An Introduction to Blockchain

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Executive Summary

Blockchain is a new technology that removes cost and complexity from multi-party transactions using a shared, secure, synchronized & immutable ledger. Best use cases are transferring assets (physical, financial or virtual) where multiple parties are involved, and validation or verification is needed.

Benefits are typically shorter cycle times, reduced costs, and increased confidence. In some cases, Blockchain may also enable a significant performance improvement – because it allows a company to completely reengineer the process.

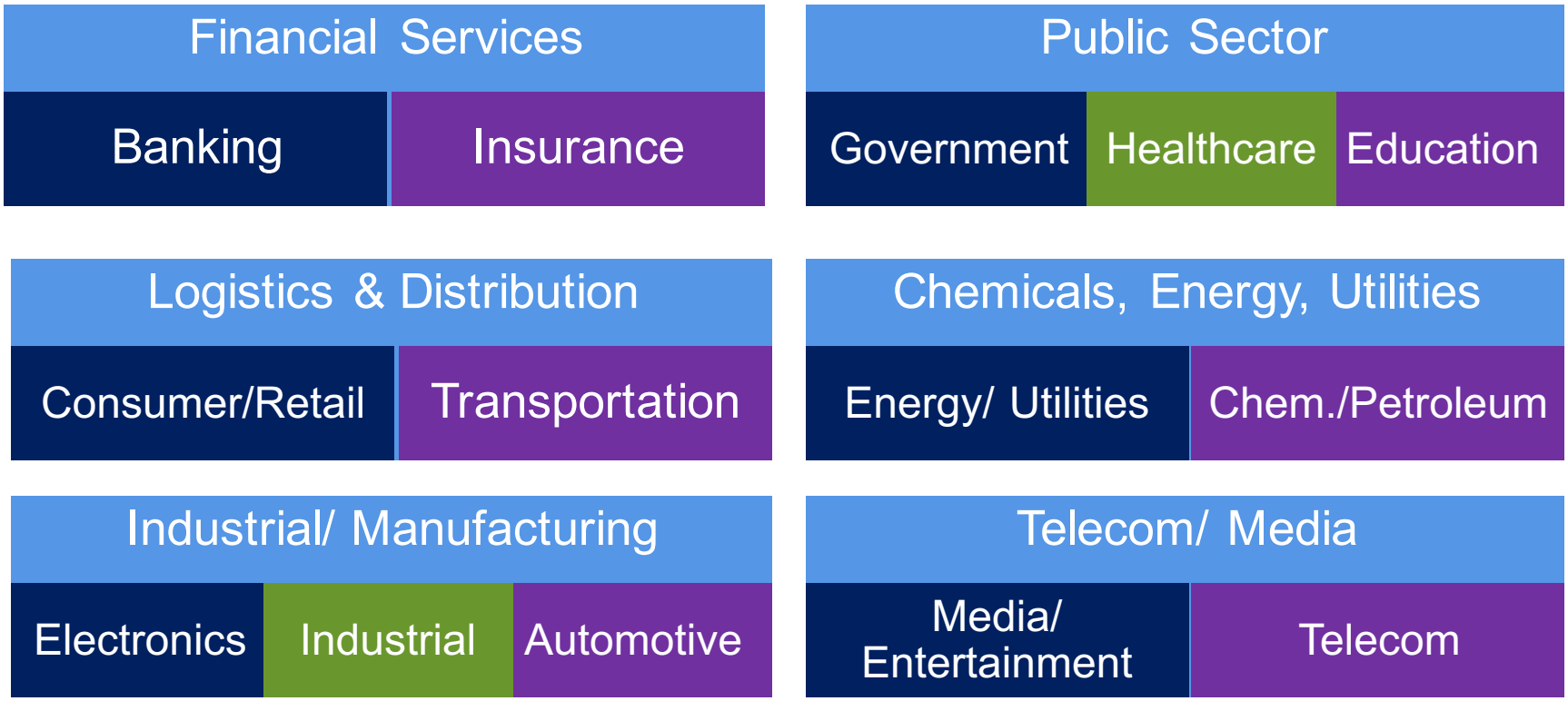
Costs to get started are reasonable. Of course, more complex processes with higher performance will require a higher investment.

Partners (suppliers, logistics partners, etc.) may be full participants in the Blockchain, or simply interact with the process. Most of their costs are driven by the process, but in some cases they may need to build integration with (or extracts from) their own systems.

Inappropriate use of Blockchain is those situations where an existing solution works well, where no asset is being exchanged, or high-volume/ low-value/ real-time transactions.

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Where can blockchain be used?
Where is it being used?



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Think about situations like these:

- “I could make the _____ function more efficient if I could streamline the _____ process with _____.”
- ”It would be easier and cheaper to comply with _____ regulation if I could automate the _____ process.”
- “I hate even thinking about the _____ process! Every time I have to do that, I lose half a day.”
- “It’s so hard to keep track of _____ while they are in/ at _____. I wish there was a way to automatically get updates.”
- ”It’s so time-consuming to manage the _____ process with my business partners.

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Other types of blockchain exist

bitcoin is an example of an unpermissioned, public ledger:

- The first blockchain application
- Defines an unregulated shadow-currency
- Resource intensive

- Blockchains for business are generally permissioned and private, and prioritize:
  - Identity over anonymity
  - Selective endorsement over proof of work
  - Assets over cryptocurrency
- Blockchain technology is a core component of bitcoin.
- But bitcoin has no role in blockchain technology when used to enable business processes.

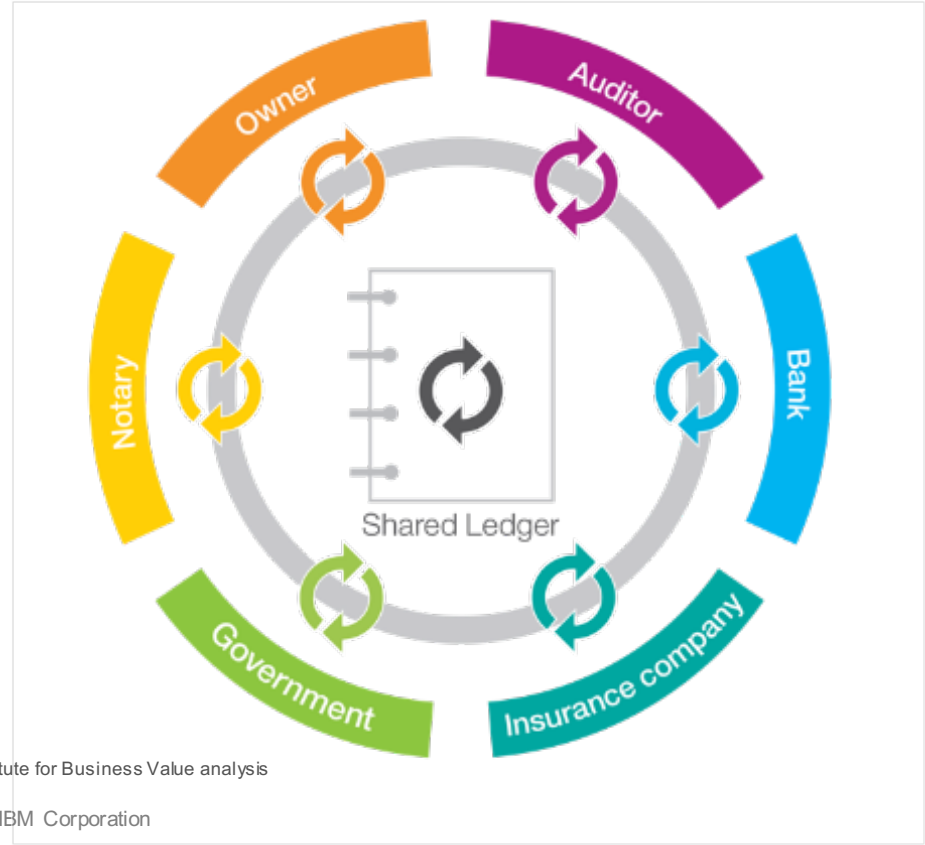




Foundational Principles: Speaking With Confidence on Blockchain

A few simple slides, and an example

Blockchain's key concept: a shared, secure ledger that creates a permanent record of transactions



"This is what the blockchain does at its core. It is a shared ledger technology that allows participants in a business network to transact assets where everyone has control but no one person is in control"

Leanne Kemp
CEO and Founder, Everledger

Source: IBM Institute for Business Value analysis

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A (non-blockchain) ledger most of us have encountered… a bank account

Post Date	Transaction Description	Debit	Credit	Balance
30-Apr-16	Withdrawal: ATM Withdrawal (Community FCU, Crystal Lake)	$40.00		$2
29-Apr-16	Withdrawal @ Office Max 4429 US 14 Crystal Lake IL US	$16.20		,591.42
29-Apr-16	Deposit: ATM (Community FCU, Crystal Lake) ILUS		$45 .00	$2,607.62
29-Apr-16	Withdrawal @ Costco Whse #0774 Lake in the H ILUS	$48.29		$2,157.62
29-Apr-16	Withdrawal @ Online Transfer "DTD" 50.00 to account 691235	$50.00		$2,205.91
29-Apr-16	Withdrawal @ REI #118 SCHAUMBURG SCHAUMBURG ILUS	$164.37		$2,255
28-Apr-16	Withdrawal @ Fandango.com Fandango.com CAUS	$25.25		
28-Apr-16	Withdrawl-ACH-A-Lowes Lowes (Online Payment)			$2,445.53
28-Apr-16	Withdrawal Item 2208, Annie Montenegro	$61.00		$2,895.53
28-Apr-16	Withdrawal-ACH-A-ANYTIME FIT ABC ANYTIME FIT ABC (CLUB FE	$75.00		$2,956.53
27-Apr-16	Withdrawal @ NE MOTORCYCLE GEAR 806-832-5190 TXUS	$190.00		$3,031.53
26-Apr-16	Withdrawal Item 2206, El Luchador Catering	$200.00		
26-Apr-16	Deposit-ACH-A-INTER.BUS.MACH. INTER.BUS.MACH. (EXP)		$134.30	$3,421.53

Involves multiple parties (me, my bank, stores and other parties)

Ledger is only updated when a properly configured transaction has been received.

At least 3 parties agree to most transactions: the bank, the other party, & myself. (Could also include a payment-processing company.)

Ledger status may lead to actions ("suspicious transaction" notification, low balance, etc.)

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But we can do a lot more with Blockchain…

- In this scenario, a lot of fresh fish is given a serial number & then tracked from source, to transport company, to destination.
- IoT devices monitor temperature while in transit & report on average and maximum temperature reached.

Post Date	Time (GMT + 8)	Transaction Description	Serial Number	SN Payload	Details
15-May-17	13:00	New SN Created	TFM17515.1367	112 kilos fresh yellowfin tuna	Prepared 15 May 2017/ 12:58
15-May-17	13:02	SN Transferred to Shipment	TFM17515.1367	112 kilos fresh yellowfin tuna	Added to Ship Ticket 8573
15-May-17	13:10	SN accepted on Transport	TFM17515.1367	112 kilos fresh yellowfin tuna	Refrigerated Truck, TN3 135
15-May-17	13:30	Transport Started	TFM17515.1367	112 kilos fresh yellowfin tuna	-3◦C
15-May-17	15:23	Destination Reached	TFM17515.1367	112 kilos fresh yellowfin tuna	Avg temp -2.8◦C / MAX -1.5◦C
15-May-17	15:25	SN accepted at destination	TFM17515.1367	112 kilos fresh yellowfin tuna	Avg temp -2.8◦C / MAX -1.5◦C
15-May-17	15:26	Funds Transfer Initiated	TFM17515.1367	112 kilos fresh yellowfin tuna	¥616,000

- Once the shipment has been accepted at the destination, funds are automatically transferred to pay for the fish.

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Blockchain benefits – from reduced time, cost & risk; and increased confidence.

Saves Time

Transaction time from days to near instantaneous

Removes Cost

Overheads and cost intermediaries

Reduces Risk

Due to errors, misunderstandings and conflicting standards, as well as tampering, fraud & cyber crime

Opens New Business Models

Business networks reshaped and profit pools are redefined

Blockchain's key attributes enable building powerful business applications on a shared ledger



Shared: All parties can access the ledger. Blockchains aren't owned by any one organization.

Synchronized and Transparent: Transactions are updated in real time across the Blockchain.





Secure and immutable: Cryptography ensures that network participants see only the parts of the ledger relevant to them. Transactions can't be altered after the fact.

Consensus-Based and Controlled: Participants can ensure valid transactions before they are recorded using smart contracts. Government requirements & audit can be built into the Blockchain application too.



Source: IBM Institute for Business Value analysis

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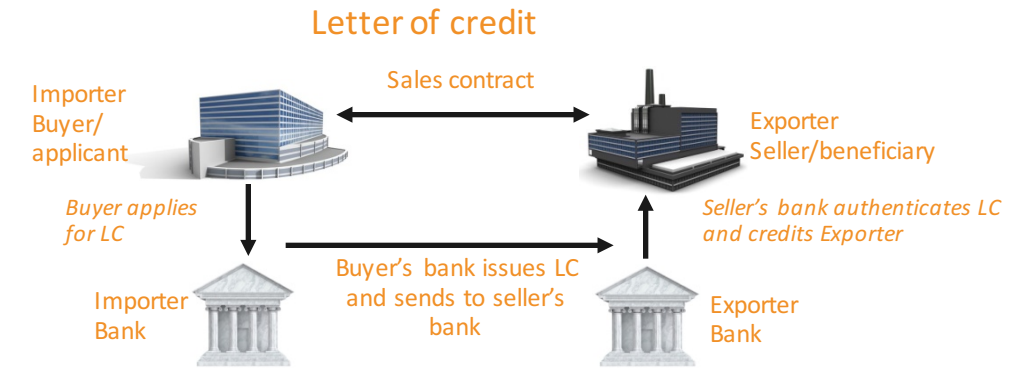
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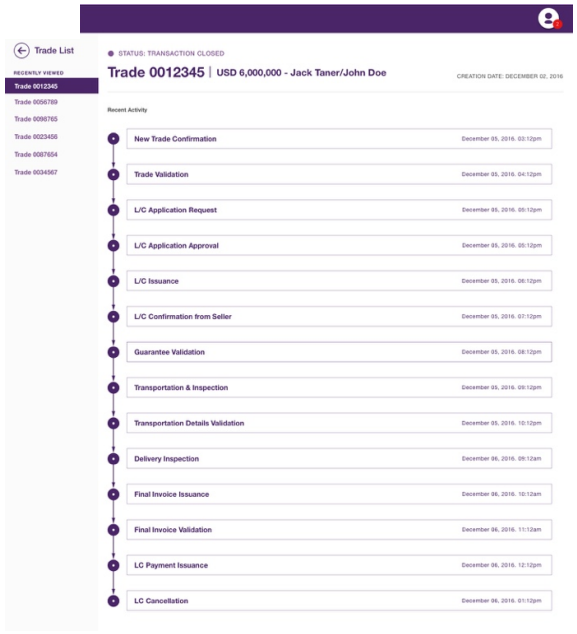
Natixis, IBM and Trafigura introduce first-ever Blockchain solution for U.S. crude oil market

NEW YORK - 28 Mar 2017: Natixis, IBM (NYSE: IBM) and Trafigura have pioneered the first blockchain solution in commodity trade finance for US crude oil transactions. The distributed ledger platform, built on the Linux Foundation open source Hyperledger Fabric, allows major steps in a crude oil transaction to be digitized on the blockchain, ensuring improved transparency, enhanced security, and optimized efficiency.

By having the buyer, seller and their respective banks all on the same ledger, all parties can simultaneously view and share data on the status of a transaction, from the time a new trade is confirmed and validated, to when the crude oil is inspected, to its final delivery and cancellation of the letter of credit.

Key benefits of the solution include reduced cash cycle times, improved efficiency via lower overhead costs and fewer cost intermediaries, increased transaction visibility to help reduce the threat of tampering, fraud and cyber-crime, and the creation of transparent transactions by using shared processes and recordkeeping.









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If you think Blockchain is "one of those IT things"…

Are you wondering if it can solve real-world business problems?

Use Cases for Blockchain … look for multi-party, complex and inefficient business processes.

Especially pay attention to situations where people express frustration or mention that customer service or business performance suffers because of a particular process.

Append-only distributed system of record shared across business network





Business terms embedded in transaction database & executed with transactions

Ensuring appropriate visibility; transactions are secure, authenticated & verifiable







All parties agree to network verified transaction

… Faster processing, lower cost, increased efficiency

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Sample Use Cases

Operations/ Supply Chain

- Buy/Sell
- Product Visibility/ Tracking
- Supplier-Managed Inv.
- ➢ Logistics 1010 Video
- ➢ Customs Clearance IBM

Provenance

- Conflict Minerals Management Demo
- ➢ Counterfeit Prevention Video
- ➢ Food Safety 1010
- Recalls Management Demo

Quality + Procurement

- Supplier Certification
- ➢ Supplier Quality Data
- ➢ Dispute Resolution IBM

Finance

- ➢ Trade Finance IBM Video
- Car Lease Video Demo
- Software Asset Management

Engineering

- Design Sharing/ Synchronization
- ➢ Remote Device Control 1010 Video

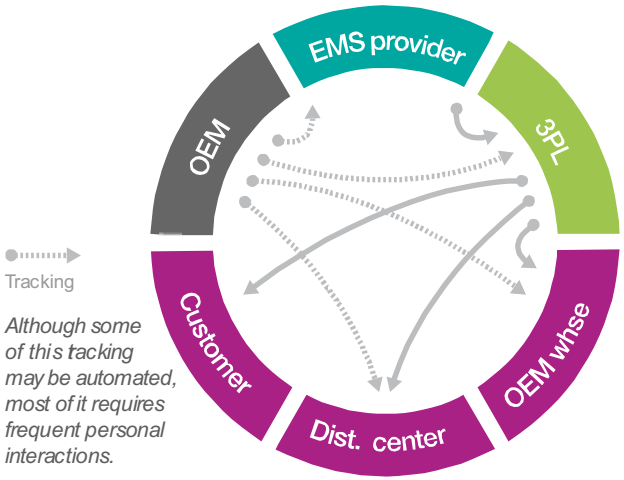
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▸ Use case:

Product Tracking

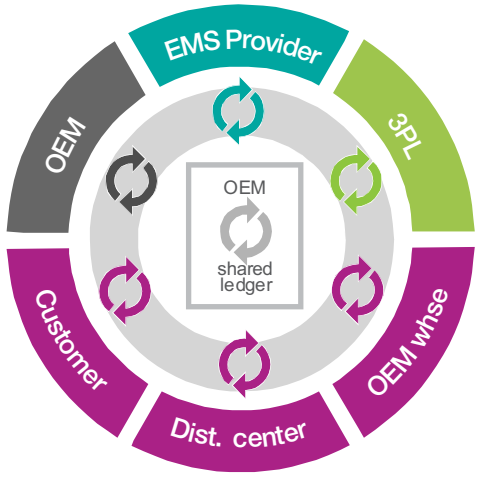
Visibility across the supply chain gives OEMs info on "where are my products?"

Problem



OEMs working with EMS providers can spend a large amount of time tracking and determining exactly how many products have been completed.

Blockchain solution



Use a blockchain shared ledger to track and trace product all the way from the EMS's production line, through the shipping process, to each possible destination.

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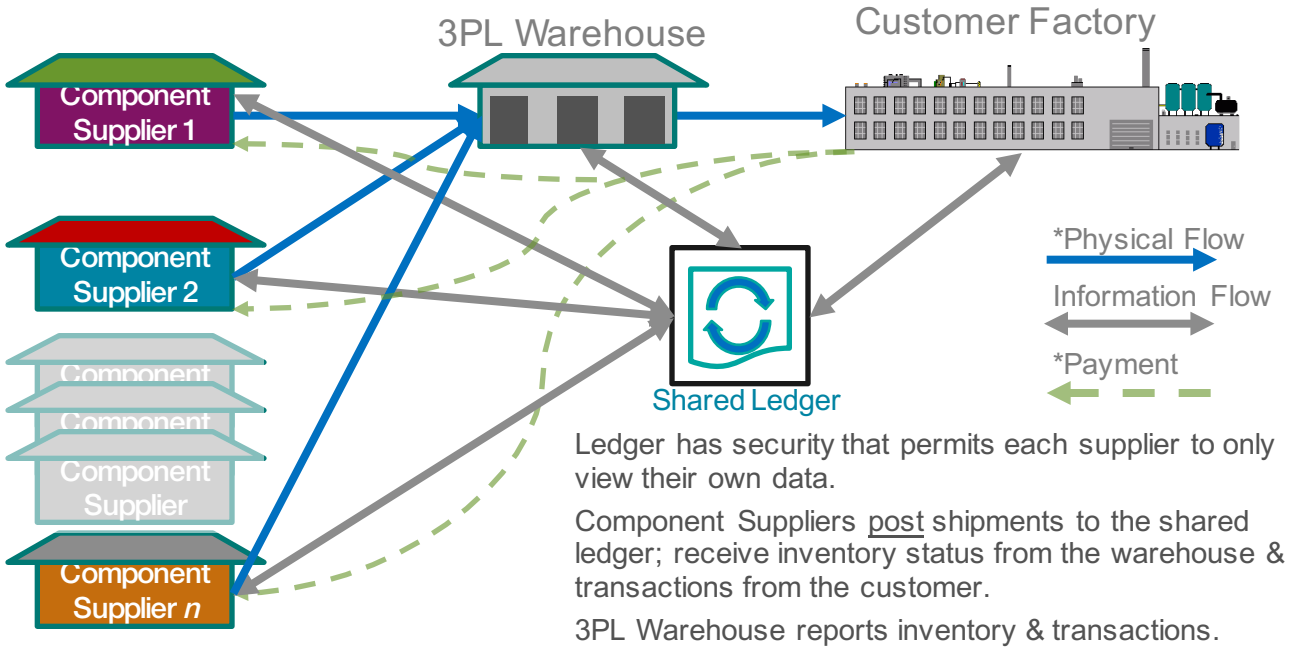
▸ Use case: Supplier-Managed Inventory (SMI/VMI)

Similar to Product Tracking, but with a focus on supplier-owned inventory that is intended for use by a particular customer.

SMI/ VMI often involves a 3PL-managed hub where the supplier-owned goods are stored. The central problem is that:

- The supplier owns the goods but doesn't have physical control of them.
- The 3PL has physical control of the goods but doesn't own them.
- The customer neither owns the goods, nor has physical control while they are at the warehouse, but needs real-time information on them – and determines when to take ownership of them.

Blockchain provides an elegant solution.



Ledger has security that permits each supplier to only view their own data.

Component Suppliers post shipments to the shared ledger; receive inventory status from the warehouse & transactions from the customer.

3PL Warehouse reports inventory & transactions.

Customer views inventory & pulls stock from warehouse.

*Physical Flow is an independent process but must update the ledger.
*Payment may be a completely independent process.

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▸ Use case:
Logistics

Global Trade Digitization

IBM MAERSK

Video

An open, extensible platform for sharing shipping events, messages, and documents across all the actors and systems in the supply chain ecosystem.

Workflow Capability

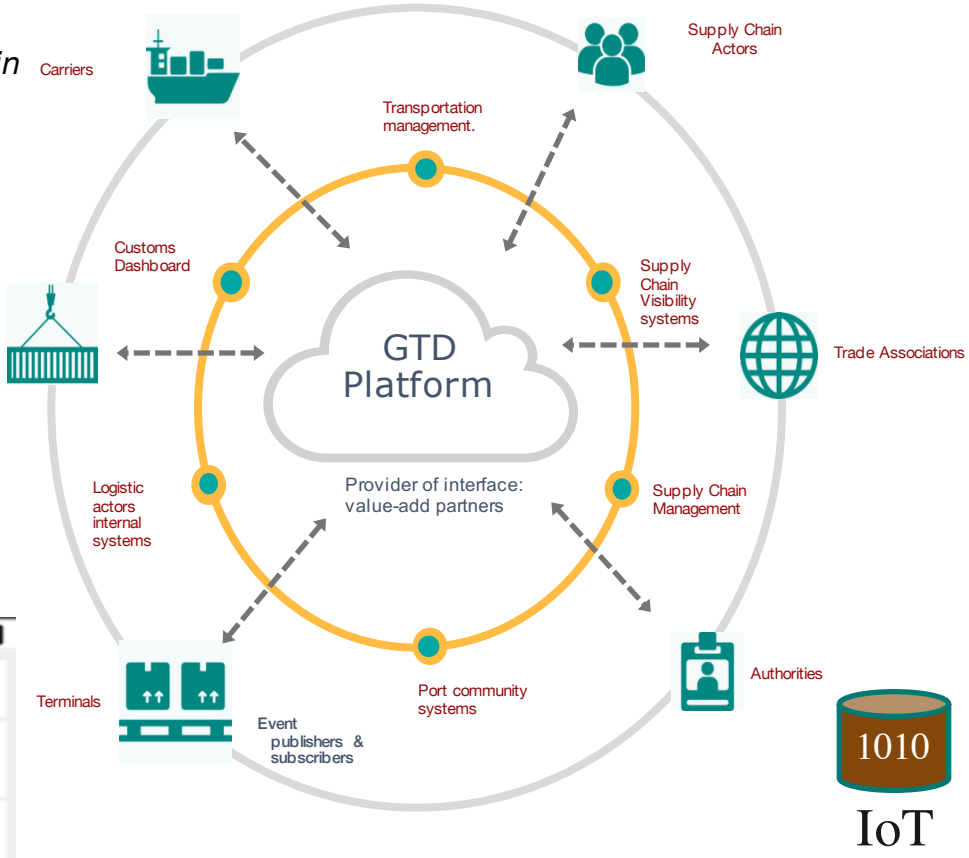
Providing Trusted, Tamper-Proof, Cross-Border Workflows for Digitized Trade Documents

Visibility Capability

Providing Shared Visibility and Shared State for Container Shipments

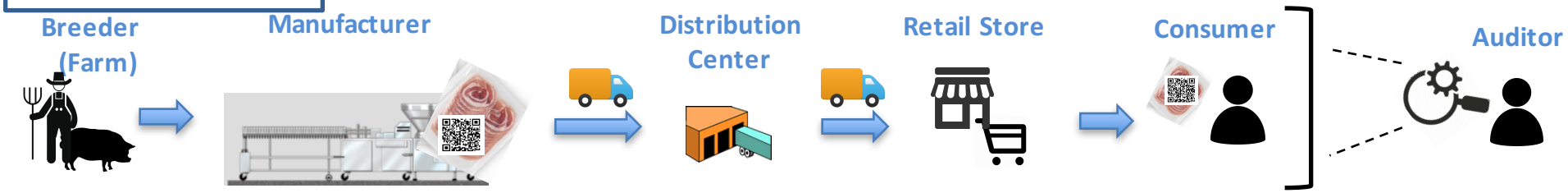
Real Time Access to Container Events Across Participants





▶ Use case:
"Cold Chain"

Food traceability through Blockchain Provenance



Requirements

- **secure documentation** of key data: raw materials, machinery, processing, & logistics.
- **product packages labeled using RFID or** bar/QR code for regulators and consumers
- **aggregate products** into packages
- **validation of packages** to ensure no fraudulent replacements / introduction of counterfeits
- **disaggregation** of product packages and re-packaging for retail stores
- **visibility** of product across lines of transport

- **retrieval of traceability information** at checkout
- **checkout transactions disabled** for expired products (or alarm raised)
- customer ratings and preferences with regard to the source of the product
- **end-to-end visibility** of each product path across the supply chain
- check compliance with respect to machinery, expiry dates, product quantities, etc.
- certify the supply-chain; creation of audit records

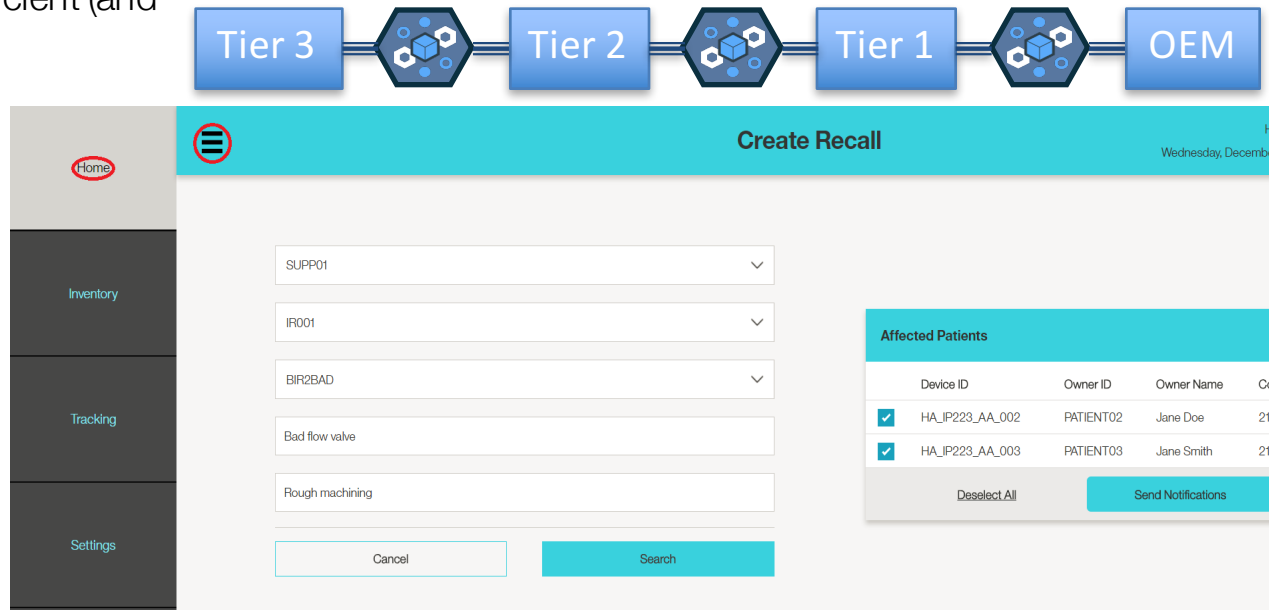
1010
IoT

UNDERLYING BLOCKCHAIN PROVENANCE CAPABILITIES	association of labeling with data on Blockchain	product data aggregation and disaggregation	end-to-end permissioned visibility	basic analytics	authentic traceability through immutability	information retrieval in a simple manner	audit capabilities: handle changing regulations through smart contracts

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Recalls Management

- Problem: products that can expose consumers to high risks (e.g. autos, medical electronics) occasionally have to be recalled due to bad materials/ parts.
  Without detailed records, OEMs may be forced to recall months of production to check whether each product contains the defective part. This is expensive and inefficient (and often not very effective).
- Existing solutions may capture information on the source of items used directly on the final product, but not the parts used on subassemblies (like PCB assemblies, engines, etc.)
- Solution: a blockchain-enabled database that captures manufacturing information at multiple stages in the supply chain (e.g. Tier 3 – valve; Tier 2 – fuel injector; Tier 1 – engine producer; then OEM), and links that detailed provenance data to individual product serial numbers (e.g. auto VINs).

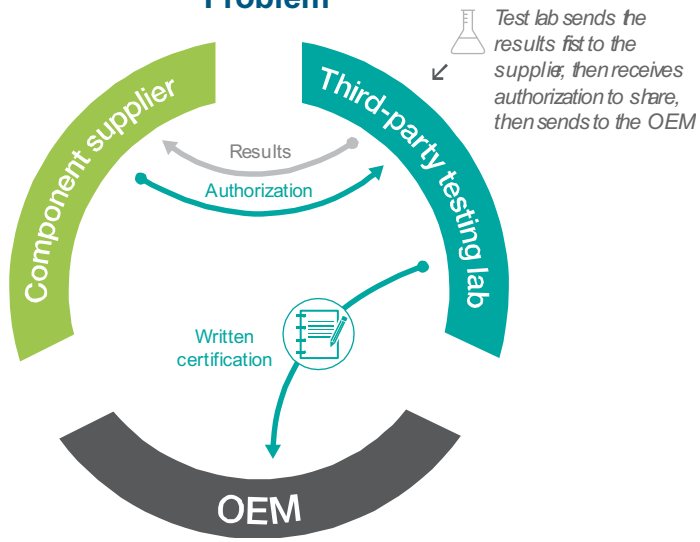


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▶ Use case:
Supplier Certification

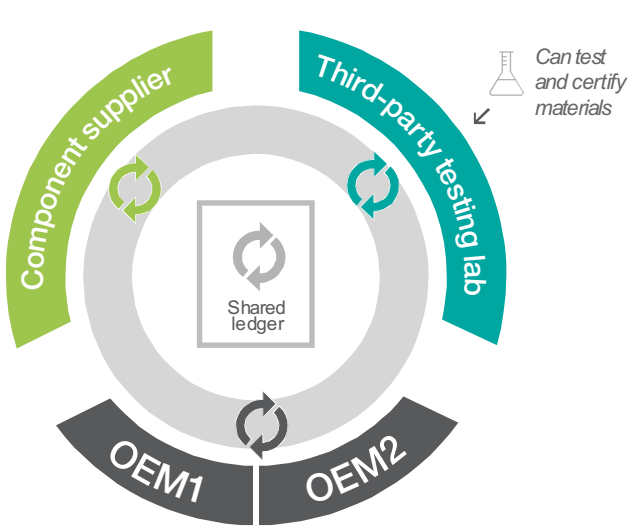
Outside testing organizations validate suppliers' parts; Blockchain's shared ledger permits immediate access to test results.

Problem



OEMs make individual demands on suppliers for detailed tests; for highest trust level, use third-party labs. Interaction is point-to-point, manual and time-consuming.

Blockchain solution

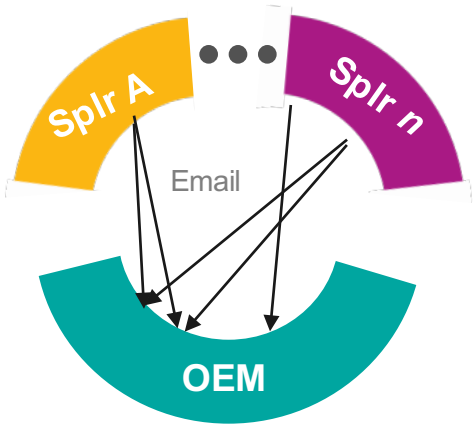


Use an established blockchain ledger visible to the supplier, the lab and OEM(s), with security permissions by supplier. As soon as the lab completes its tests, results are visible to the supplier, which can then share with multiple OEMs.

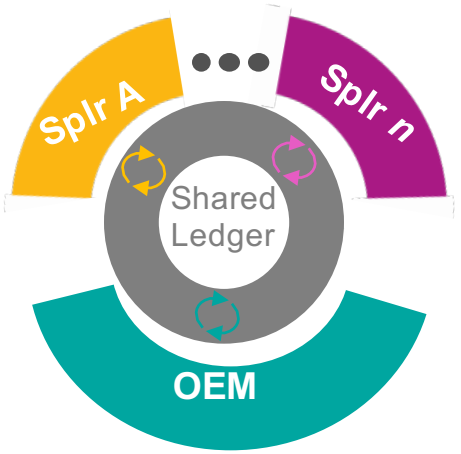
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▶ Use case:
Supplier Quality Data

Routine sharing of key data on component production lots will improve product quality and speed up incoming inspection.



When quality data is needed, it usually gets transmitted via email (no security, limited access). Low reliability that data will be transmitted on a consistent basis, hard to verify and validate data. Data formatted inconsistently. Difficult to count on data availability.



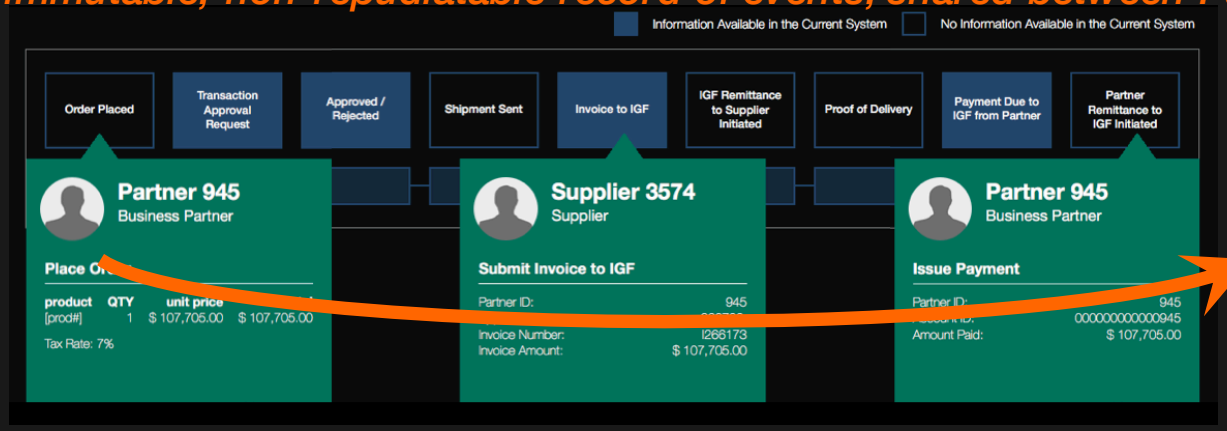
Suppliers feed quality/ process/ parametric data to a blockchain-based ledger as they produce components, for review by the OEM. The OEM can review each production lot's data before it is received (or even shipped), to ensure that inbound materials meets all requirements.

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- Use case:
  Global Finance

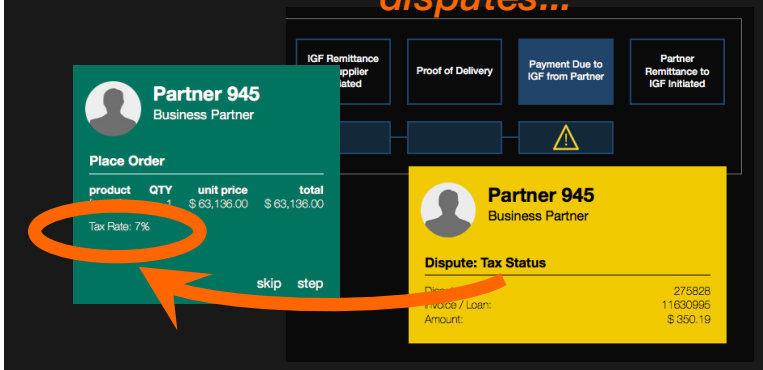
Blockchain for IBM Global Financing

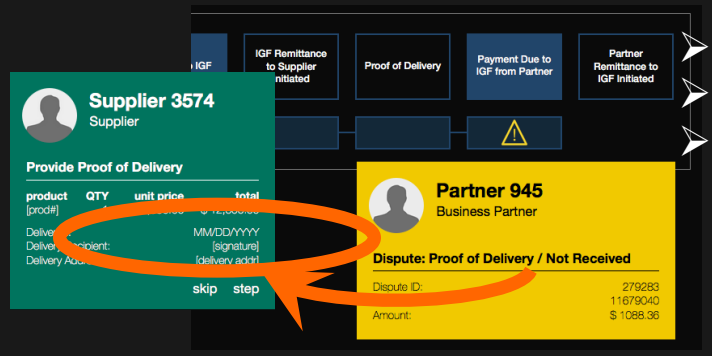
An immutable, non-repudiatable record of events, shared between Partners, Suppliers and IGF…



…enabling a comprehensive view across the entire transaction lifecycle….

…with enhanced visibility to prevent or speed the resolution of disputes…





- Fewer disputes
- Faster settlement
- Free flow of capital between parties

Video

SW Asset Management

A control mechanism that secures all-time SW license compliance

1. *Multiple SW vendors and each has unique license agreement T&C's*
2. *Time consuming reconciliation workload in managing entitlements, obtaining a true picture of the install base or dealing with SW compliance audits.*
3. *Multiple parties with conflicting interests around SAM are keeping track independently from each other. This demands a lot of communication*





With blockchain for SAM:

1. *Process effectiveness through automation (use of smart contracts) and less resources spent in reconciliation, tracking & reporting.*
2. *Cost effectiveness out of a better control over SW assets*
3. *Increased transparency would enable OEM's take better portfolio decisions.*
4. *Better SAM standards (ISO 19770-1)*

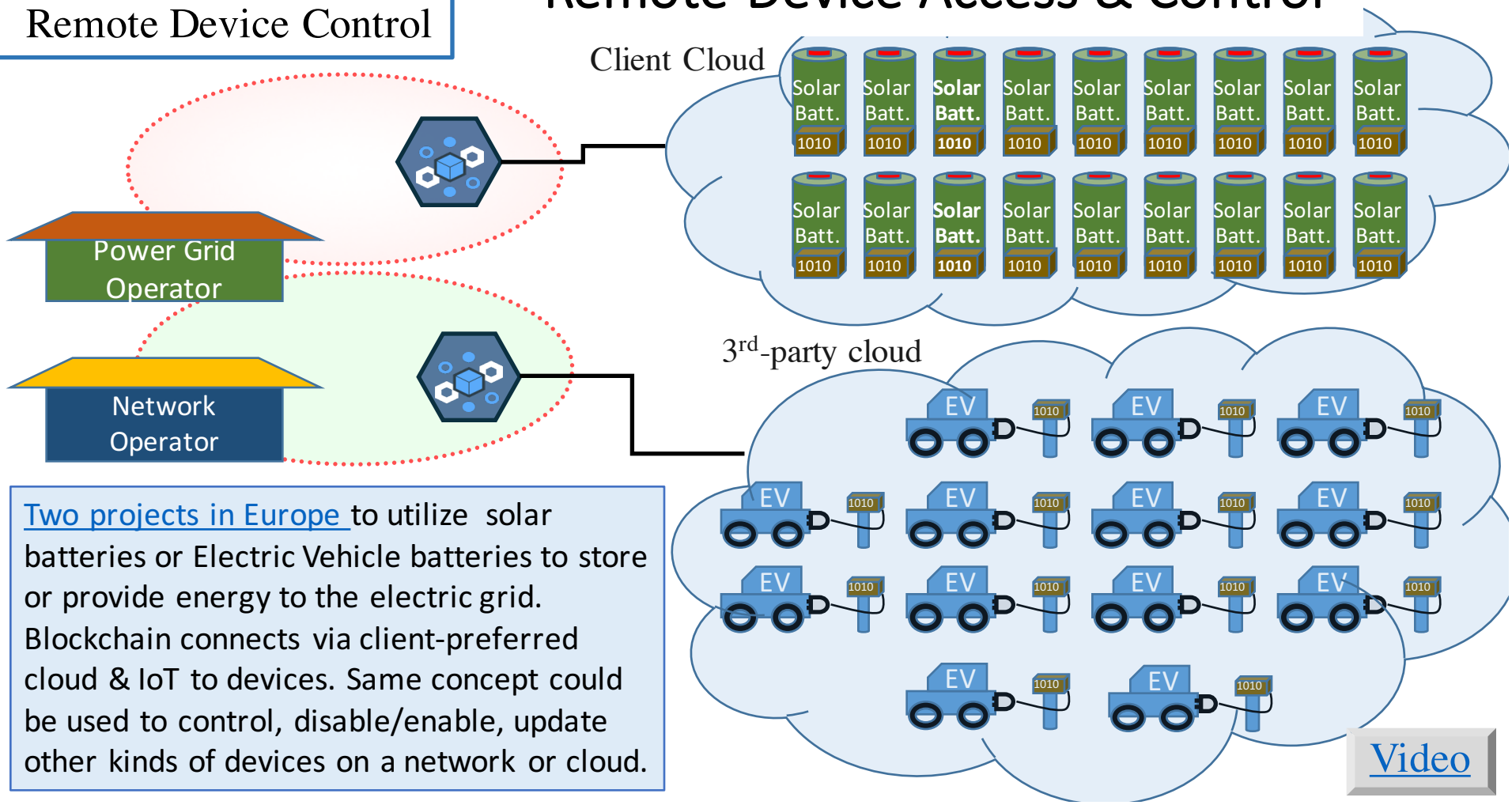
Connectable Products carry license obligations from multiple software vendors and staying compliant with all of them, managing billing and entitlements is a chimeric task.

Blockchain can effectively assign the SW entitlement to the HW component and link back to the SW license. It can be used to report the SW installation/removal events to all network participants. Alert when this happens or which participant did it.

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- Use case:
  Remote Device Control

Remote Device Access & Control



Two projects in Europe to utilize solar batteries or Electric Vehicle batteries to store or provide energy to the electric grid. Blockchain connects via client-preferred cloud & IoT to devices. Same concept could be used to control, disable/enable, update other kinds of devices on a network or cloud.



Integrating Blockchain with existing Point-to-Point transactions

Integrating Blockchain to a Business Network

Existing e-Hubs / business networks are set up primarily to:

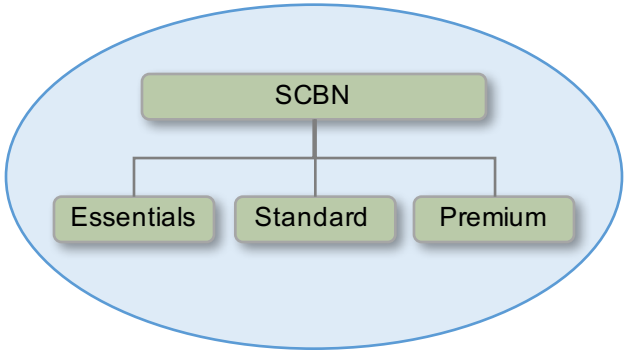
- exchange data between partners
- using existing standards (e.g. EDI, RosettaNet, etc.)
- The focus is to transfer the data – not to retain it. (Exceptions exist.)
- Data exchange is point-to-point (e.g. Supplier-Customer or Supplier-Logistics Company); data transfers are in one direction at a time.
- There can be significant barriers for new partners to participate in existing networks. (Enabling EDI or RosettaNet is not a trivial exercise.)

IBM Supply Chain Business Network

One connection to IBM provides access to all your trading partners regardless of protocol or format
- Connectivity
- Transformation
- Visibility Tooling
- Reporting

Secondary Offerings
- Document Conversion Services
- Web Forms
- E-Invoicing
- File Transfer
- Real Time APIs

Quantifiable ROI (IDC - 2016)
- 308% average ROI
- 7.8 month payback
- 75% less staff time to support B2B Ops
- 65% less time for call center support
- $3 million average additional revenue



Core Industries: Retail, CPG, Manufacturing, Dist.
- Improve service levels – internal & external customers
- Comply with customer & government mandates
- Free up internal IT staff for other projects
- Improve time to market / project acceleration

Key Stats
- 6,700 customers
- 2.6B transactions / year
- **435,000 pre-configured trading partners**
- 120 interconnects with EDI networks

- Ave turn around time (no trans): < 3 sec
- Average file size: 4.4 kb
- Largest file (May '17): 527 MBs

- NA & European Data Centers to meet privacy & data residency
- **99.98% uptime and 96.4% customer satisfaction**

- File Formats: EDIA, UCS, WINS, X12, Rosettanet, COMPORD, TRADACOMS, ODETTE, EDIFACT, VDA, RND, PEPPOL, Flat File, Proprietary, Binary (ie PDFs) and XML
- Protocols: AS2, Connect:Direct, FTP, HTTP, SMTP, X.400, OFTP, MQ, SOAP

Adding Blockchain to the IBM Supply Chain Bus. Network will:

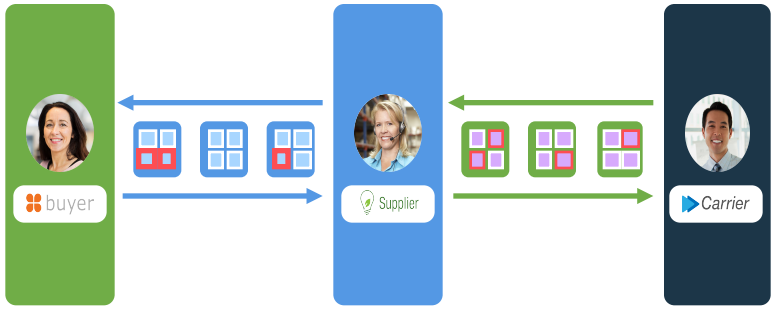
- Bring seamless bi-directional integration between Supply Chain Business Network (SCBN) with applications on IBM Blockchain
- Allow Supply Chain Business Network clients to leverage the IBM Blockchain platform for solutions requiring shared visibility across multiple participants
- Allow IBM Blockchain clients to leverage IBM **Supply Chain Insights** for advanced analytics across supply chain processes and cognitive resolution rooms for disruption management.



IBM Confidential

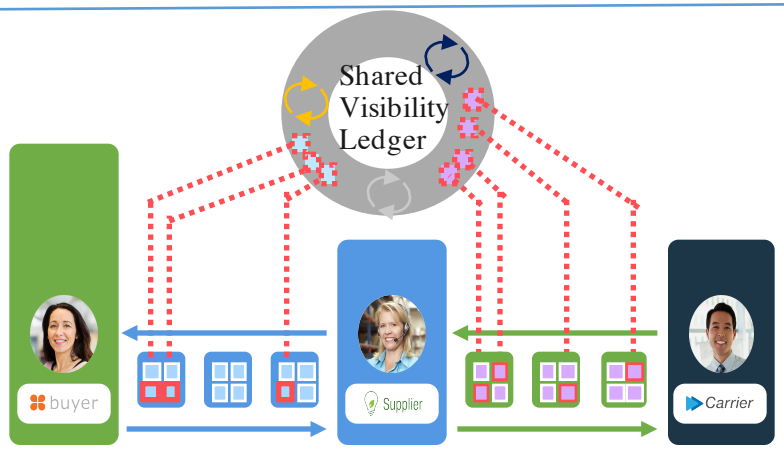
Consider the interactions between buyers, suppliers and logistics providers who use EDI messaging for their business communications

Today
Without Shared Visibility Ledger



- Messages are point to point, one way communications
- Each party has unique and limited visibility
- Each party has their own version of the truth

Tomorrow
With Shared Visibility Ledger



- Messages still travel through the business network, but selected messages are written to the shared ledger and can be shared
- All permissioned parties have broader visibility
- Shared, singular, immutable version of events

NOTE: In this model, the carrier is contracted by the supplier.



Getting Started with Blockchain: Practical Aspects

Making the case for Blockchain

Clients may discover a compelling business case to be made for Blockchain, because it:

- Enables compliance with applicable laws and regulations, or with a customer's requirements
- Eliminates a major problem (such as counterfeit materials in their supply chain, via Blockchain's provenance capabilities)
- Saves time in a complex business transaction or process
- Saves money (by reducing time spent, reducing labor, or eliminating certain process steps or costs) in a complex business transaction or process
- Eliminates a middleman or a non-value-added process step, resulting in time and cost savings
- Enables a new process that would be impossible or impractical without some aspect of the shared, secure ledger

Designing a Blockchain network

- The Blockchain network is designed to meet the business requirements of its sponsor(s) and the other participants in the process. It's typically done by a Blockchain architect.
- The requirements to participate in a Blockchain network may range from "just a browser" to a server. (Depends on type of participation, transaction rate, and data load – the transaction contents. How IoT data & devices are integrated into the Blockchain can also have an effect.)
- Not every participant needs to have a copy of the Blockchain on their own servers.
- The sponsor of the network will most likely make the most significant investment. Most "operations" networks do not require a big investment for the partners in the network.

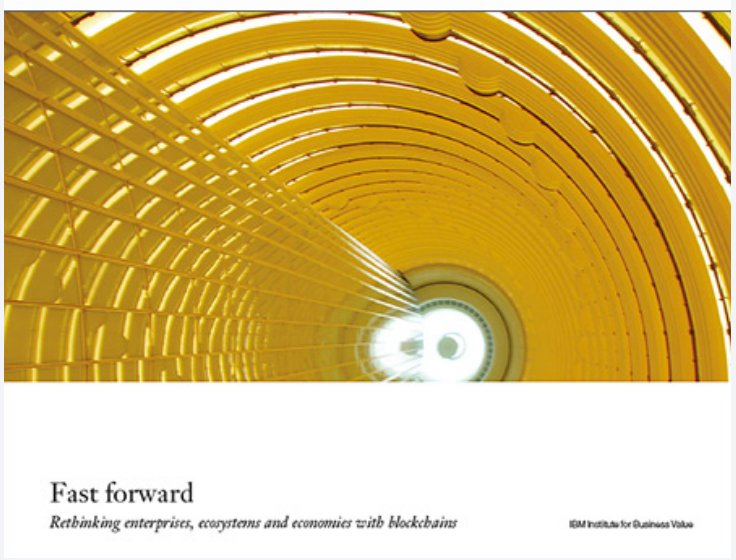
Partner Engagement & Costs

- If you want to “sponsor” a Blockchain process, how do you get other companies to participate?
- The answer is similar to any other solution that is led by one party but needs participation & cooperation from others: find a way to ensure that

Benefit exceeds Investment

- In other words, work to minimize investment needed by designing your network & process efficiently; and maximize real and perceived benefit to the partners.

Learn More





Some useful videos:
https://youtu.be/lD9KAnkZUjU (diamond example)
https://youtu.be/IgNfoQQ5Reg (car lease)
https://youtu.be/tdhpYQCWnCw (Maersk)
https://youtu.be/pee0kixUN2Q (Power Grid)
https://youtu.be/ZKscEx2lO-4 (Blockchain + IoT)
https://youtu.be/SV0KXBxSoio (Walmart Food Safety)
A more comprehensive foundational presentation:
https://www.slideshare.net/EsraUfacik/blockchainbusiness

"Fast Forward" report is at https://www-935.ibm.com/services/us/gbs/thoughtleadership/blockchain/
Blockchain in Electronics report is at www.ibm.biz/blockchainelectronics
Additional info at https://www.ibm.com/blockchain/
Helpful paper on selecting a blockchain framework:
https://developer.ibm.com/blockchain/2017/05/11/guidelines-blockchain-adoption-enterprise-compare-frameworks/

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Blockchain 101

Understand what blockchain is and how it works

What is blockchain?

It's a shared ledger for recording the history of transactions - that cannot be altered.

Why do we need it?

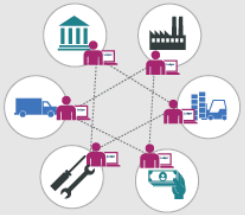


Transactions take place every second — orders, payments, account tracking. Often, each participant has his own ledger — and, thus, his own version of the truth.

Having multiple ledgers is a recipe for error, fraud and inefficiencies. The goal is to see a transaction end-to-end and reduce those vulnerabilities.



How does blockchain improve processes?



Transactions are complex.

- A Each participant has his own, separate ledger — increasing the possibility of human error or fraud
- B Reliance on intermediaries for validation creates inefficiencies
- C Can be a paper-laden process, resulting in frequent delays and potential losses for all stakeholders

Blockchain makes it better.

- A Single shared ledger that is tamper-evident. Once recorded, transactions cannot be altered
- B All parties must give consensus before a new transaction is added to the network
- C Eliminates or reduces paper processes, speeding up transaction times and increasing efficiencies



Building a blockchain.

As each transaction occurs, it's put into a block.



Each block is connected to the one before and after it.



Transactions are blocked together.



Each block is added to the next in an irreversible chain.



The benefits of blockchain are critical to enterprises.

Distributed
It works as a system of record that is shared among participants of the business network, eliminating the need to reconcile disparate ledgers.

Permissioned
Each member of the network has access rights so that confidential information is shared on a need-to-know basis.

Secured
Consensus is required from all network members, and all validated transactions are permanently recorded. No one, not even a system administrator, can delete.

Let's see how it works in one industry.

Tracking diamonds from mine to final customer is complex. Diamond smuggling, fraud, counterfeit diamonds and unethically mined stones pose real challenges. With blockchain, it's possible to:

Maintain high-resolution photos of each diamond at every touch point along its journey.



Track real-time records of every payment transaction.



Hold certificates of authenticity.



Keep a record of product details like cut, clarity, color, carats, and diamond serial numbers.



Blockchain can enable enterprises across many industries to:



Free up capital flows

Lower transaction cost

Speed processes

Provide security and trust

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