

Blockchain in Finance

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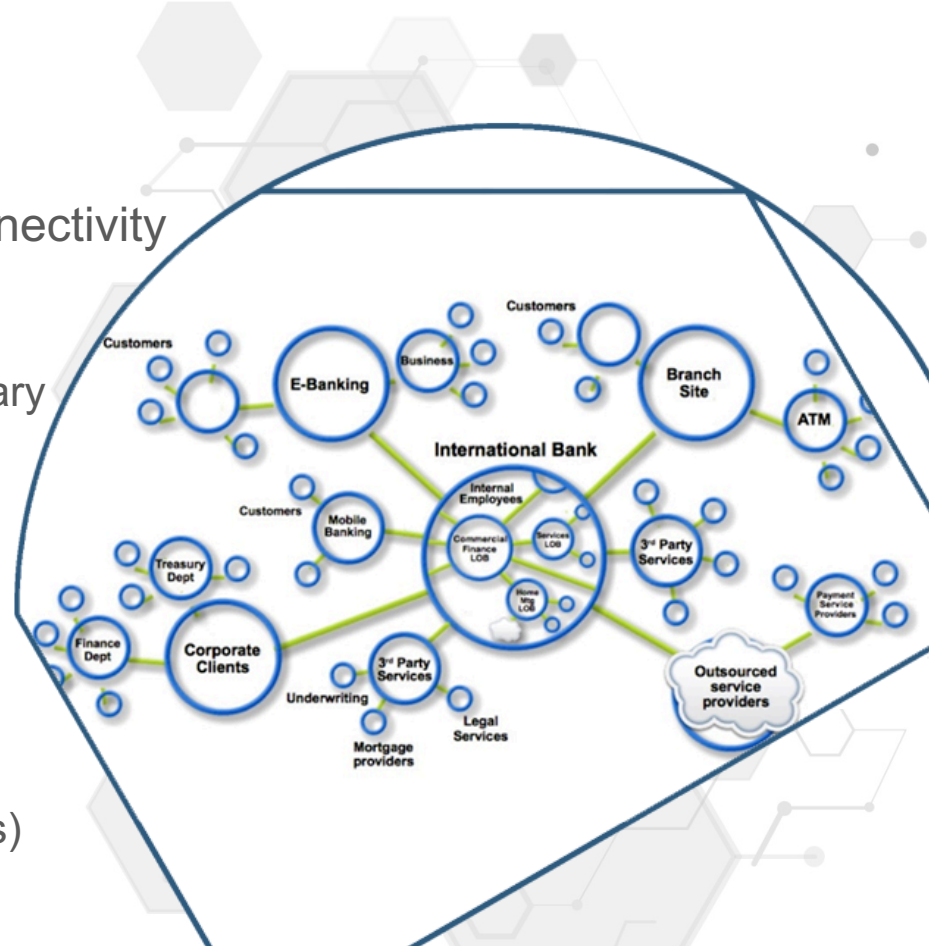
Agenda

- **Introduction to Blockchain Technology**
- **Technical Details (Optional)**
- **Popular Financial Services Use-Cases (Optional or Cover Quickly)**
- **Use-cases for Corporate Finance**

Introduction to Blockchain Technology

Business networks, wealth & markets

- **Business Networks** benefit from connectivity
 - Participants are customers, suppliers, banks, partners
 - Cross geography & regulatory boundary
- **Wealth** is generated by the flow of goods & services across business network in transactions and contracts
- **Markets** are central to this process:
 - Public (fruit market, car auction), or
 - Private (supply chain financing, bonds)



Transferring assets, building value

Anything that is capable of being owned or controlled to produce value, is an asset



Two fundamental types of asset

- Tangible, e.g. a house
- Intangible, e.g. a mortgage



Intangible assets subdivide

- Financial, e.g. bond
- Intellectual, e.g. patents
- Digital, e.g. music



Cash is also an asset

- Has property of anonymity

Ledgers are key ...

Ledger is THE system of record for a business. Business will have multiple ledgers for multiple business networks in which they participate.

- **Transaction** – an asset transfer onto or off the ledger
 - John gives a car to Anthony (simple)
- **Contract** – conditions for transaction to occur
 - If Anthony pays John money, then car passes from John to Anthony (simple)
 - If car won't start, funds do not pass to John (as decided by third party arbitrator) (more complex)

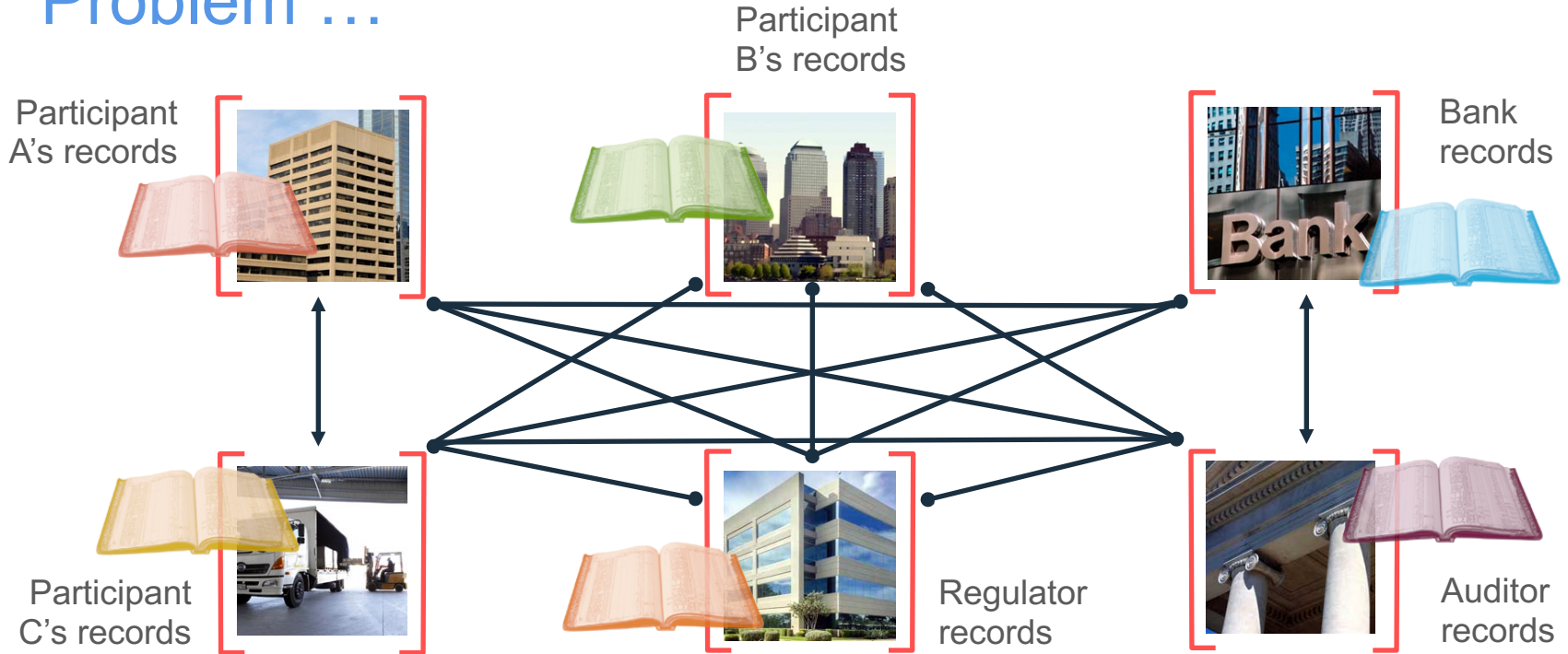


Introducing Blockchain

A trusted, distributed ledger with shared business process

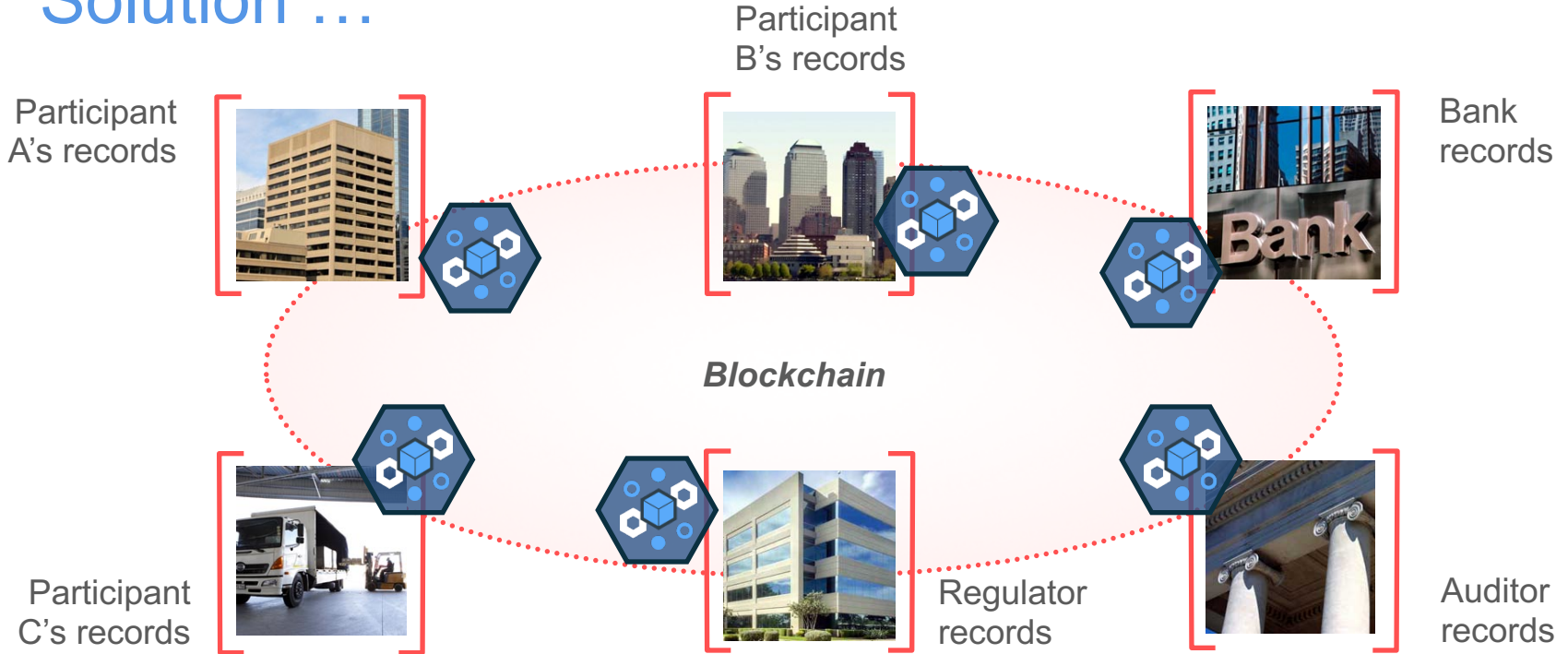


Problem ...



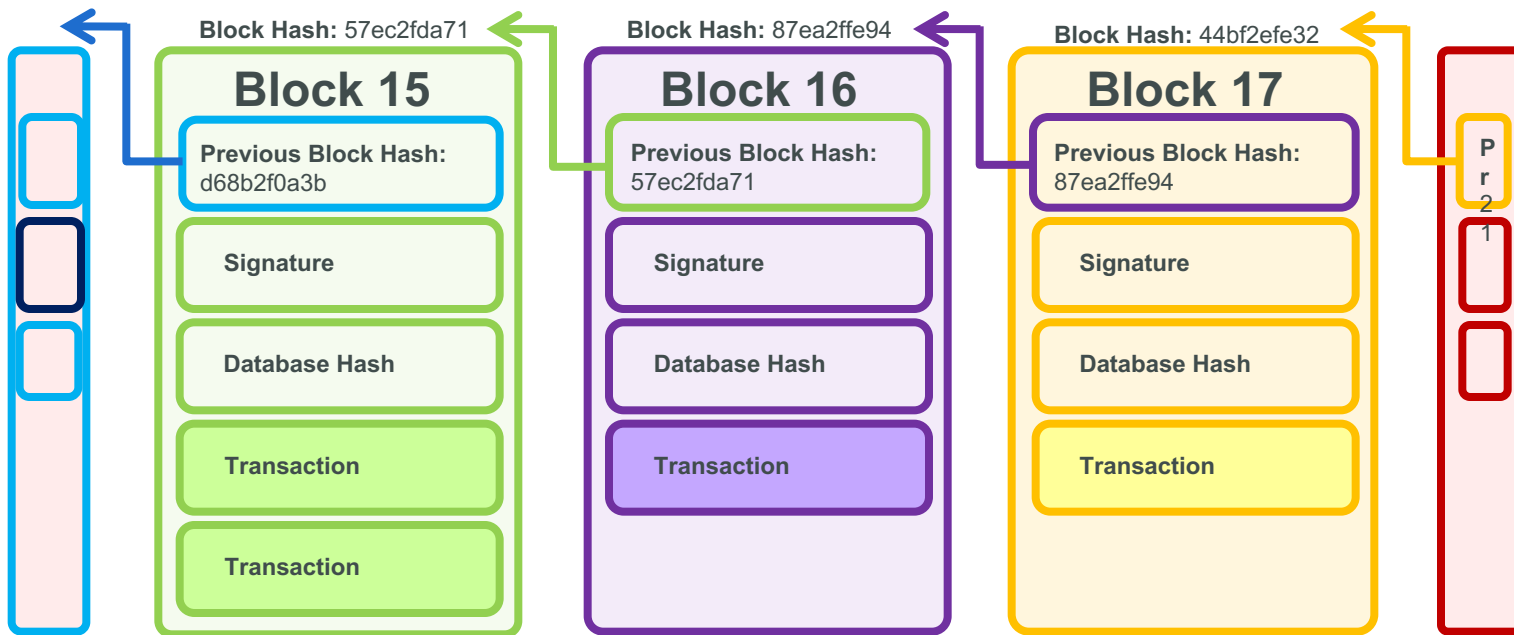
... inefficient, expensive, vulnerable

Solution ...



... A trusted, distributed, permissioned ledger

What is a Blockchain ?



Made up of a series of blocks added in **chronological order**

All **blocks must contain at least 1 transaction** as a new block will not be formed unless one is present

Blockchain for business ...

Append-only distributed system of record shared across business network



Shared ledger



Smart contract

Shared business rules apply to transactions

Ensuring appropriate visibility; transactions are secure, authenticated & verifiable



Privacy

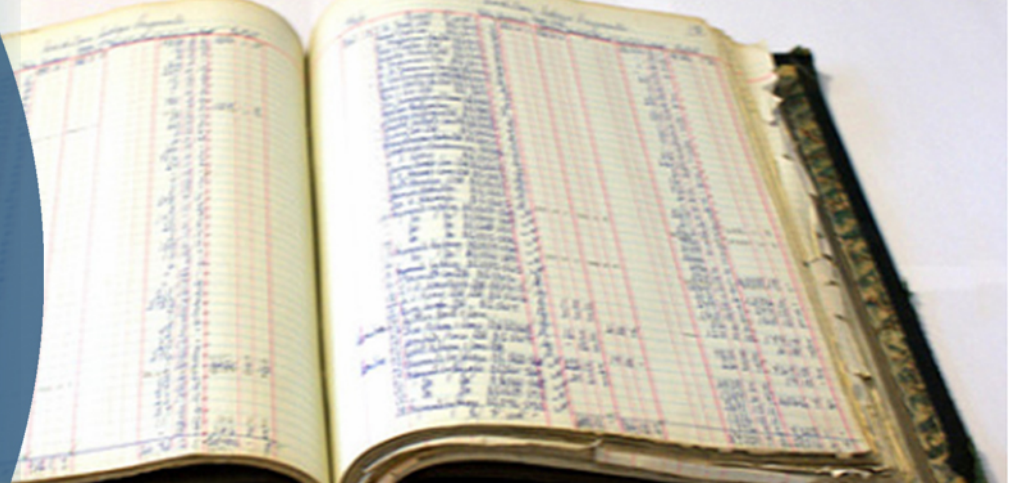


Trust

Participants are able to trust the contents of the ledger

... Broader participation, lower cost, increased efficiency

Shared ledger



Records all transactions across business network

- Shared between participants
- Participants have own copy through replication
- Permissioned, so participants see only appropriate transactions
- THE shared system of record

Smart contract



Business rules implied by the contract ... embedded in the Blockchain and executed with the transaction

- Verifiable, signed
- Encoded in programming language
- Example:
 - Defines contractual conditions under which corporate Bond transfer occurs

Privacy



The ledger is shared, but participants require privacy

- Participants need:
 - Appropriate confidentiality between subsets of participants
 - Identity not linked to a transaction
- Transactions need to be authenticated
- Cryptography central to these processes

Trust



The ledger is a trusted source of information

- Participants **endorse** transactions
 - Business network decides who will endorse transactions
 - Endorsed transactions are added to the ledger with appropriate confidentiality
- Assets have a verifiable audit trail
 - Transactions cannot be modified, inserted or deleted

Blockchain is not solution for everything ...

Blockchain is **NOT**

- ✗ Suited to high performance (millisecond) transactions
- ✗ For just one participant (no business network)
- ✗ A replicated database replacement
- ✗ A messaging solution
- ✗ A transaction processing replacement
- ✗ Suited for low value, high volume transactions



Blockchain benefits



Saves time

Transaction time
from days to near
instantaneous



Removes cost

Overheads and
cost intermediaries



Reduces risk

Tampering, fraud
& cyber crime



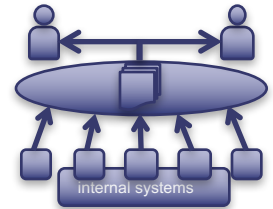
Increases trust

Through shared
processes and
recordkeeping

Customer Adoption: Categories and their Description

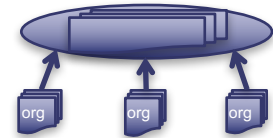
1. INTERNAL LEDGER

- A ledger primarily for internal reporting, audit and compliance, serving as a low-barrier starting point for Blockchain within a large organization. Populated from internal systems to provide a consistent view of key business assets, where provenance, immutability and finality are more important than consensus. Can extend access to auditor and regulator to provide transparency.



2. CONSORTIUM SHARED LEDGER

- A ledger created by a relatively small set of industry participants to share reference data between themselves and consumers. Provides consistent real-time view of previously partitioned which was distributed in ad-hoc manner.



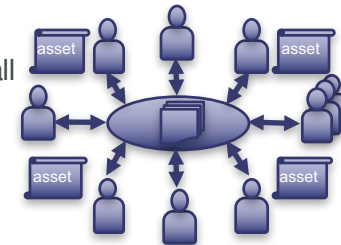
3. INFORMATION HUB

- A ledger set up around a single organization (e.g. government department) to facilitate the sharing of information between many counterparties, for example, for corporate actions (voting, dividend notification). The exchanged assets do not have a significant financial value, but represent important assets which require provenance, immutability and finality.



4. HIGH VALUE MARKET

- A full ledger for the transfer of high financial value assets between many counterparties in a market. Requires all enterprise features of Blockchain given value of assets transferred.



Technical Details

A Day in the Life of a Transaction

I am created for a purpose and often related to others of the same specie

SDK

Multilateral

Referenced Transactions

Chaincode



Then I am endorsed by those who are interested in me based on policy

Endorsers

Identity

Security Policy

And finally I am sorted on a channel to enter validation before ever lasting life

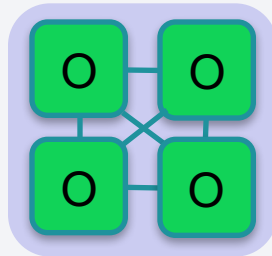
Ordering Service

Multichannel

Committer

Immutable Ledger

The ordering service packages transactions into blocks to be delivered to peers. Communication with the service is via channels.



Ordering-
Service

Different configuration options for the ordering service include:

SOLO

Single node for development

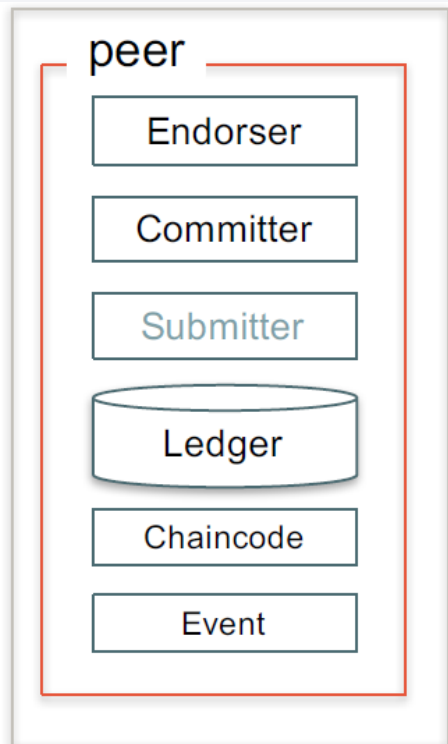
Kafka

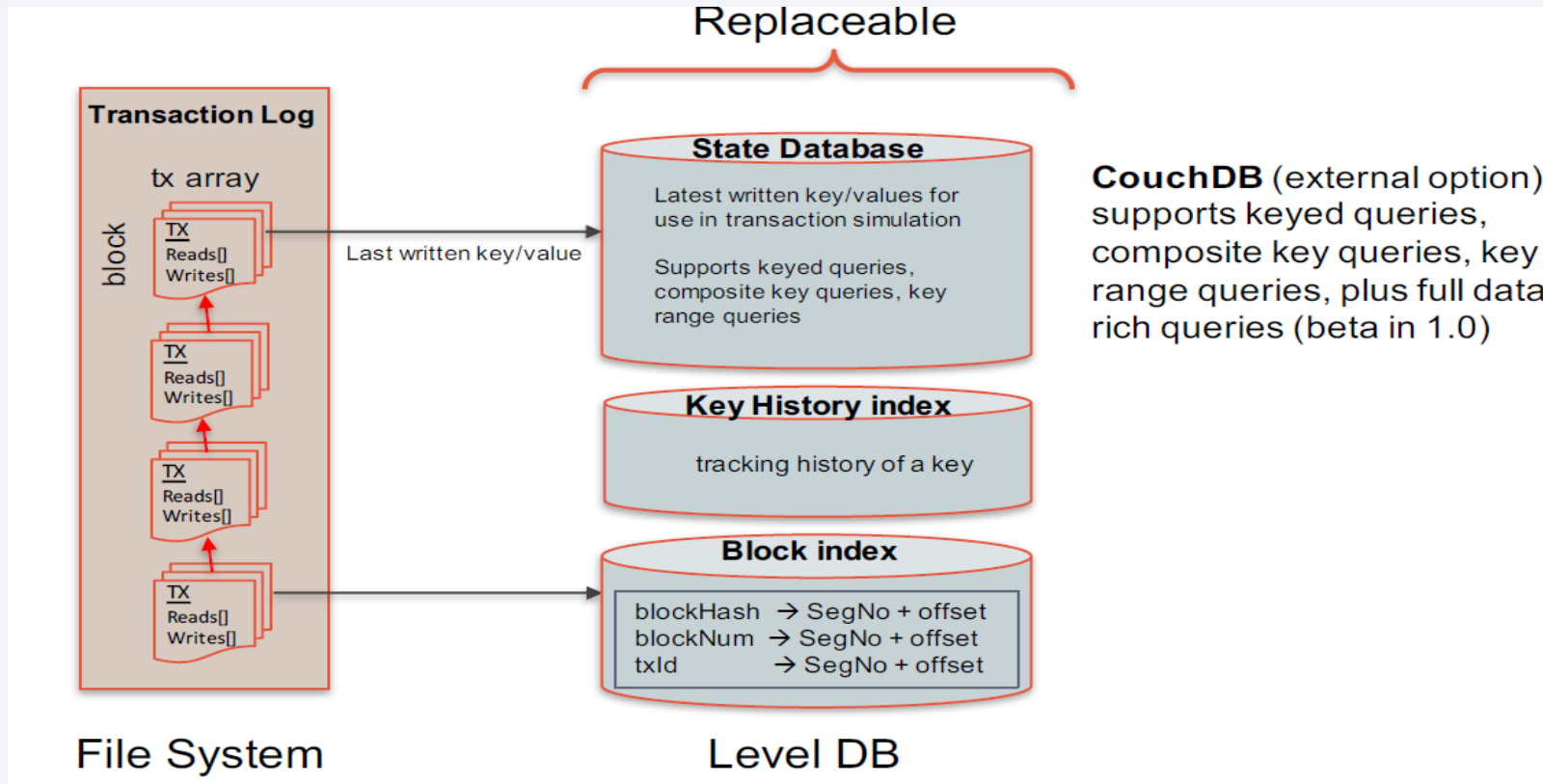
 : Crash fault tolerant consensus

3 nodes minimum

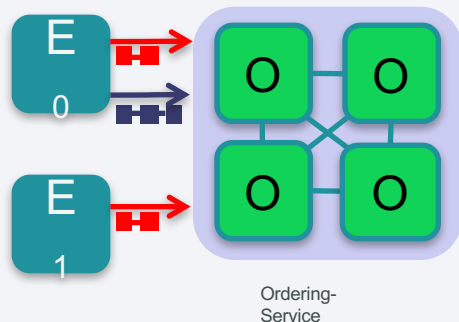
Odd number of nodes recommended

- A Peer is a node on the network maintaining state of the ledger and managing chaincodes
- Any number of Peers may participate in a network
- A Peer can be an endorser, committer and/or submitter (submitter has not been implemented). An endorser is always a committer
 - An endorser executes and endorses transactions
 - A committer verifies endorsements and validates transaction results
- A Peer manages event hub and deliver events to the subscribers
- Peers form a peer-to-peer gossip network





Channels provide privacy between different ledgers



Ledgers exist in the scope of a channel

Channels can be shared across an entire network of peers

Channels can be permissioned for a specific set of participants

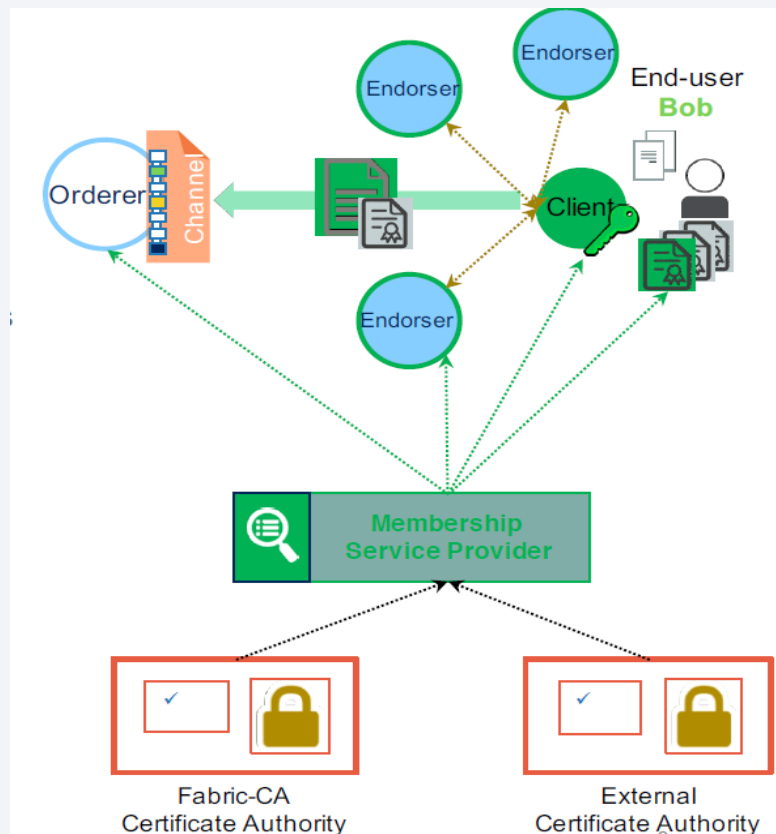
Chaincode is **installed** on peers to access the worldstate

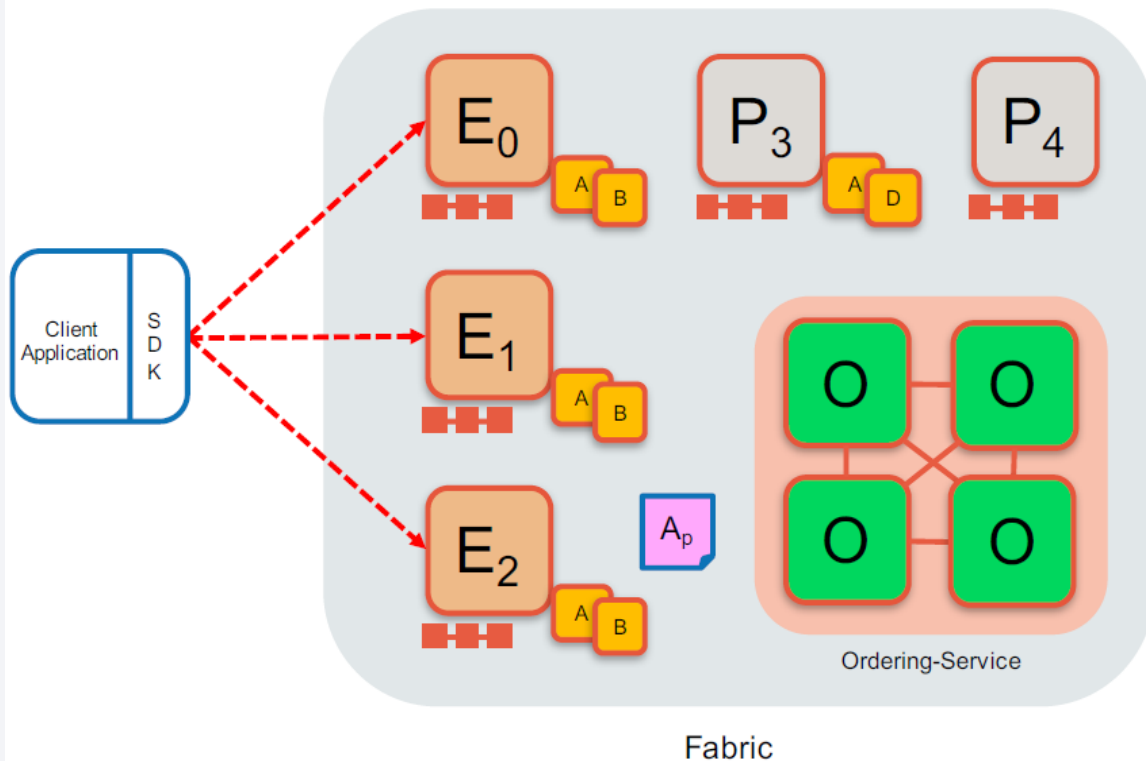
Chaincode is **instantiated** on specific

Peers can participate in multiple channels

Concurrent execution for performance and scalability

- An abstraction of identity provider
 - $\langle \text{MSP.id}, \text{MSP.sign}, \text{MSP.verify}, \text{MSP.validateid}, \text{MSP.admin} \rangle$
 - govern application, endorser and orderer identities
- Used as building blocks for access control frameworks
 - at the system level (read/write access on system controls, and channel creation)
 - at the channel level (read/write access),
 - at the chaincode level (invocation access)
- Represent a consortium or a member





Application proposes transaction

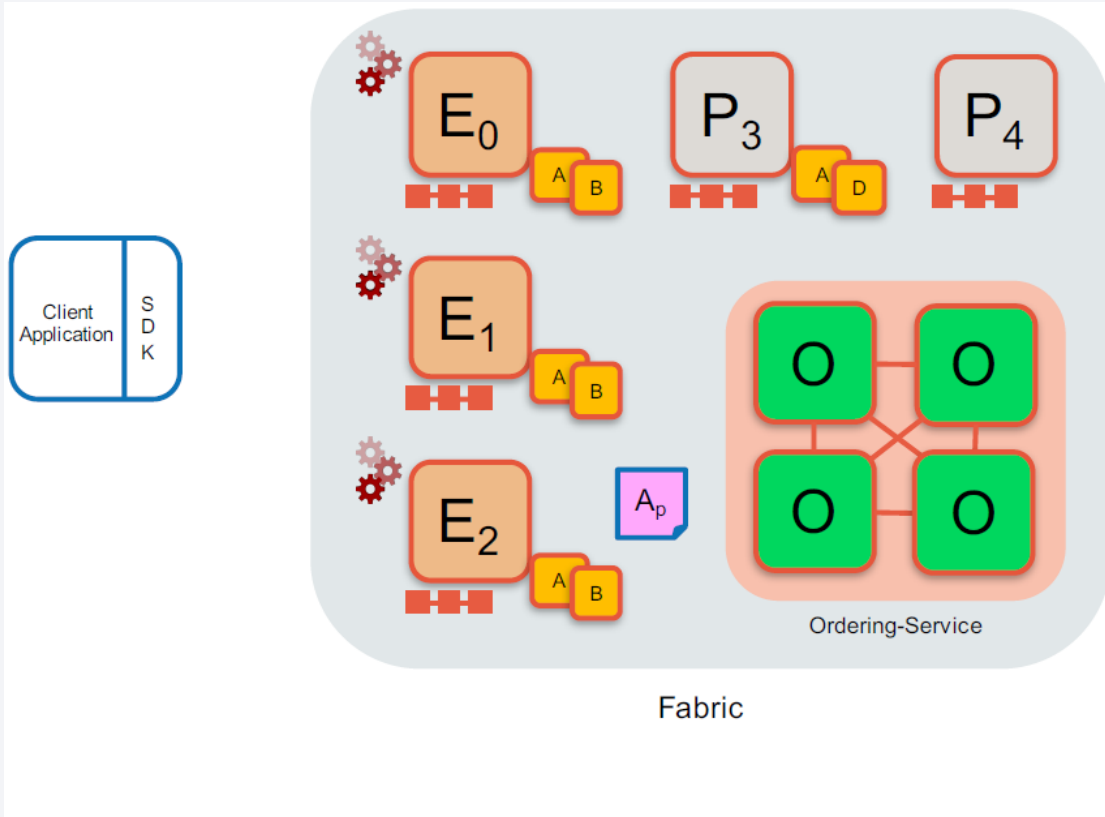
Endorsement policy:

- “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
Orderier			
Smart Contract (Chain code)			Endorsement Policy

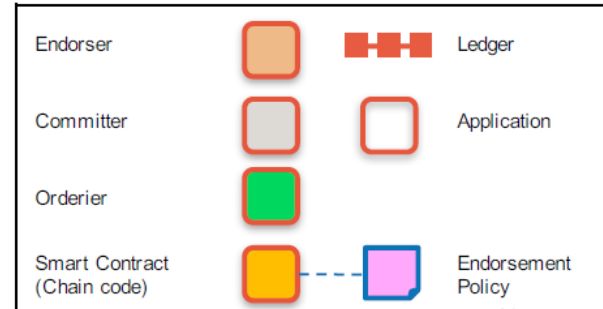


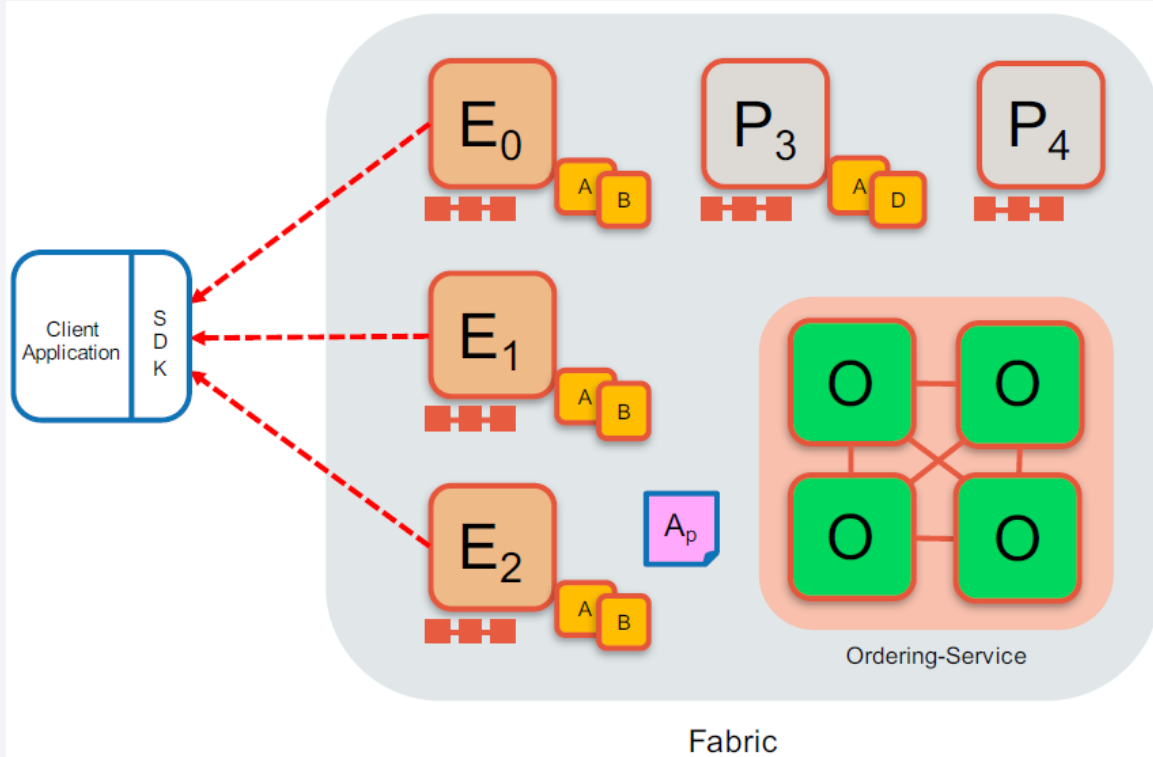
Endorsers Execute Proposals

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

Each execution will capture the set of **Read** and **Written** data, called **RW sets**, which will now flow in the fabric.

Key:



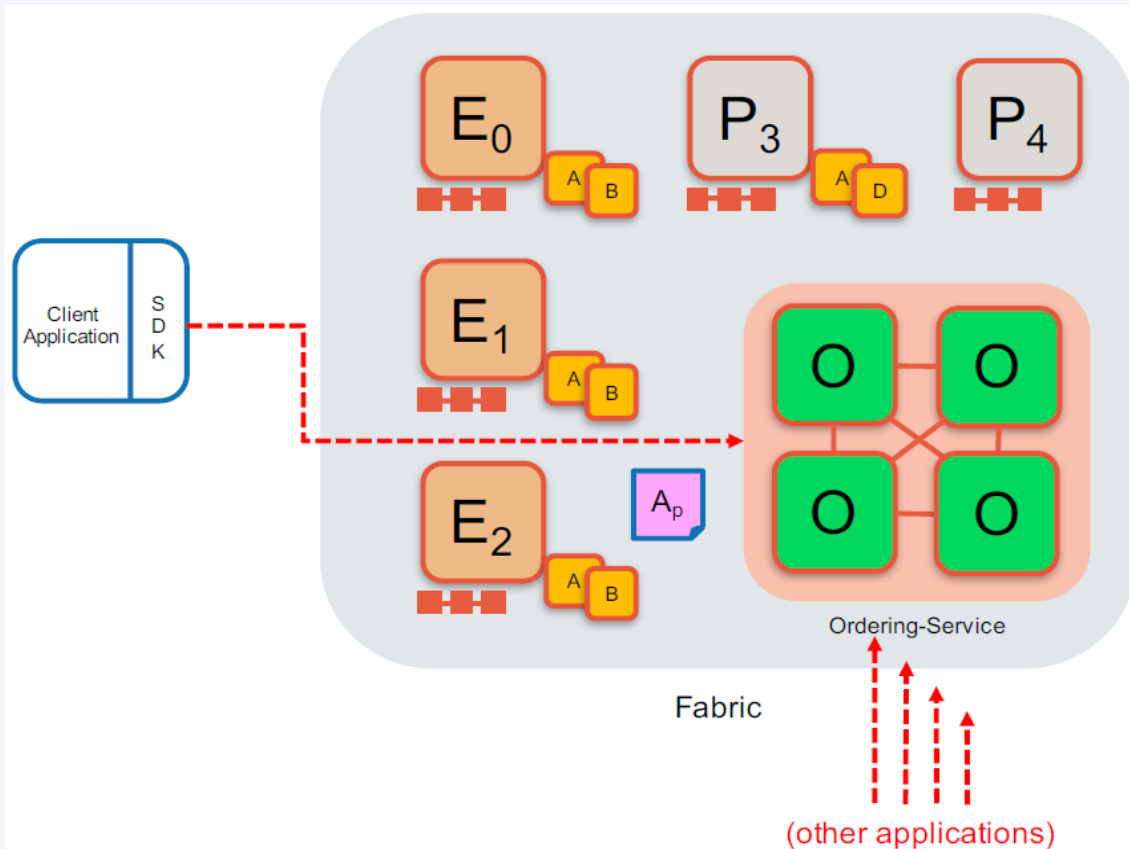


Application receives responses

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

Key:

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



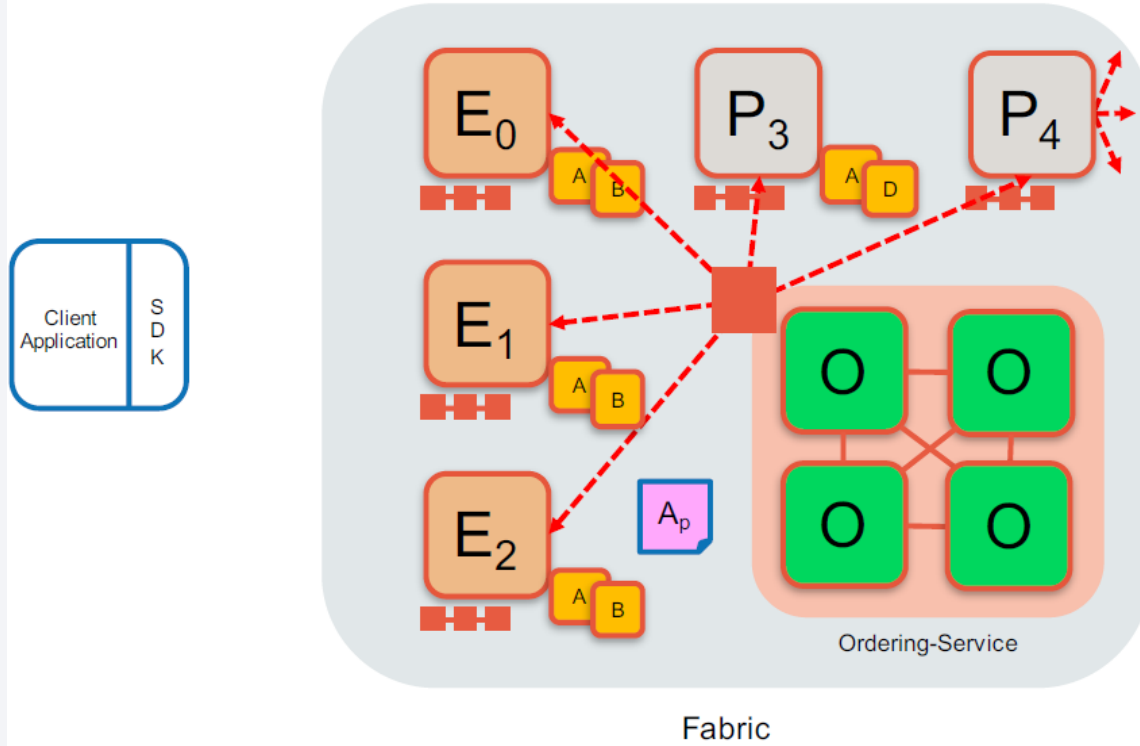
Application submits responses for ordering

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
Orderier			
Smart Contract (Chain code)			Endorsement Policy



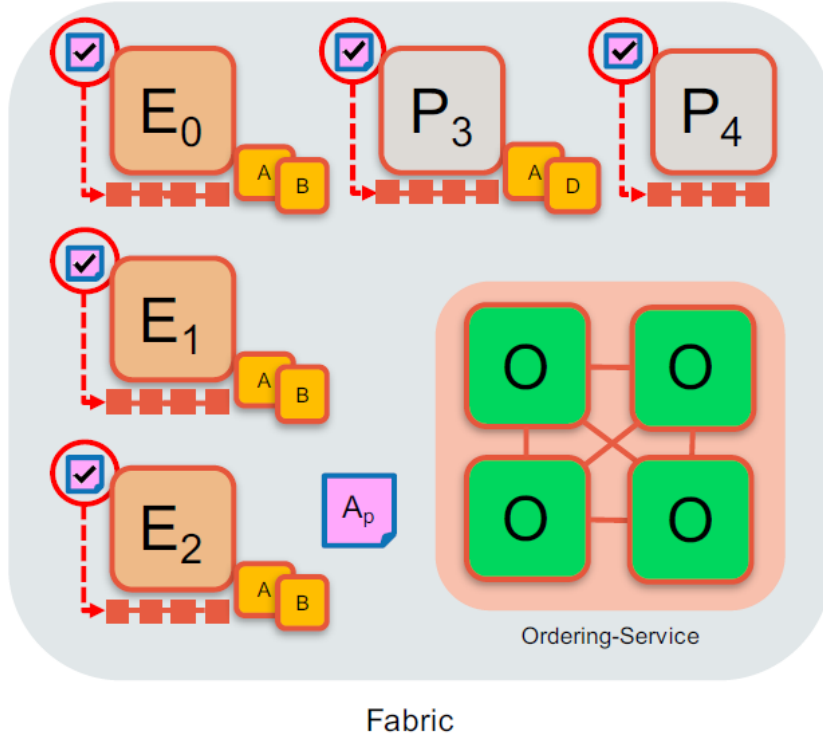
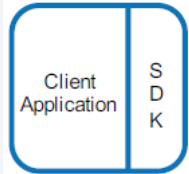
Orderer delivers to all committing peers

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:

Endorsor			Ledger
Committer			Application
Orderier			
Smart Contract (Chain code)			Endorsement Policy



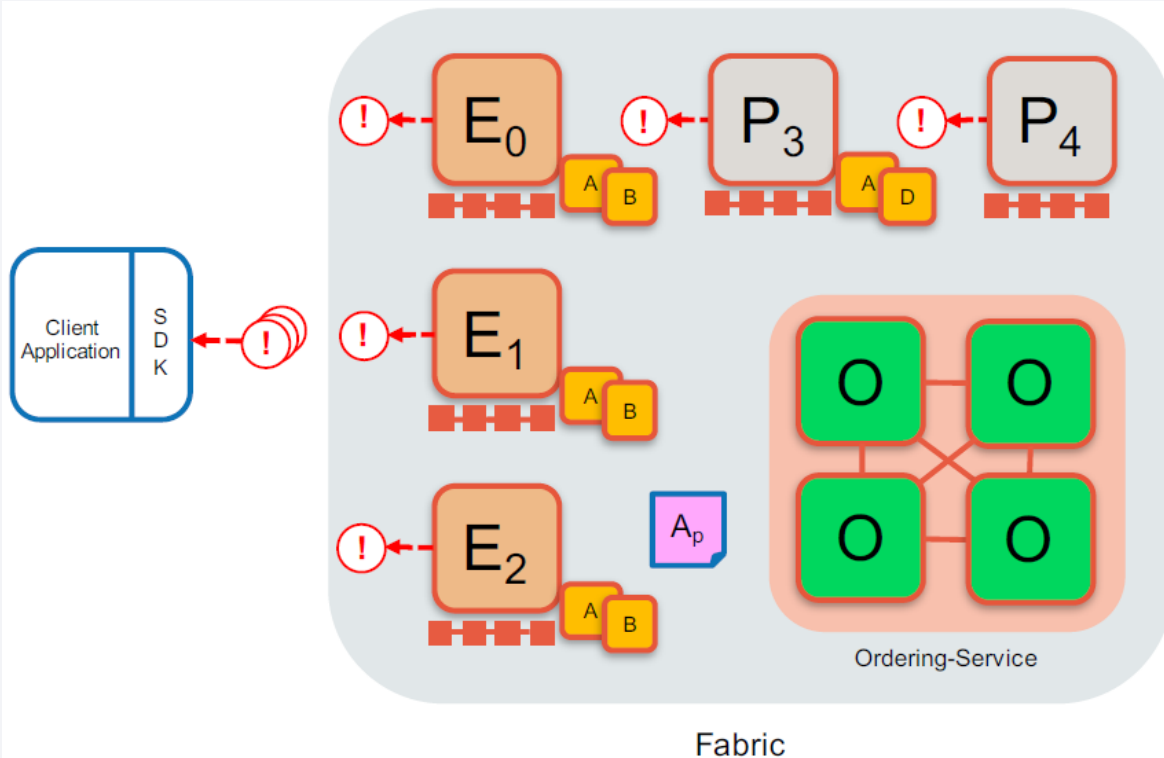
Committing peers validate transactions

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
Orderier			
Smart Contract (Chain code)			Endorsement Policy



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:

Endorsor			Ledger
Committer			Application
Orderier			
Smart Contract (Chain code)			Endorsement Policy

Popular Financial Services Use-Cases



Example: Invoice Discounting

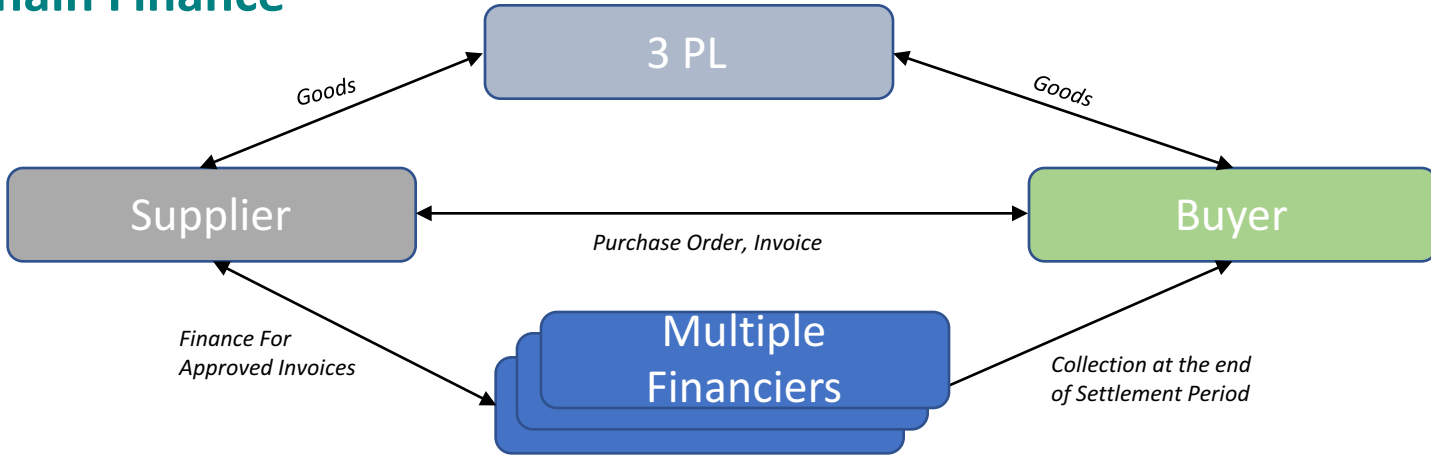
- What**
- Involves multiple participant with its own ledger
 - Reconciliation issue between OEM & financier
 - Stuck capital due to disputes

- How**
- Blockchain allows visibility to all participant and concurrence for txn thus reducing dispute

Benefits

1. Fewer disputes and shorter dispute resolution time
2. Better return from capital
3. Enable to extend the finance to tier II supplier

Supply Chain Finance



✗ 4-10 Days delayed Payment

✗ Possible Double Spend

✗ Manual & Error-Prone

✗ Complex Rejections

✓ Payment Clearance < 1Hr

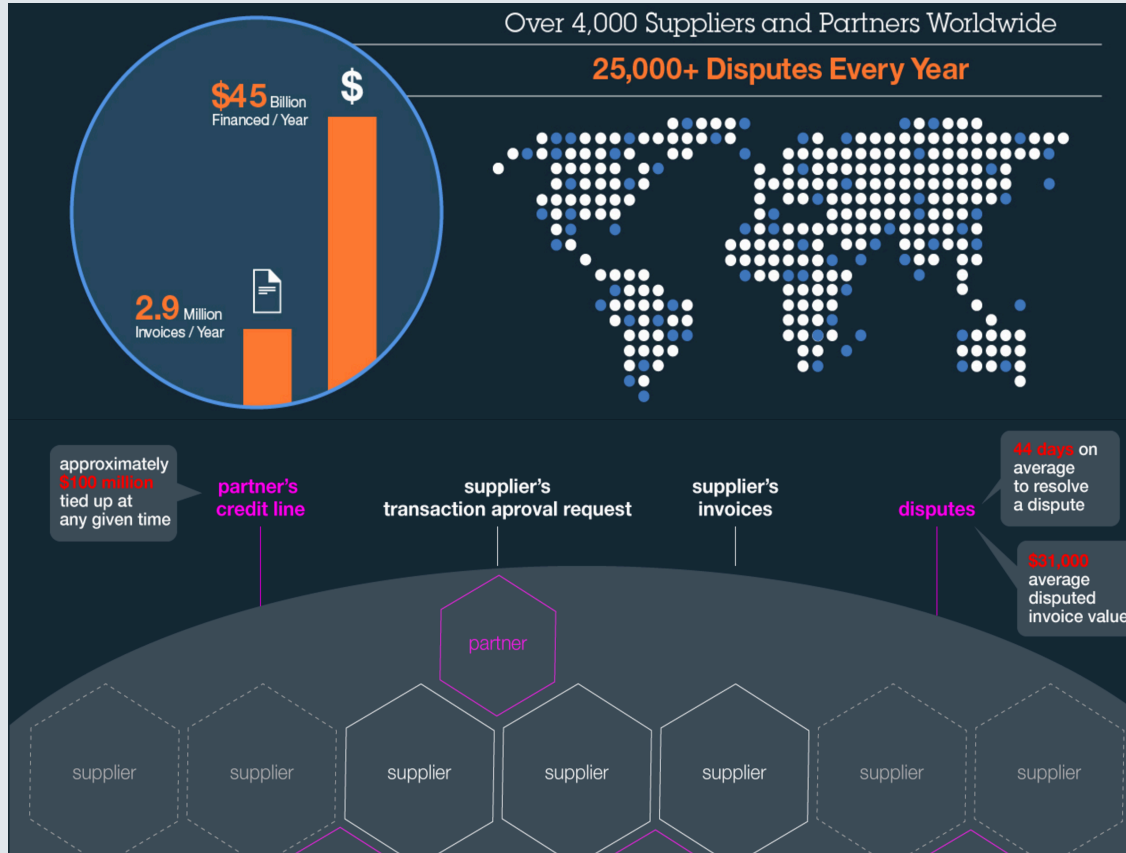
✓ Privacy Preserving Duplicate Spend Avoidance

✓ Automated & Compliant

✓ Expedited Debit & Clearance

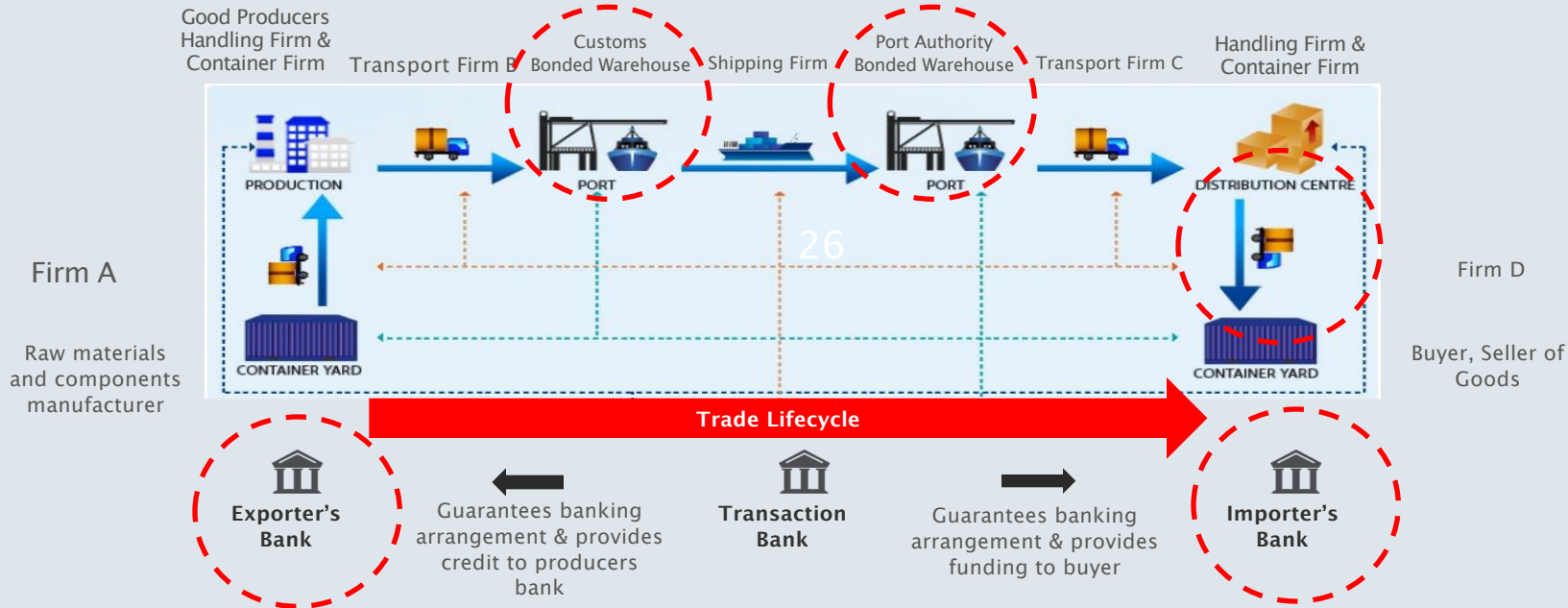


Channel Finance Solution (IGF): Smart Contract for Credit Issuance



- ❖ Immutability / Non-repudiability of blockchain ledger => Comprehensive view of all operational data
- ❖ Less disputes, faster settlement => Free flow of capital between parties
- ❖ Distributed & Replicated => Less Outages, Highly extensible

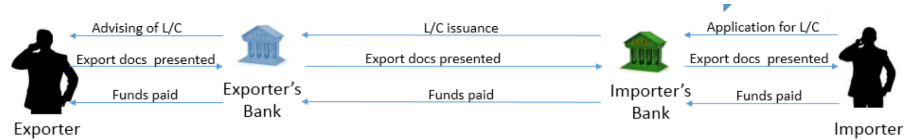
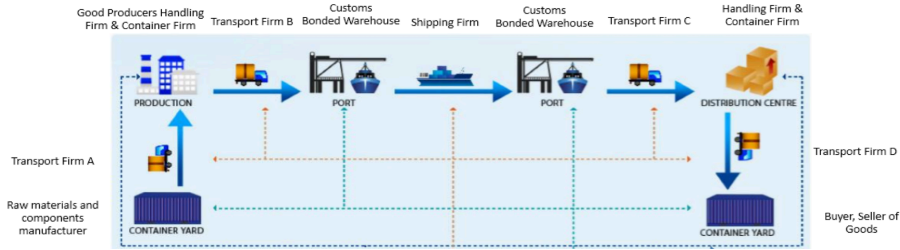
Traditional Trade Finance: > 10 parties, ~30 documents, physical presence and overwhelmingly paper based



Pain Point

- Time-intensive process based on paper documents
- Requires many intermediaries
- Error and delay prone

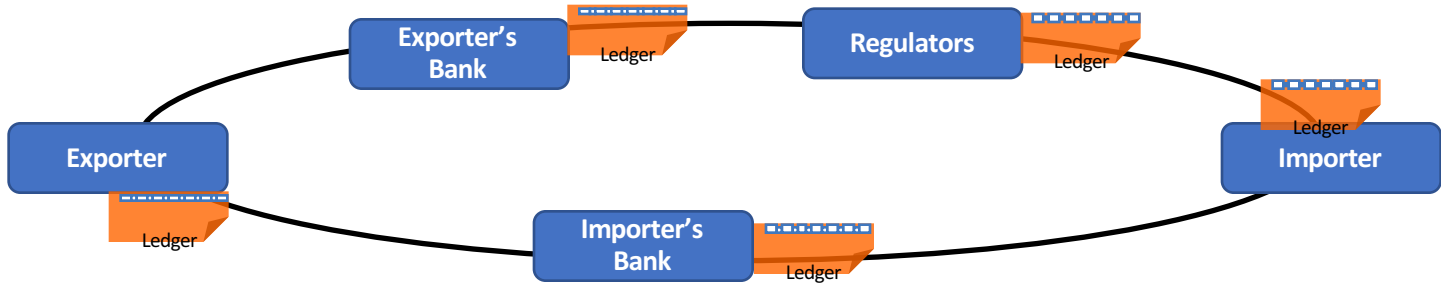
Trade Finance



- Inefficiencies**
- 12 parties
 - 27 documents
 - Low automation

- Risks**
- Currency fluctuation
 - Non-completion

- Result**
- Financing is expensive
 - SMEs locked out



✗ Sequential & Delayed Visibility leading to Frauds

✗ Disputes on Inconsistent Recording of Ts & Cs

✗ Complex Reconciliation of Ts & Cs.

✗ Complex Workflow of Multiple Documents

✓ Global & Immediate Visibility

✓ Consistent Recording of Ts & Cs

✓ Smooth Orchestration of Workflows

✓ Creates Higher Barrier for Committing Financial Frauds

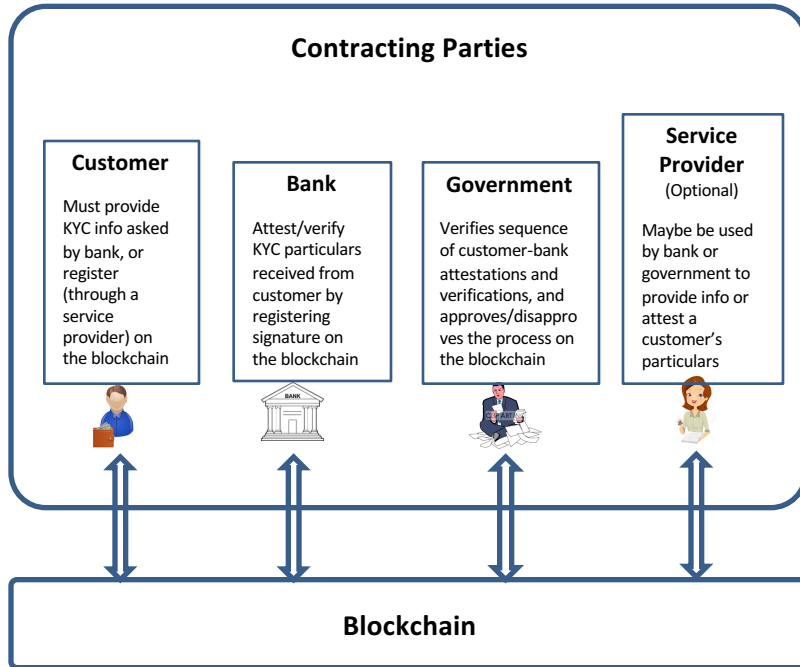


Compliance (KYC, AML)



- Problems and deficiencies:
 - Work done in collecting KYC information unnecessarily replicated by multiple institutions
 - Isolated view of customers and their transactions insufficient to detect money laundering
 - Uncertainty in knowing if implemented practices are sufficient (over-stringent policy hurtful for business)
 - AML processes are too fragmented and dependent on subjective human decision making

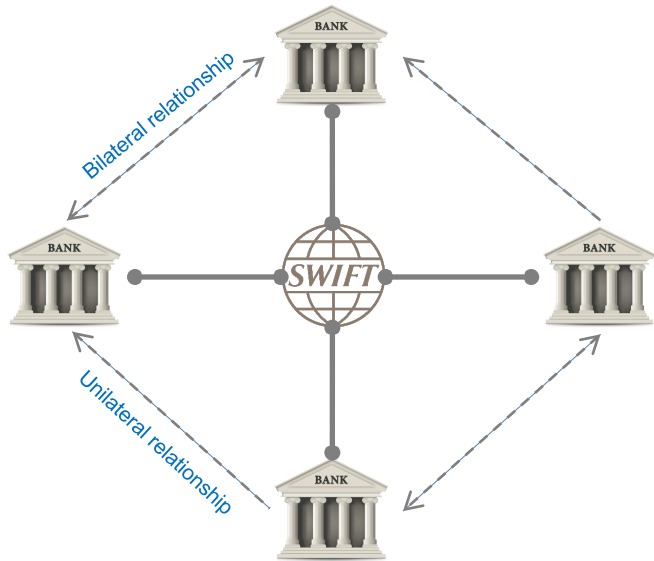
Blockchain for Compliance



Potential enabler for the Central Know Your Customer Registry (CKYCR) initiative

- **Value proposition**
 - Avoid replication of KYC effort
 - History of changes in identity or address can easily be tracked
 - Government as a participating entity in the network can simplify auditing and monitoring
 - Regulator-approved smart contracts can auditably record entire history of changes to KYC information
 - Transition from periodic monitoring to real-time monitoring (self executing smart contracts)
 - KYC and AML can be supported as utilities provided by third parties that multiple banks can leverage

Correspondent Banking – Nostro Vostro



Correspondent Banking

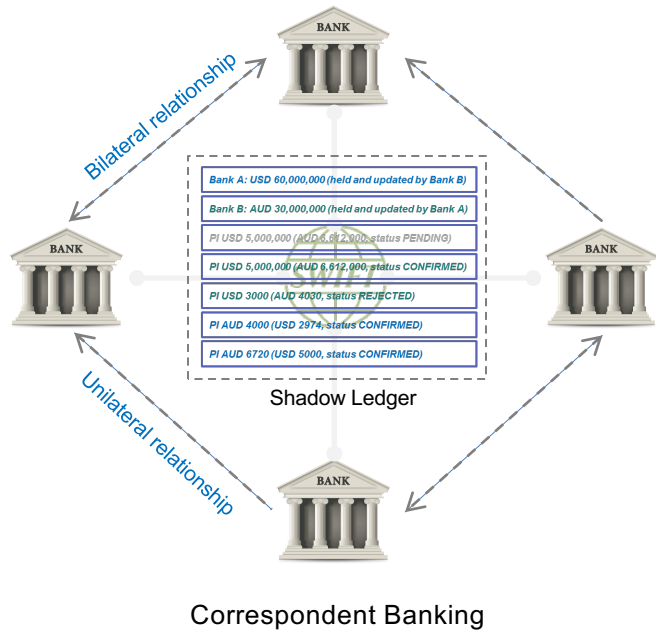
Problems

- Reconciling separately held views of the same account (Nostro)
- Delayed visibility on the settlement or rejection of payment instructions
- Delays in resolution of pending payment instructions
- No visibility on actual currency position of Nostro account
 - Ineffective allocation and management of capital
 - Fees applied to overdrafts and excess capital in Nostro accounts at CoB*
 - Nostro accounts do not accrue interests

RECONCILIATION

LIQUIDITY MGMT

DLT for Reconciliation and Liquidity Management



Benefits

- Single, shared view of Nostro and Vostro accounts
- Immediate visibility on status of payment instructions
- Reduced time-frame for resolving open/pending transactions
- Near-realtime view on currency position of Nostro accounts enabling better liquidity management
- Improved auditability and reporting

Securities Trading -- Ecosystem

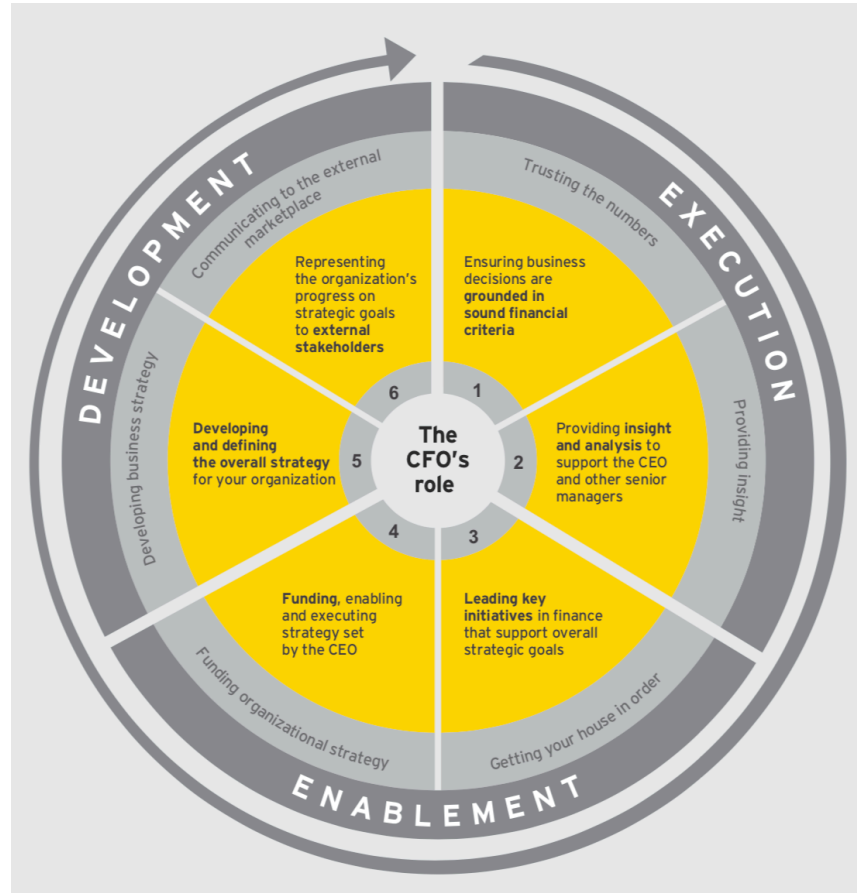


Blockchain for Securities Trading - Examples

Use Case	Block Chain Participants	Value Proposition
Asset Ownership	Issuer, Custodians, CSD, Regulator	Transparency in securities ownership, and associated regulatory compliance and benefits
Clearing and Settlement	Exchange, Custodians, Clearing House and its members, Clearing Banks, ICSD/CSD	Increased efficiency can save billions of dollars (\$2.7Bn for T+1) improve cross border flow of capital, market liquidity
Asset Servicing: Dividend Payouts	Issuer, Custodians, Share Transfer Agent, Regulator, Investors, Payment Bank	Transparent and quicker payout
Asset Servicing: Proxy Voting and Voluntary Actions	Issuer, Custodians, Share Transfer Agent, Regulator, Investors, Investor Communications Agent	Quicker information dissemination and corporate action, increased efficiency, reduced risk
Derivatives (Futures and Options) Contracts	Counterparties for OTC, Exchange, Custodians, Clearing House and its members, Clearing Banks for exchange traded	Quicker Settlement and lower transaction fees

Use-Cases for Corporate Finance

CFO -- Role and Responsibilities



Four Forces Disrupting the CFO

Digital

58%



of finance leaders say they need to build their understanding of digital, smart technologies and sophisticated data analytics.

Data

57%



of group CFOs believe that the delivery of data and advanced analytics will be a critical capability for tomorrow's finance function.

Risk and uncertainty

57%



of finance leaders believe that risk management will be a critical capability in the future.

Stakeholder scrutiny and regulation

71%



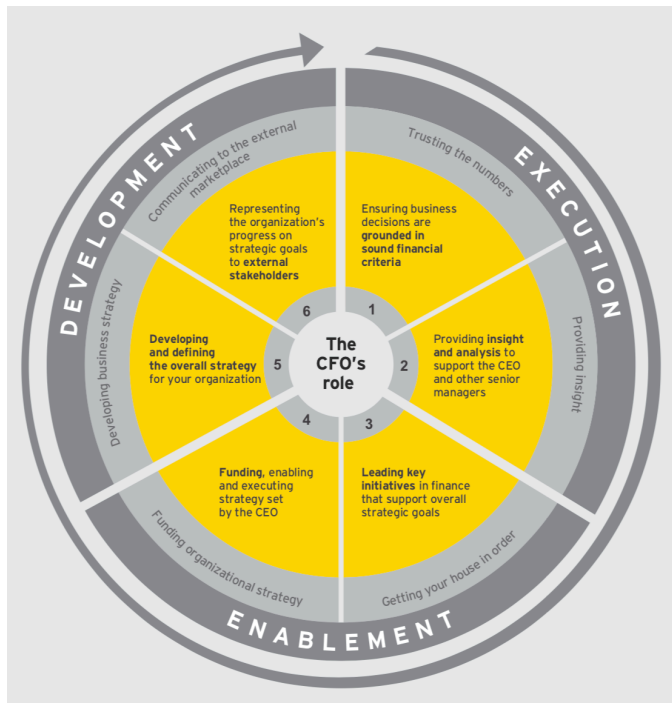
of finance leaders say they will increasingly be responsible for the ethics of decision-making in support of their organization's purpose.

Takeaway Message

- Blockchain can aid the CFO in effectively performing the role and deal with the forces of disruption
- Mix of use-cases that are
 - Purely internal
 - Involving External Entities

Use-Case Big Picture

- Regulatory Compliance
- Indirect Taxation



- Inter-company Transactions
- Better Control of Procurement
- Project Risks Controls
- Trusted Source of Data

- Trusted View of Investment Payoffs
- New Business Models while addressing associated risks

Inter-Company Transaction

- In Globally Integrated Organizations, it is common to have
 - Inter-country Transactions
 - Inter-unit Transactions
- Ensuring these transactions are recorded accurately matters
 - Regulatory Compliance
 - Detect/Prevent Malpractices
 - Multiple Functions may be affected: Accounting, Tax, Treasury
- Idea: A Blockchain network with internal participants and an optional participation from Regulatory Authorities
 - To record all inter-company transactions
 - Smart Contracts to check for Compliance and Fraud
 - Real-time audit, thus making overall audit robust and faster

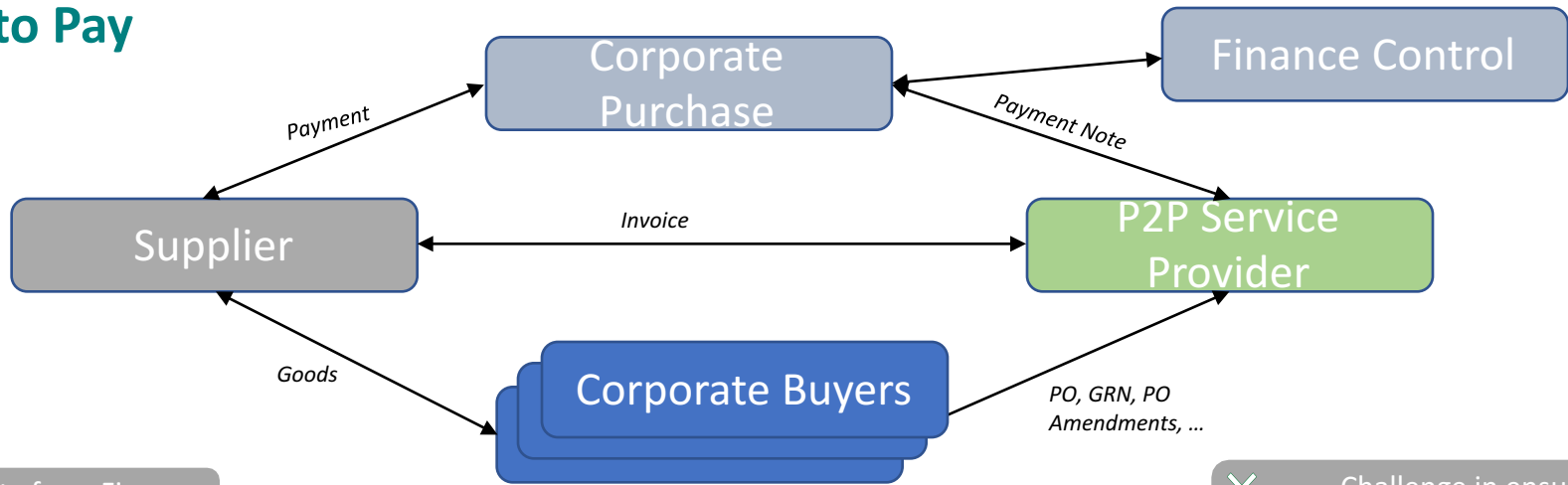
Risks in Project Controls

- Consider the internal stakeholders of a project
 - Organization Side
 - Sales Team interacting with the Client
 - Technical Sales team providing technical input to the feasibility of the project
 - Solutioning Team Responsible for Determination of Tools, Effort Estimate, and Resource Requirement
 - Delivery Team responsible for Project Delivery
 - Client Side
 - Stakeholder for the project: Business/IT team
 - Procurement Team Responsible for Price Negotiation
- The view of the project to the different stakeholders is “Sequential” and therefore, delayed in terms of addressing infeasibility; data is stored in disparate systems
 - Ex: Delivery team typically is not involved during technical sales; assumptions made in technical sales may not be true during delivery
 - Ex: Data stored in Sales Opportunity Tool could be at variance with Data in Pricing Tool
- All of this results in
 - Mismatch of expectation across the entities during execution
 - Lack of clarity on payment milestones
 - Gap between effort estimate and real effort
 - Gap in execution status between client, sales, and delivery team
 - Result from CFO PoV: **High Financial Risk (Significant Portion of Revenue is at Risk/Dispute)**

Blockchain to Manage Risks in Project Controls

- We envisage a Blockchain Network that initially begins with internal participants and upon maturity brings clients
 - Organization Side
 - Sales Team interacting with the Client
 - Technical Sales team providing technical input to the feasibility of the project
 - Solutioning Team Responsible for Determination of Tools, Effort Estimate, and Resource Requirement
 - Delivery Team responsible for Project Delivery
 - Client Side
 - Stakeholder for the project: Business/IT team
 - Procurement Team Responsible for Price Negotiation
- What will it do?
 - It will bring all the participants onto a common platform along with a Project Lifecycle from sales initiation to client delivery
 - It will seamlessly bring data from disparate systems into one ledger
 - It will ensure every entity takes its steps in timely manner, provide ability to check if due diligence was followed, appropriate stakeholders are informed proactively, etc
- **Benefits**
 - Help identify deviations and exceptions to the fore at the earliest
 - Help identify and mitigate risks early
 - Improve Customer Experience as they get “One Team” experience
 - The Finance team benefits from reduced risk and better projects risk control

Procure to Pay



✗ Late Visibility from Finance Perspective

✗ Challenge in ensuring procurement is compliant with finance control

✗ Cost/Invoice: \$7 - \$10

✗ Cycle Time ~ 10 Days

✗ Manual & Error-Prone

✗ Complex Amendments

✓ Cost/Invoice: < \$2

✓ Cycle Time < 1 Day

✓ Automated & Compliant

✓ Expedited Debit & Clearance

✓ Global and Simultaneous Visibility



Investment Payoff Tracking

- Relates to the Enablement aspect of CFO Role
- CFO's office receives large number of investment proposals in capacity building, market expansion, and so on.
 - Decisions made on the basis of business-case proposals
 - Multiple Stakeholders: Finance, Executive Sponsor, Capacity Building Team, Sales, Delivery Teams
 - Evaluations are mostly post-facto (perhaps at the level of milestones)
 - Lot of Assumptions Built into Business-Case
 - Result: Sub-optimal realization of ROI on Investments
- Idea: A Blockchain network
 - which brings all the participants on a common network
 - The business-case split into finer granularity of micro-milestones, timelines, stakeholders (input providers and validators)
 - Mapping of Assumptions into "Reality Check" smart contracts associated with micro-milestones
 - Proactive Notification of Significant Deviations

Investment Payoff Tracking

- **Benefits**

- Real-time tracking of investments and performance
- Early discovery of gaps between assumptions and reality
- Better channelization of investments into areas where the business case and ground reality match

New Business Models

- Both Product Companies and Service Companies are getting disrupted with new business models
 - Ex: Transaction Based Pricing (investment happens upfront and recovery over a long period of time)
 - Ex: Asset Leasing by OEMs rather selling equipment (pricing linked to asset performance in the field)
- Poses significant Risk and lack of control from Finance Perspective
 - Financial Planning for these business models is complicated
 - Needs to build in contingency from uncertainties during execution
 - Leading to slower adoption of business models resulting in erosion of business (ex: cloud)
- Idea: Combination of Project Risk Controls and Investment Tracking can enable early experiments with New Business Models and Ability to become a Disruptor rather than being Disrupted.

Indirect Taxation

- Relates to the communication aspect of the CFO role
- Indirect Tax Compliance is a big challenge for Global Companies
 - Multiple Geos, Multiple Different Taxation Systems and Authorities, Cross-border Transactions, Complicated Invoice Lifecycle
 - Significant Effort (Time and Money) is spent in providing convincing responses to queries from Tax Regulation Authorities, especially related to Compliance or Tax Dues
- Idea: A Blockchain network
 - which brings a company, its business partners, sellers/buyers for its products/services, and Tax Authorities on a common platform
 - Checks the compliance of each transaction and its tax implications via smart contracts
 - Provides real-time access to Tax Authorities as transactions get recorded on the ledger

Indirect Taxation

- **Benefits**

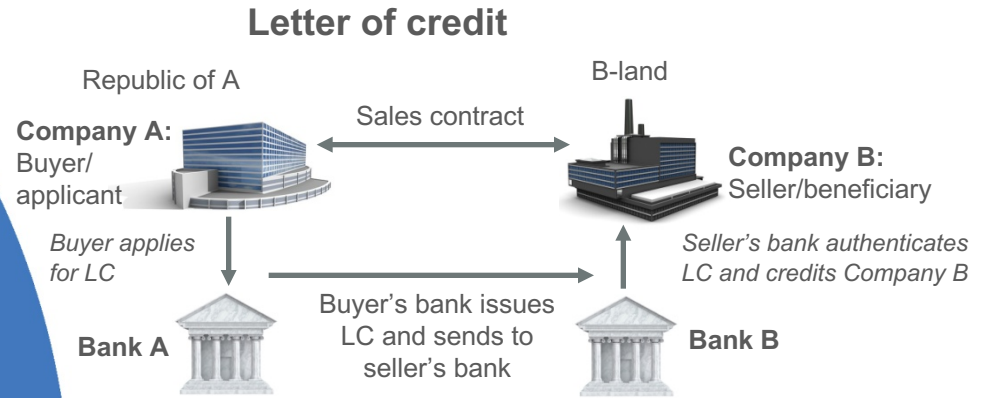
- Company and its business ecosystem have a common view of their Tax Implications in Multiple Geos
- Tax Authorities can verify tax compliance in real-time and also dig into a trusted ledger for verifying claims by different parties
- Thereby, (a) minimizing cases of disputes and (b) making dispute resolution simpler, quicker, and cost-effective

Thank you!



Back-Up

Example: Letter of credit



What

- Bank handling letters of credit (LOC) wants to offer them to a wider range of clients including startups
- Currently constrained by costs & the time to execute

How

- Blockchain provides common ledger for letters of credit
- Allows all counter-parties to have the same validated record of transaction and fulfillment

Benefits

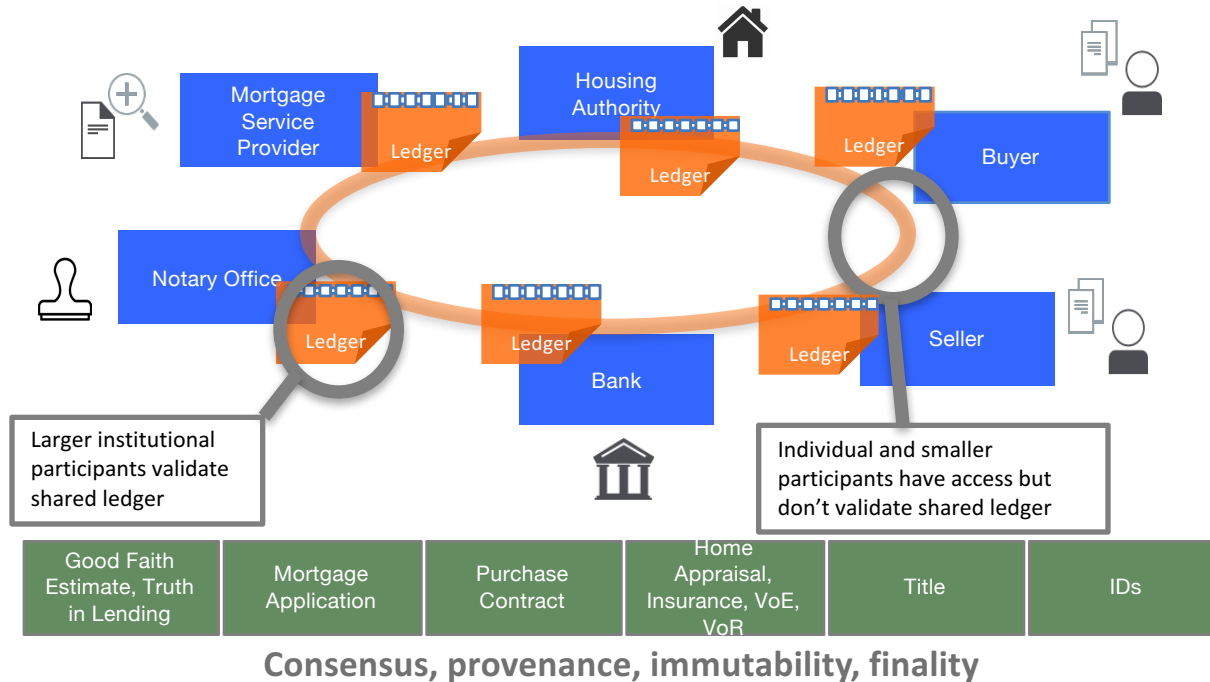
1. Increase speed of execution (less than 1 day)
2. Vastly reduced cost
3. Reduced risk, e.g. currency fluctuations
4. Value added services, e.g. incremental payment

Commercial Paper

- Parties involved: Issuer Front Office, Broker Dealers, Settlement Desk, *Optional Custodian*
- Key process steps: Negotiation of Issuance Terms (amount, discount, maturity date), Booking of Transactions, Settlement
- Proposed Solution: Blockchain based shared ledger acts as a central record keeping entity to (a) record state of the Commercial Paper Issuance process OR (b) function as an alternate p2p lending process between large corporates without brokers.
- Opportunity areas:
 - **Slow settlement process with tight deadlines:** settlement involves many manual steps, usually must be completed by 12 noon
 - **Benefits:** automated hand-off between front office & settlement desk, settlement desk & custodian, better tracking of settlement progress and history
 - **Lack of transparency in negotiation of issuance terms:** communication takes place through Bloomberg terminal or phone calls; may require negotiating with multiple broker dealers
 - **Benefits:** broker dealers can have view of negotiation, transparent real time rate setting, posting can be automated once agreement is reached
 - **Manual booking process:** involves manual validation, copying of information between screens, creation of PDF documents, and emailing
 - **Benefits:** smart contract enforces trade validation on booked transactions, booking can take place automatically

Mortgage

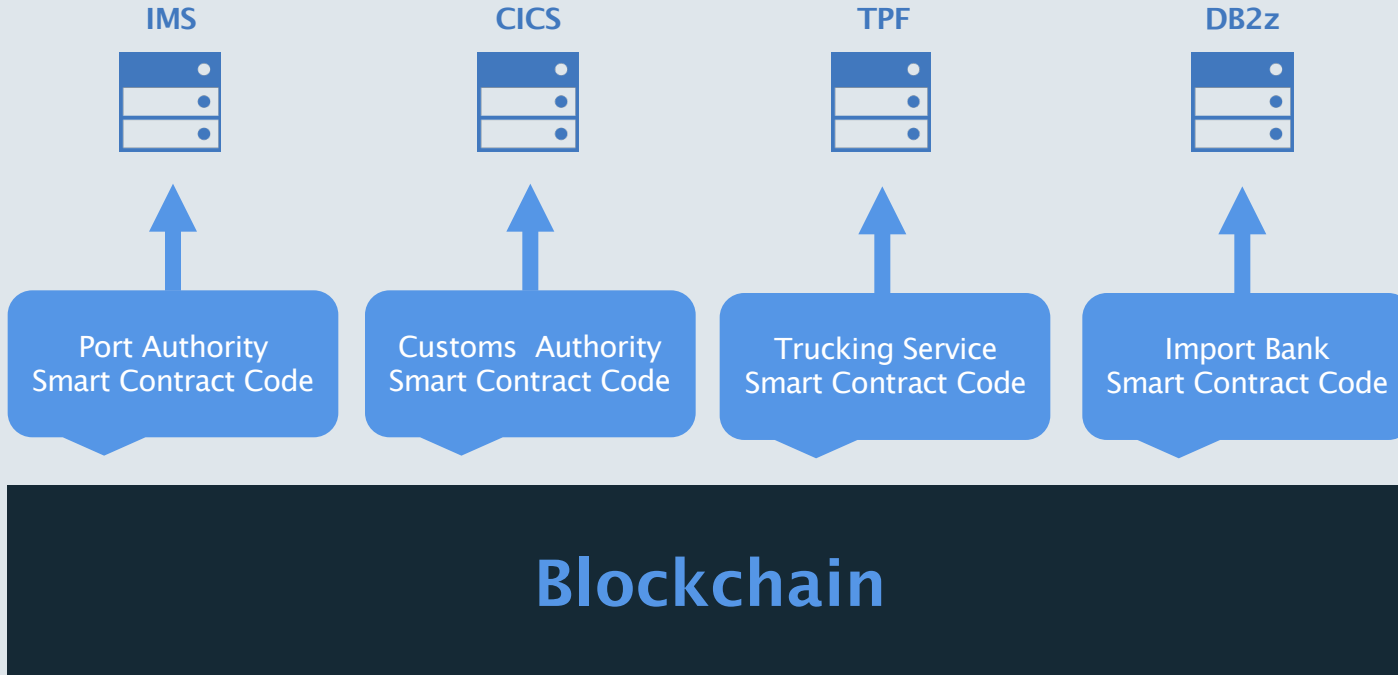
A shared ledger between involved parties can increase trust, speed of execution, auditability and cost



Painpoints today:

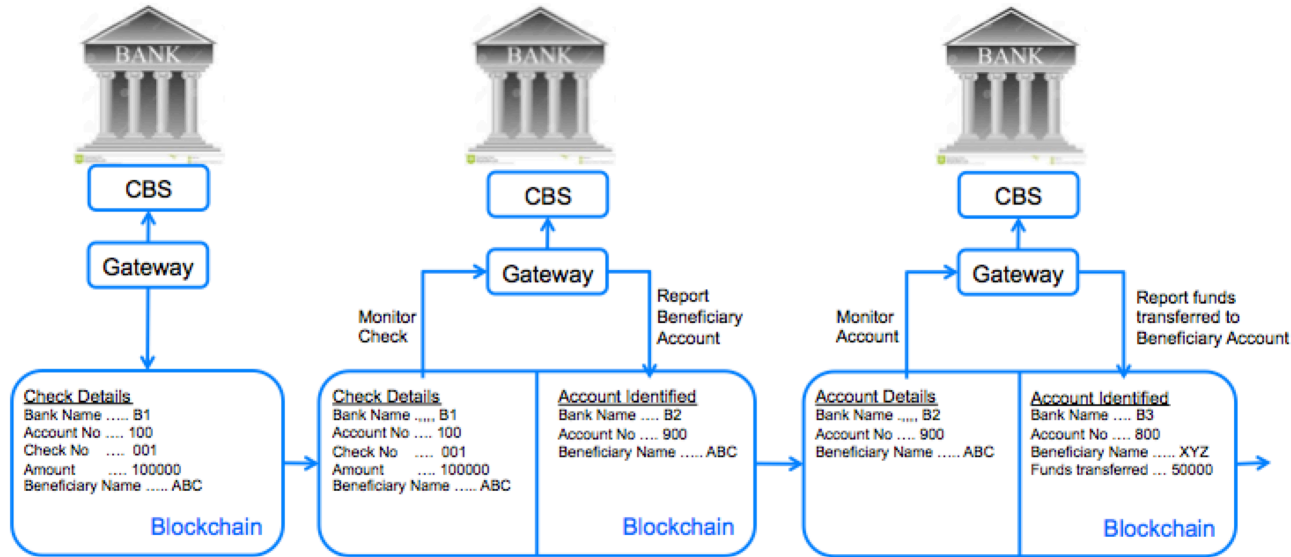
- Time and paper intensive process
- No standardized process and data formats
- Disparate IT systems for default management, borrower engagement, payoff processes
- Lack of transparency for mortgage backed securities

Trade Finance: Smart Contract



- Unambiguous shared view of contract terms & status of goods across importer, exporter, banks, common carrier, etc.
- Common store of all documents (L/C, B/L, Drafts, etc.)
- Automation of business workflow across organizational boundaries
- Improved transparency and accuracy of process workflow
- Flexibility to model a variety of contracts (revocable/irrevocable, confirmed/unconfirmed, time/sight drafts, etc.)

Money trail on Blockchain

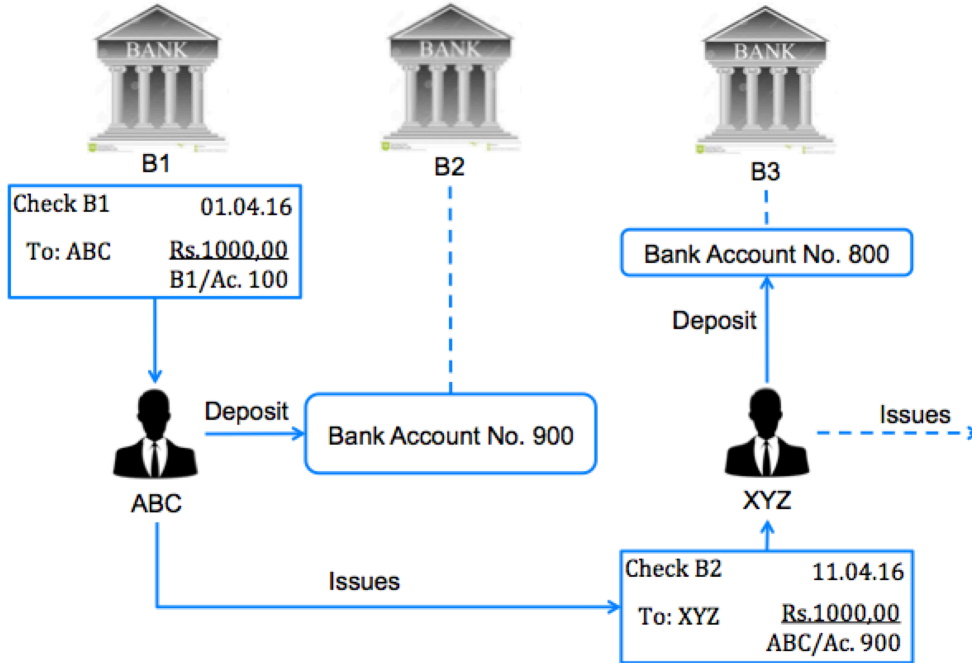


- Blockchain enables **self regulation** and **compliance** by participating CBSs
- Enables end to end **auditing** and **analytics**

Blockchain for Tracking Money Trail

Motivating Problem -

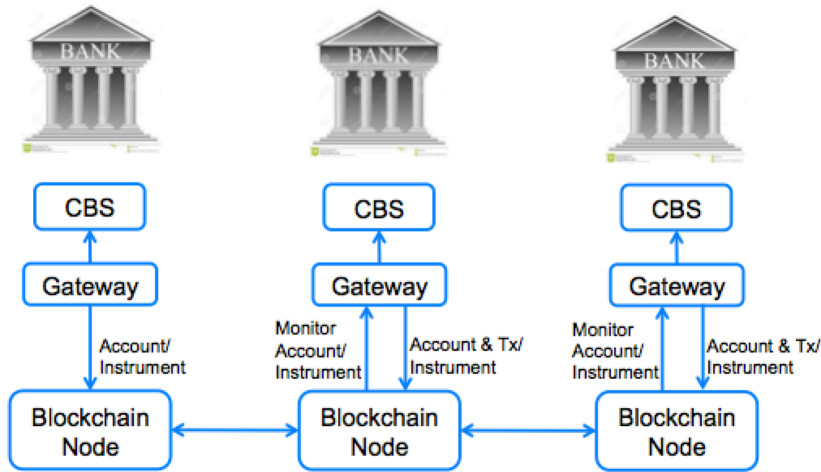
Difficult to track movement of money between accounts maintained across multiple financial institutions



- Following trail by hand is slow, cumbersome, and manual
- Data may be incomplete or missing during investigation

Incomplete, Expensive, Distributed

Solution: Blockchain – shared, replicated, secure ledger



- Each institution owns/runs a Blockchain node as equal peer (via a gateway)
- Gateway monitors any transactions to any other bank
- Record is encrypted on Blockchain for confidentiality
- A virtual account/instrument record is created for each relevant entity and transaction recorded on the blockchain
- To track movement of money across banks, the shared ledger can be queried

Collaborative, transparent, accountable