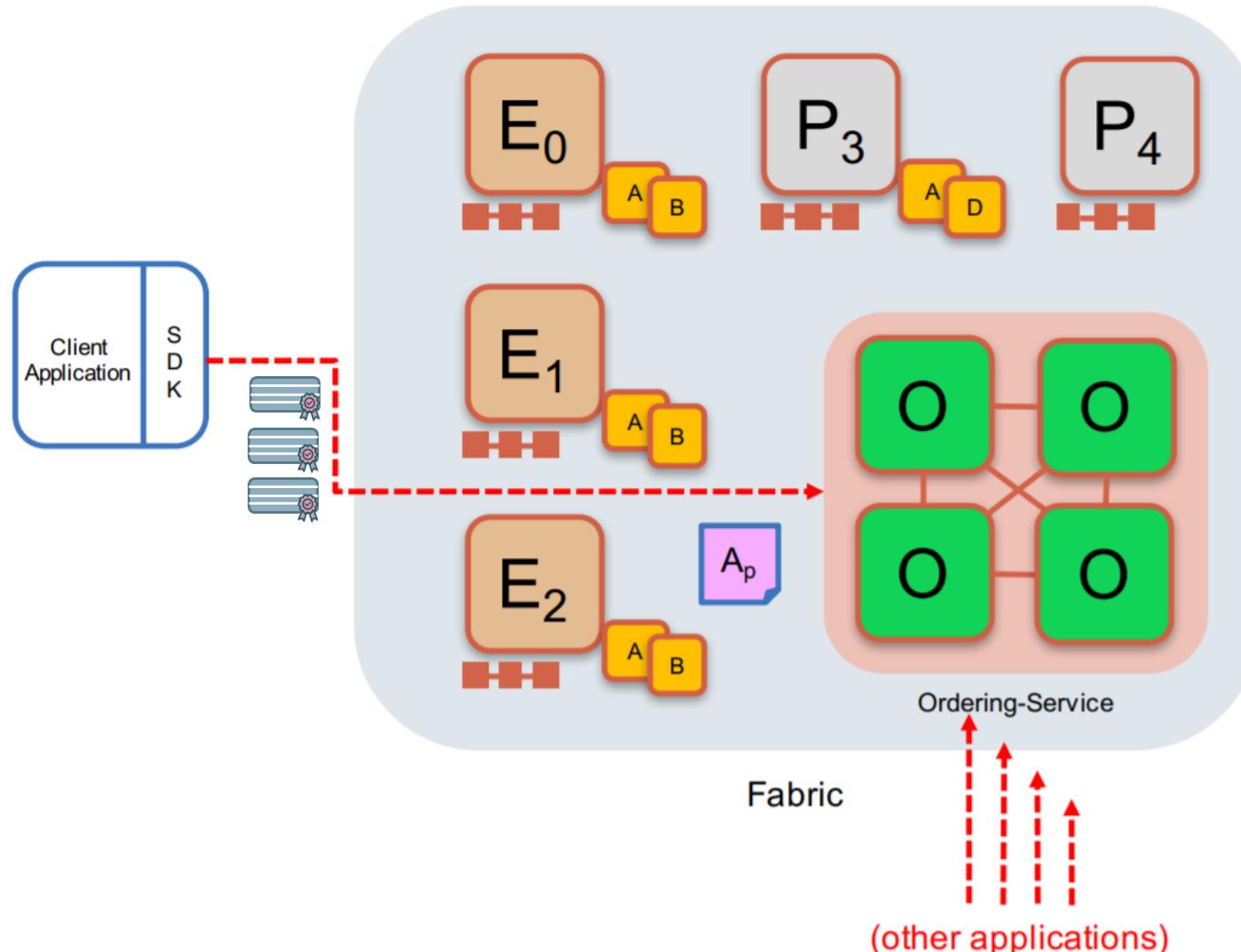
Endorser		Ledger
Committer		Application
Orderer		
Smart Contract (Chain code)		Endorsement Policy

22

RW-Set Semantic

```
<TxReadWriteSet>
  <NsReadWriteSet name="chaincode1">
    <read-set>
      <read key="K1", version="1">
      <read key="K2", version="1">
      </read-set>
    <write-set>
      <write key="K1", value="V1">
      <write key="K3", value="V2">
      <write key="K4", isDelete="true" >
    </write-set>
  </NsReadWriteSet>
<TxReadWriteSet>
```

Order Transaction



Application submits responses for ordering

Application submits responses as a **transaction** to be ordered.

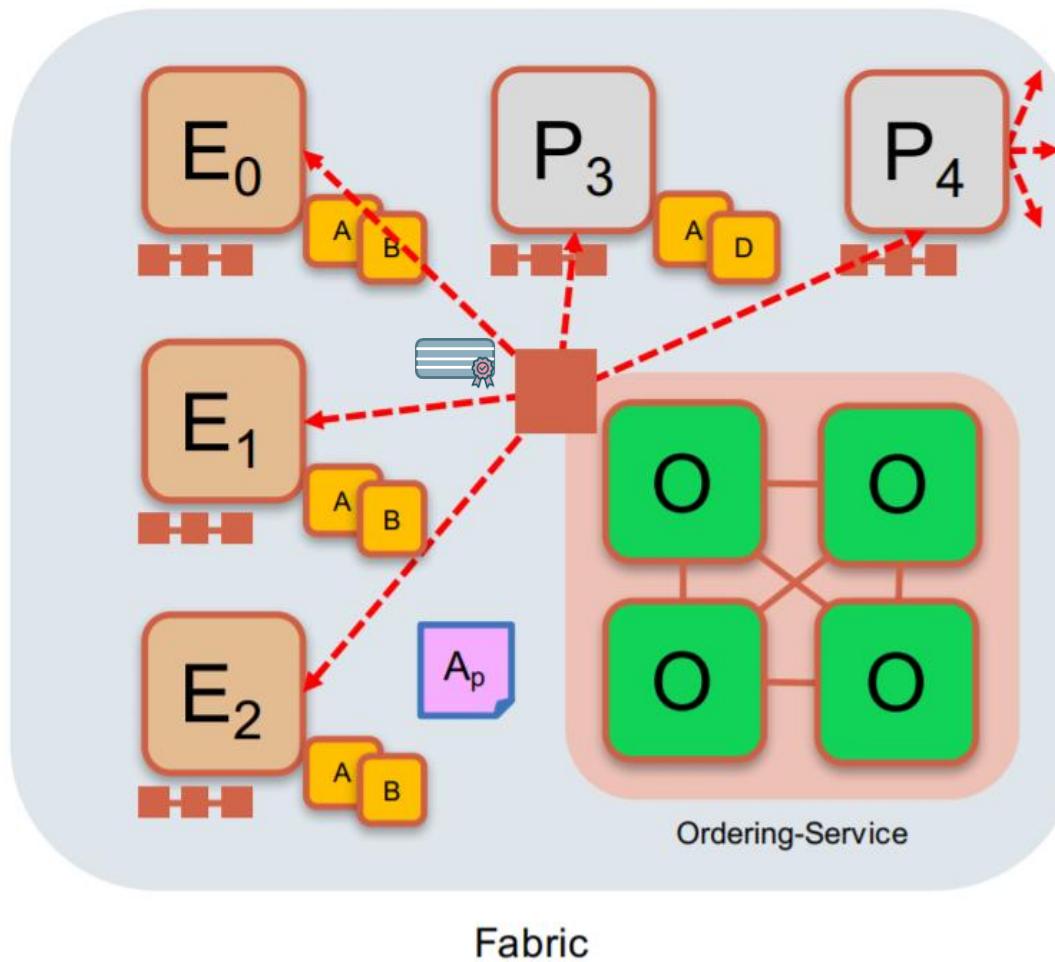
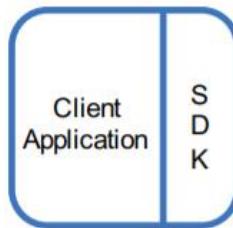
Ordering happens across the fabric in parallel with transactions submitted by other applications

Key:

Endorser		Ledger
Committer		Application
Orderer		
Smart Contract (Chain code)		Endorsement Policy

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Deliver Transaction



Orderer delivers to all committing peers

Ordering service collects transactions into blocks for distribution to committing peers. Peers can deliver to other peers using gossip (not shown)

Different ordering algorithms available:

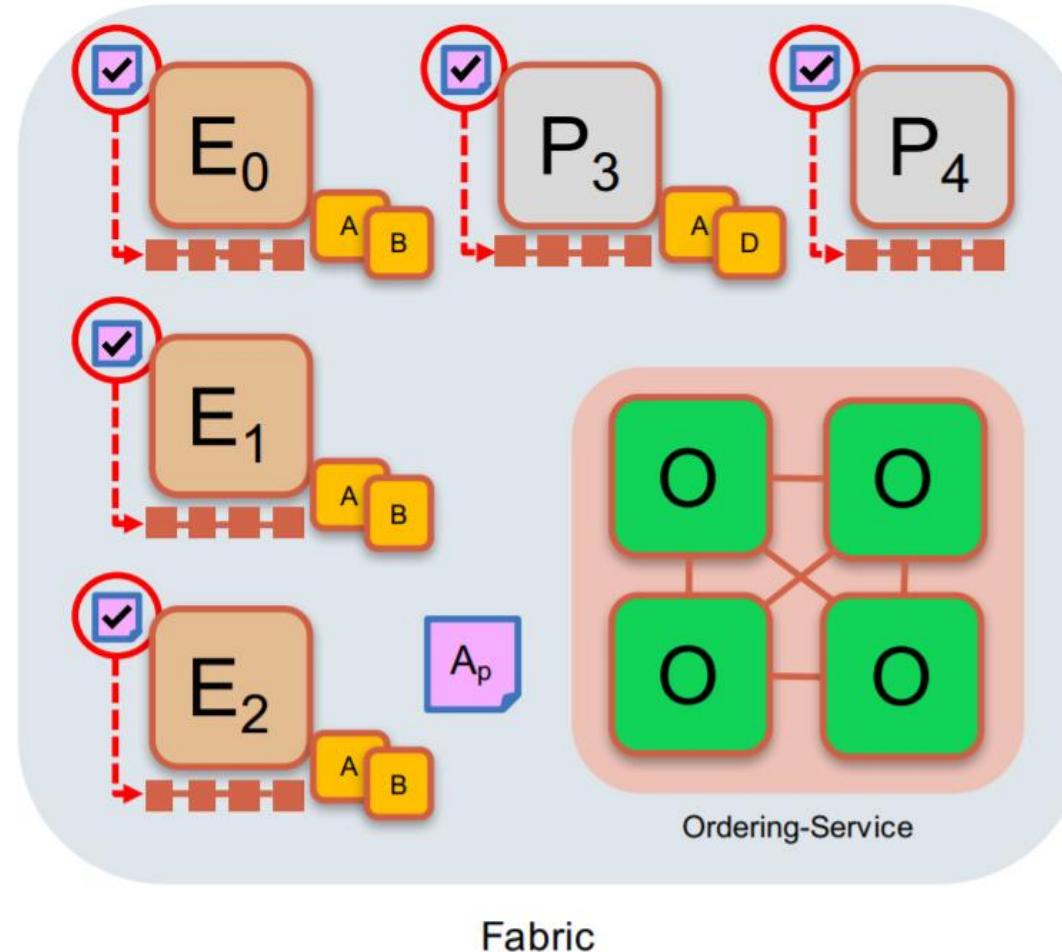
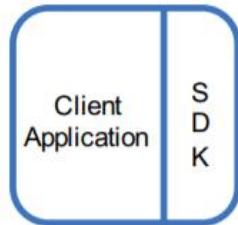
- SOLO (single node, development)
- Kafka (blocks map to topics)
- SBFT (tolerates faulty peers, future)

Key:

Endorser			Ledger
Committer			Application
Orderer			
Smart Contract (Chain code)			Endorsement Policy

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Validate Transaction



Committing peers validate transactions

Every committing peer validates against the endorsement policy. Also check RW sets are still valid for the current state

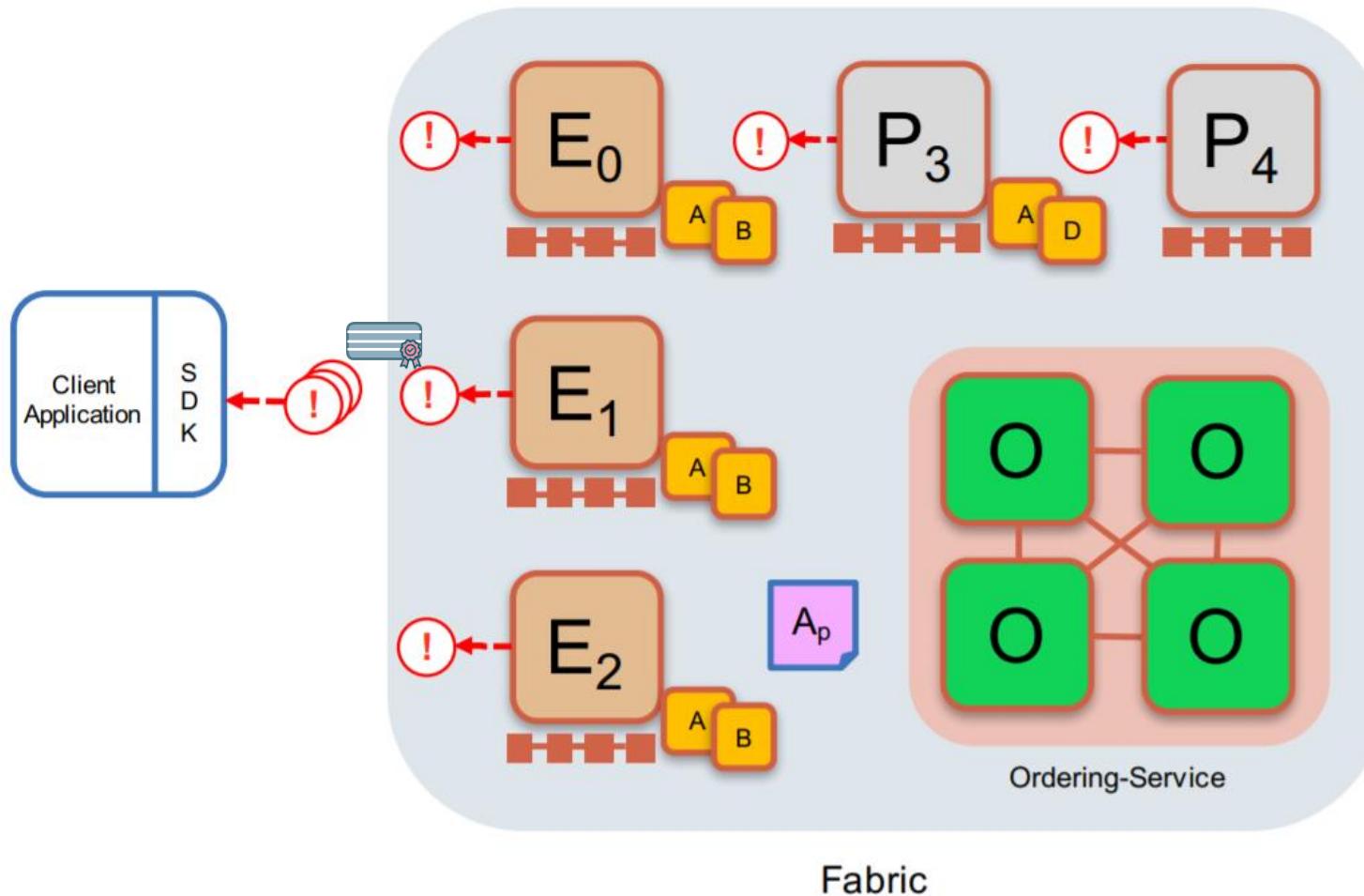
Transactions are written to the ledger and update caching DBs with validated transactions

Key:

Endorser		Ledger
Committer		Application
Orderer		
Smart Contract (Chain code)		Endorsement Policy

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Notify Transaction



Committing peers notify applications

Applications can register to be notified when transactions succeed or fail, and when blocks are added to the ledger

Applications will be notified by each peer to which they are connected

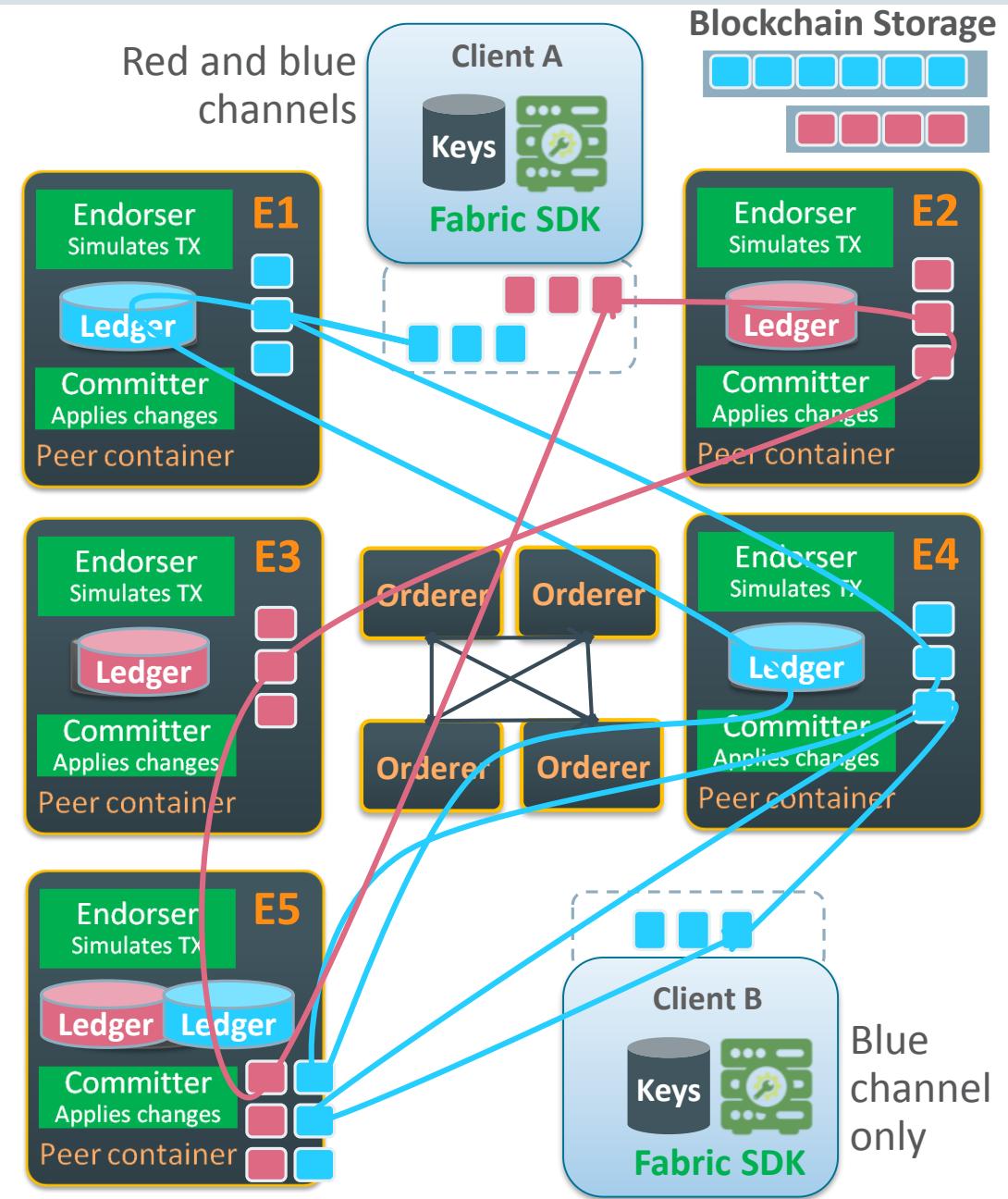
Key:

Endorser		Ledger
Committer		Application
Orderer		
Smart Contract (Chain code)		Endorsement Policy

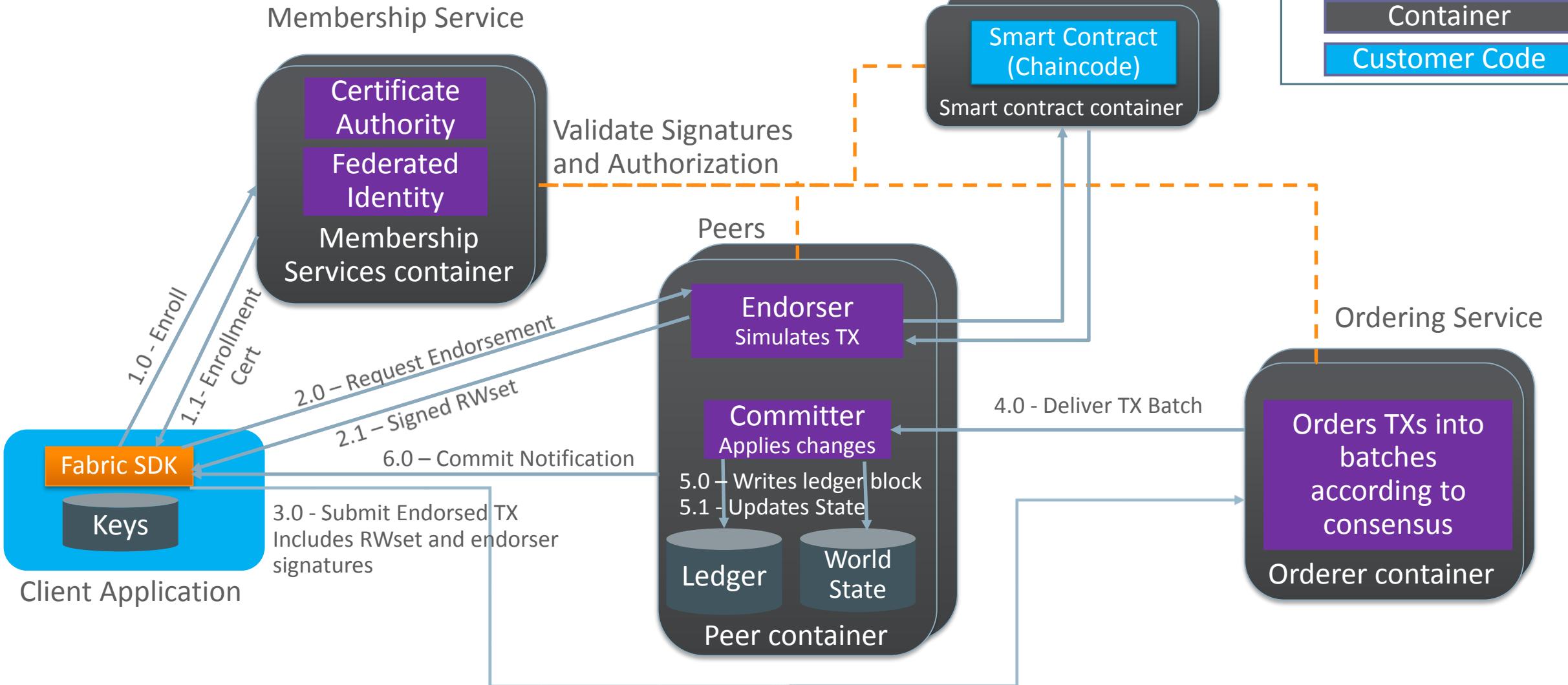
Channels

A data (and transaction) partitioning mechanism to limit access and visibility only to authorized members

- A channel is created to represent a group of member organizations, defined as a consortium
- Each channel's participating members assign peers who maintain a separate ledger – a "subnet" within a blockchain
- Confidentiality provided through restricted access to each channel is governed by joining and data access (R/O, R/W) policies
- Single Peer can join multiple channels and maintain multiple ledgers
- Ordering service treats transactions on different channels independently



Transaction Flow



Oracle and PrimeSourcing in Blockchain

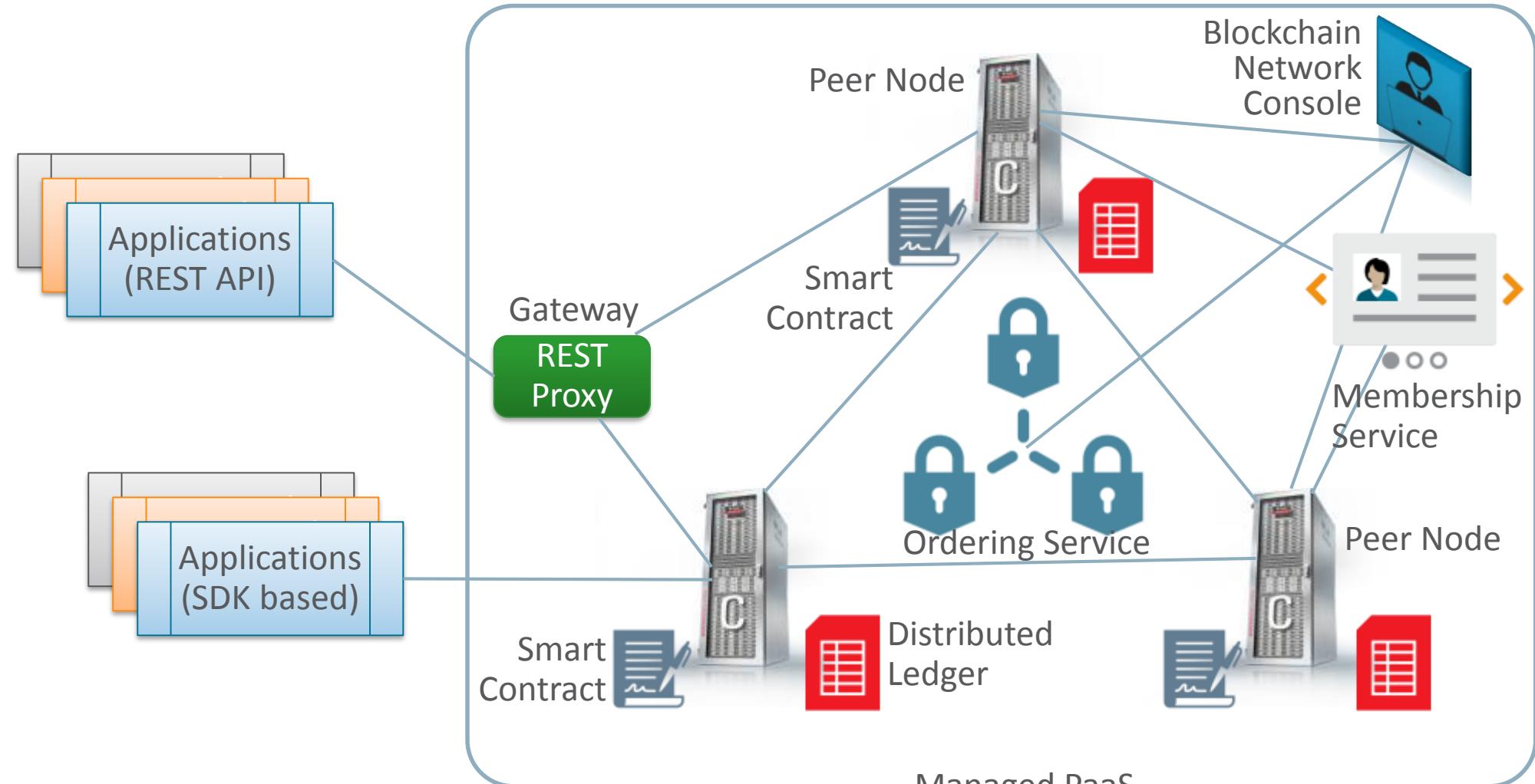
What are Enterprises looking for in Blockchain

- Increase business velocity by accelerating transactions, enabling new business models and revenue stream
- Automate multi-party business processes
- Reduce cost and risk of using intermediaries
- Reduce cost of fraud and regulatory compliance
- Improve data quality and timeliness by avoiding offline reconciliation and manual exception handling
- Increase auditability and trust, reduce audit costs

Oracle Strategy

- Deliver Enterprise-Grade Blockchain Cloud Platform
- Help Customers In Many Industries Adopt Blockchain and Distributed Ledgers
- Enable Rapid Experimentation and Production-Readiness
- Simplify Integration to Accelerate Blockchain Use in SaaS and PaaS Applications
- Leverage Oracle IP and Open Source to Advance the Enterprise Blockchain Capabilities

Oracle Autonomous Blockchain Cloud Service 'OABCS'



Key Oracle Advantages in Enterprise Blockchain



Enterprise-Ready

- Highly secure, built-in privacy
- Scalable business networks
- Highly resilient, built-in backups and recoverability



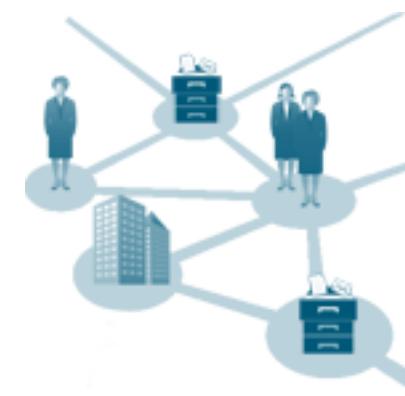
Ease of Integration

- REST API and SDKs for Java, Node.js
- API-driven development
- Plug-n-play integration from Oracle SaaS, PaaS, and on premises apps



Quick Time-to-Value

- Pre-assembled, managed PaaS
- Dynamic configurability and member on-boarding
- Start developing applications within minutes

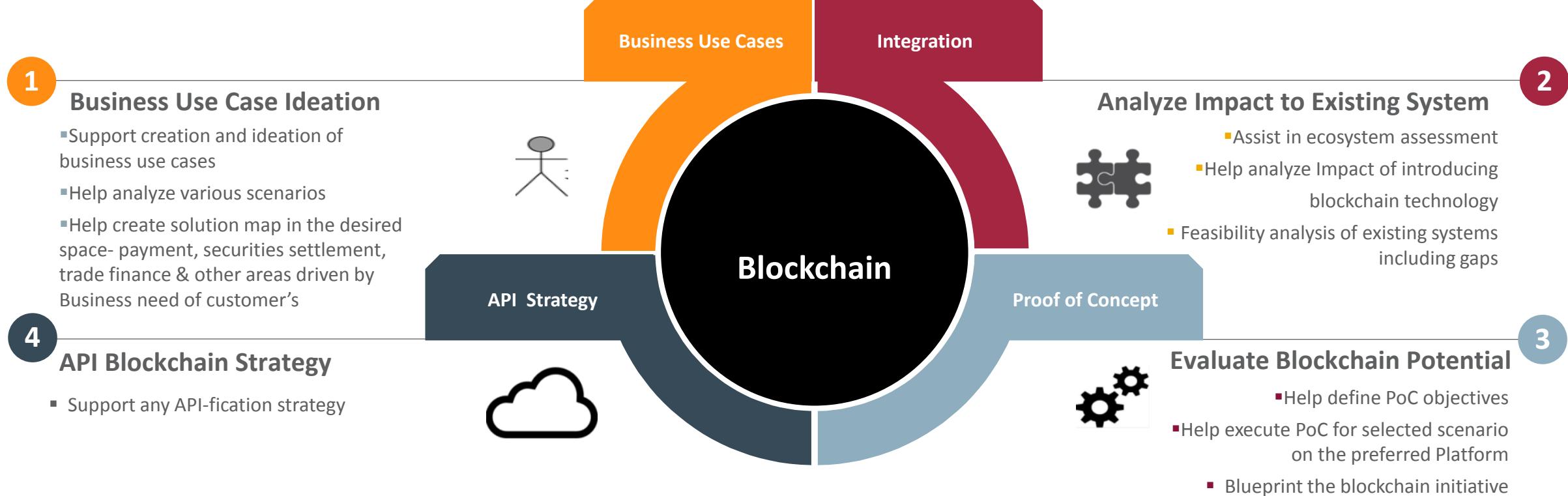


Extending Enterprise Boundary

- Securely extend ERP/SCM/GL business processes in Oracle SaaS, on premises and non-Oracle systems to streamline data exchange and conduct trusted transactions with other organizations
- Enables trusted transactions between Corporates and Banks in Oracle's Digital Innovation Platform for Open Banking

Blockchain - Strengths and Capabilities of PrimeSourcing

Helping Banks realize the potential presented by Blockchain



References

Reading Materials to Prepare for Deep Dive on Blockchain

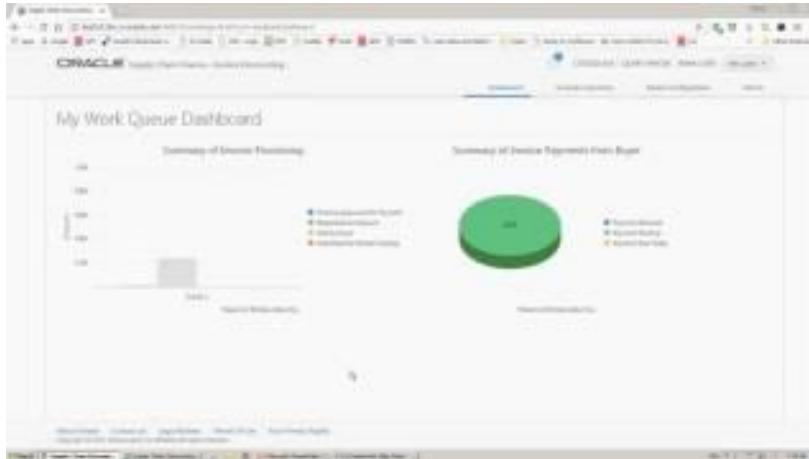
- If you are new to **Blockchain**, read the following guide: <https://blockgeeks.com/guides/what-is-blockchain-technology/> then read <http://www.oracle.com/blockchain>
- To get familiar with **Oracle BCS** read <http://cloud.oracle.com/blockchain> page and the eBook linked there. Then go to Learn More tab and watch first two demo videos.
- If you want a comprehensive understanding of **Hyperledger Fabric**, please go through the following site: <http://hyperledger-fabric.readthedocs.io/en/latest/>. For deeper understanding of Hyperledger Fabric, you can access design docs at: <https://wiki.hyperledger.org/community/fabric-design-docs>
- If you are new to **Docker**, please read: <https://docs.docker.com/learn/> and <https://www.calazan.com/docker-cleanup-commands/>
- If you are new to **GO (Golang)** programming language, some useful tutorials are at: <https://tour.golang.org/welcome/1>, <https://gobyexample.com/>, and <https://www.tutorialspoint.com/go/>

Stay connected to Blockchain Community

Below are few avenues to be connected with Blockchain happenings in Oracle and outside

- Hyperledger Fabric mailing list → <https://lists.hyperledger.org/g/fabric>
- Oracle Blockchain Community →
<https://confluence.oraclecorp.com/confluence/display/OBCS/Oracle+Blockchain+Community+Space>
- OABCs mailing list → blockchain_cloud_ww_grp (You can subscribe through [OIM](#). Select Request Access → Request for Self and then search for group name)
- Join OSN conversation → <https://eeho.fa.us2.oraclecloud.com/osn/web/cList/conversations/339079065>
- Oracle Blockchain Portal →
<https://stbeehive.oracle.com/content/dav/st/Technology%20and%20Systems/web/blockchain.html>

Proof of concept Videos



- SCF Invoice Discounting -
<https://www.youtube.com/watch?v=OyiFjAptD9Y>
- Settlement and Reconciliation as a Service -
https://otube.oracle.com/media/t/0_hub88hx9

Integrated Cloud Applications & Platform Services

ORACLE®