An Introduction to Blockchain in Shipping

BLOCKCHAIN, DISTRIBUTED LEDGERS & SMART CONTRACTS IN SHIPPING

MLA CARRIAGE OF GOODS COMMITTEE

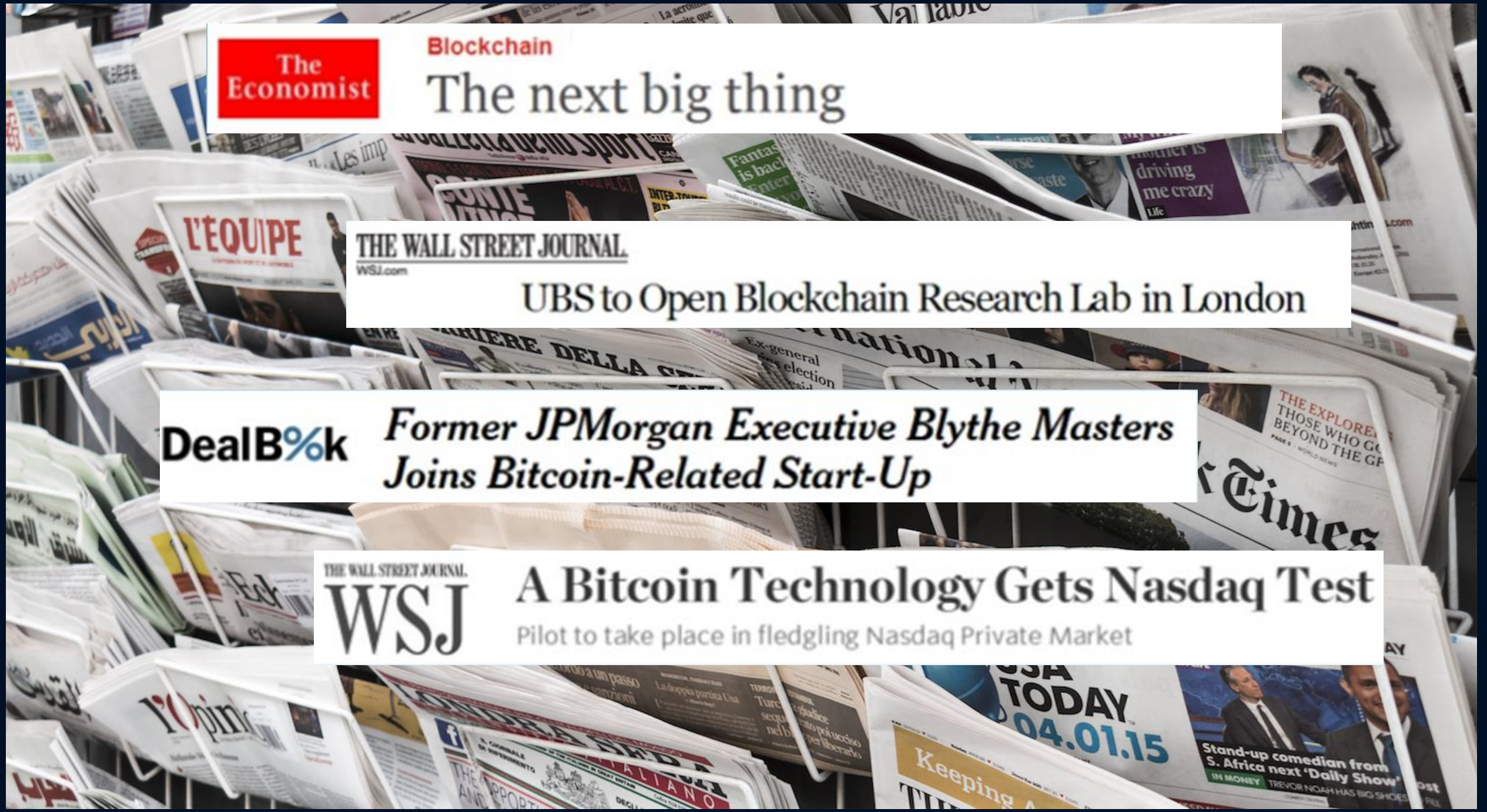
SPRING 2018 MEETING
NEW YORK, NY

DANIEL S. MALAND, ESQ.

Kozyak Tropin Throckmorton, LLP
2525 Ponce de Leon Blvd., 9th Floor
Miami, Florida 33134
(305) 372-1800
www.kttlaw.com

PETER F. BLACK, ESQ.

Flynn, Delich & Wise LLP
1 World Trade Center, Ste. 1800
Long Beach, California 90831
(562) 435-2626
www.fdw-law.com


The Economist
Blockchain
The next big thing
THE WALL STREET JOURNAL.
WSJ.com
UBS to Open Blockchain Research Lab in London
DealB%k
Former JPMorgan Executive Blythe Masters Joins Bitcoin-Related Start-Up
THE WALL STREET JOURNAL.
WSJ
A Bitcoin Technology Gets Nasdaq Test
Pilot to take place in fledgling Nasdaq Private Market

Agenda

- What is blockchain?
- What are smart contracts?
- How is the shipping industry using this technology?
- Potential Future Uses
- Potential Future Problems
- Takeaways

What is blockchain?

Blockchain's Background

- First conceptualized by Satoshi Nakamoto in 2008
  - Who Satoshi Nakamoto really is remains a mystery!
- In 2009, Bitcoin – the digital currency- became the first practical application of this technology
- Distributed Ledger Technology is the foundation of Blockchain.
- All Blockchains use distributed ledger technology – not all distributed ledger technology is a blockchain!
- Simply put - Blockchain is a digital, transparent and incorruptible decentralized ledger that keeps a record of all transactions that take place across a peer-to-peer network.


I THINK WE SHOULD BUILD A BLOCKCHAIN
UH-OH
S. Adams E-mail: SCOTTADAMS@AOL.COM
DOES HE UNDERSTAND WHAT HE SAID OR IS IT SOMETHING HE SAW IN A TRADE MAGAZINE AD?
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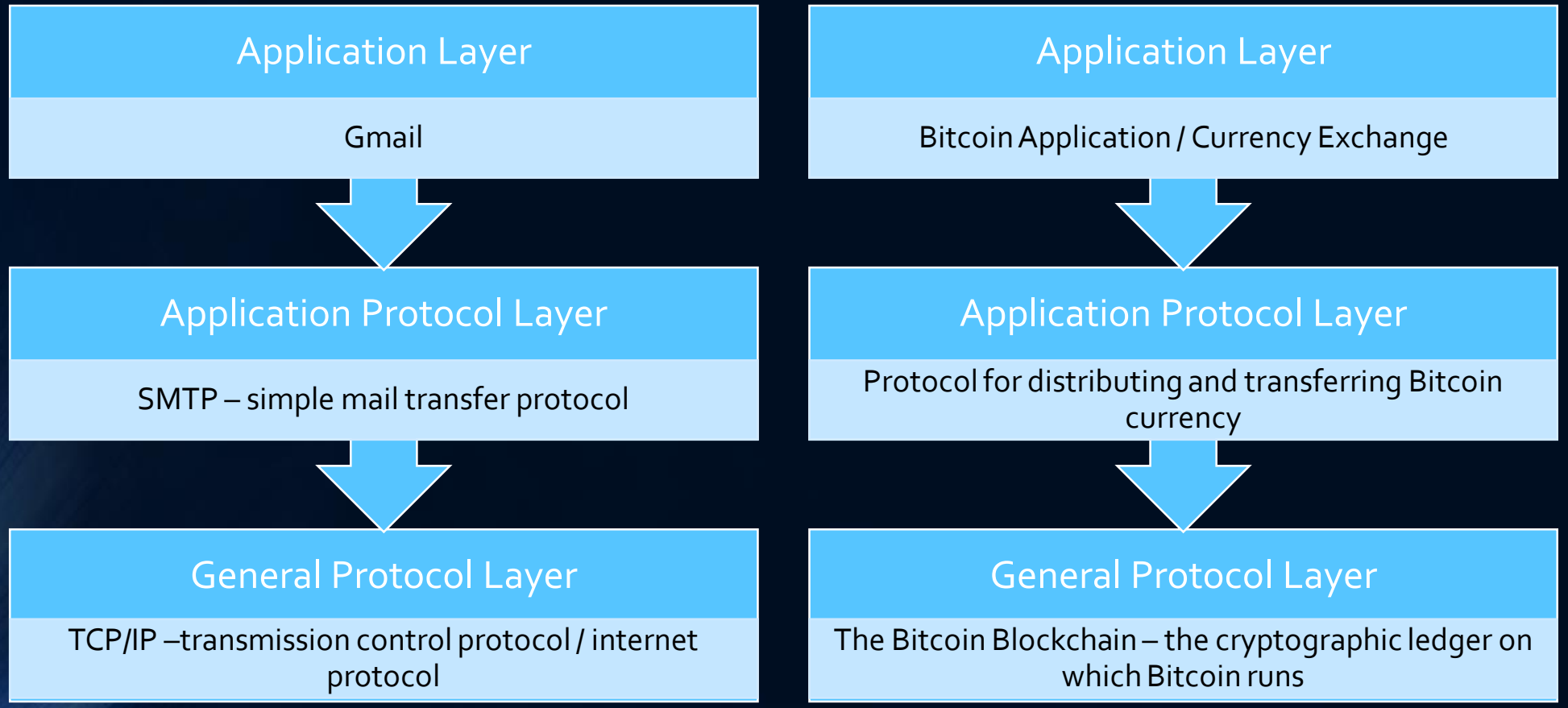
WHAT COLOR DO YOU WANT THAT BLOCKCHAIN?
I THINK MAUVE HAS THE MOST RAM.

Blockchain is:

- A protocol (set of standardized rules, like the internet)



Blockchain: Protocol

- A ***digital ledger*** (or database) that is
- ***Distributed across a network of digital devices*** (i.e. computers connected via a decentralized peer-to-peer network)
- Containing an ***increasing number of data records*** that are
- ***Protected*** by cryptography, and ***verified*** digitally.

- One of the safest, most secure and tamper-proof methods of record keeping known.

Blockchain: Foundational Points

- There is no single or definitive ‘blockchain’.
- There can be an infinite amount of blockchains and anyone with the necessary coding skills can create one.
- Blockchains are not stored in any single location
  - Hosted by all computers ("nodes") on the blockchain simultaneously
  - Picture an excel spreadsheet that is identically duplicated across a network of computers and uniformly updated
- Key Concept: I know what I see is what you see and we can all trust that information.

Types of Blockchains

- ***PUBLIC (a/k/a permisionless or unpermissioned*)- open networks that anyone can access and use.
  - Bitcoin is a public blockchain- anyone can buy and sell bitcoin
- ***PRIVATE (a/k/a permissioned)***- proprietary networks where only specific individuals or entities are allowed to access and use this information
  - Permission levels may be tiered so different entities and individuals can have different levels of authority to transact and view data.
  - A blockchain between a shipper and its and partners in a supply chain would likely be permissioned

Blockchain: Security

- Data must be verified by one or more of the "nodes" before it can be added to the blockchain
  - "Node" - a participating member of the network that has a complete copy of the entire blockchain

Blockchain: Verification

- ***Consensus Based Verification:*** a majority of the network's participants confirm the integrity of the data in a transaction before the transaction is verified and recorded on the blockchain.
- ***Proof-of Work Based Verification:*** new transactions are authenticated by users known as 'miners' (using specialized IT equipment) before being recorded as a new 'block' and being made available to view by other members of the blockchain.
  - Miners run time intensive, complex formulas to validate data and are compensated for their efforts –often with crypto currency.
- Bitcoin uses a combination of proof-of-work and consensus-based verification, and each transaction confirmation takes between a few seconds and 90 minutes, with 10 minutes being the average time.
- If you read in the news that Bitcoin uses a lot of electricity, this is why!
  - Source: Bitcoin.org, https://bitcoin.org/en/faq#why-do-i-have-to-wait-10-minutes

Blockchain: Cryptographic Protection

- Verified transactions are "cryptographically hashed" and permanently recorded on the blockchain.
    - Hashing = using a math formula to convert data into a unique and non-predictable value that is ***non-reversible***
        - This means that someone looking at a blockchain can see a hash and confirm that it represents a corresponding dataset, but cannot identify the data by looking at the hash value (the hash hides the actual data)
- The records are time stamped and displayed in a sequential manner with each hash linking it to the previous 'block' in the chain.
- Blockchain networks live in a state of consensus- they are set to automatically check in with themselves at set intervals to confirm their uniformity across all nodes.
    - The network reconciles every transaction that happens in set intervals.
    - Each group of these transactions is referred to as a "block".

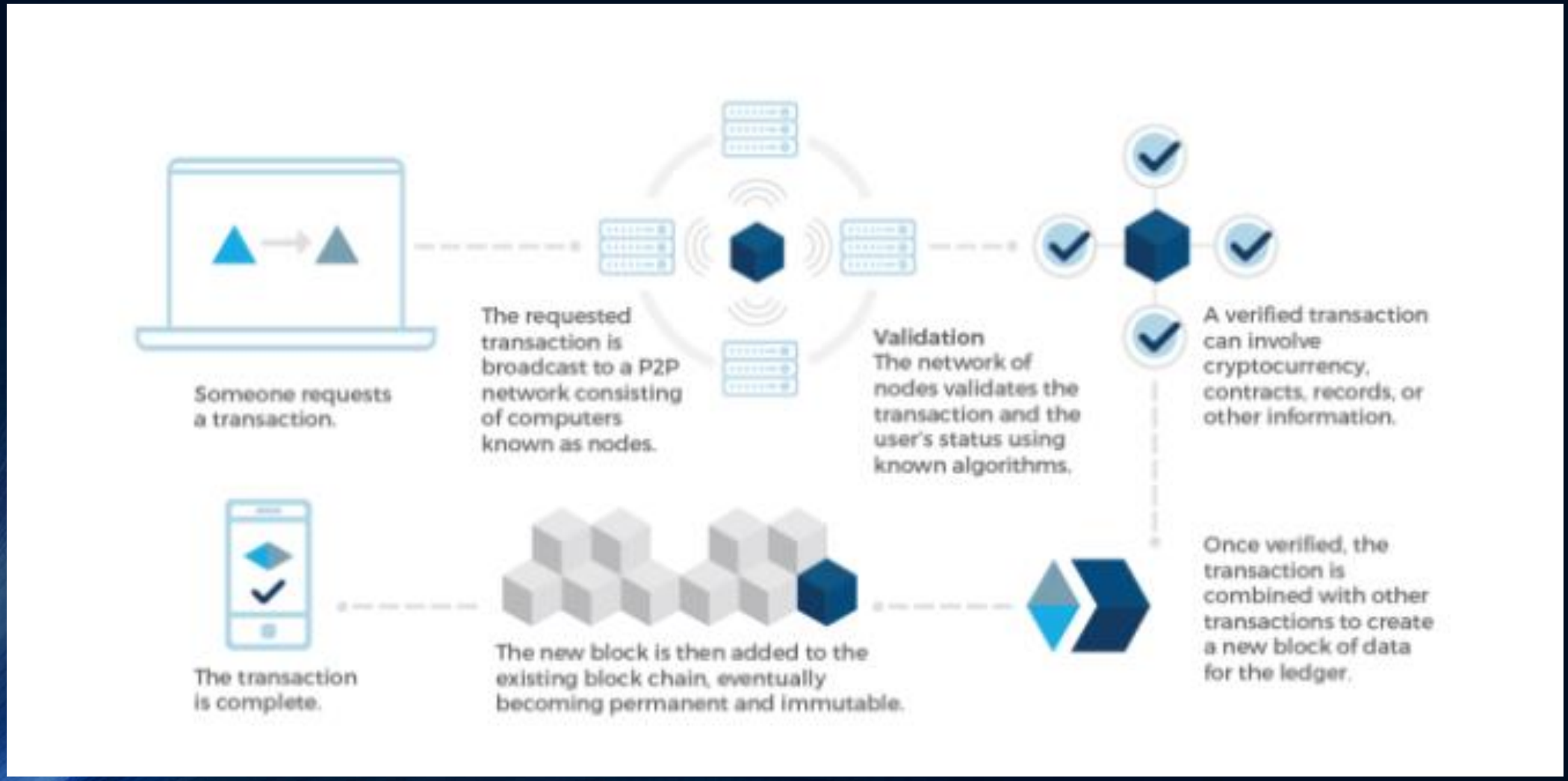
Blockchain: Security

- Two important properties result from this:

1. **Immutable**
    - Blocks on the blockchain cannot be modified
        - All errors can only be fixed with new correcting block entries.
        - By storing blocks of information that are identical across its network, the blockchain cannot be controlled by any single entity and has no single point of failure.

2. **Transparent**
    - The hashed data on the blockchain is visible to all who have access to the blockchain.

Blockchain Visualized



Source: https://www.blockchain.com/whitepaper/index.html

What are "smart contracts”?

Smart Contracts

- The term “smart contract” is used to describe a computer program that is capable of facilitating, executing, and enforcing the performance of an agreement using blockchain technology.
- The entire process is automated and the terms of the contracts are recorded in computer code as a set of instructions
- Smart contracts hold parties accountable and remove unnecessary middlemen.

Smart Contracts

- Shipment events, such as delivery, would trigger a change of ownership of the goods or bill of lading and the release of payments
- Can be as simple or as complex as the contract.
  - From pure delivery from one party to another
  - To as complex as a Rube Goldberg contraction with multiple payments to multiple parties based on the timing of events.

Smart contracts are coded instructions that happen automatically when certain criteria are met.

Think :Gumball Machine

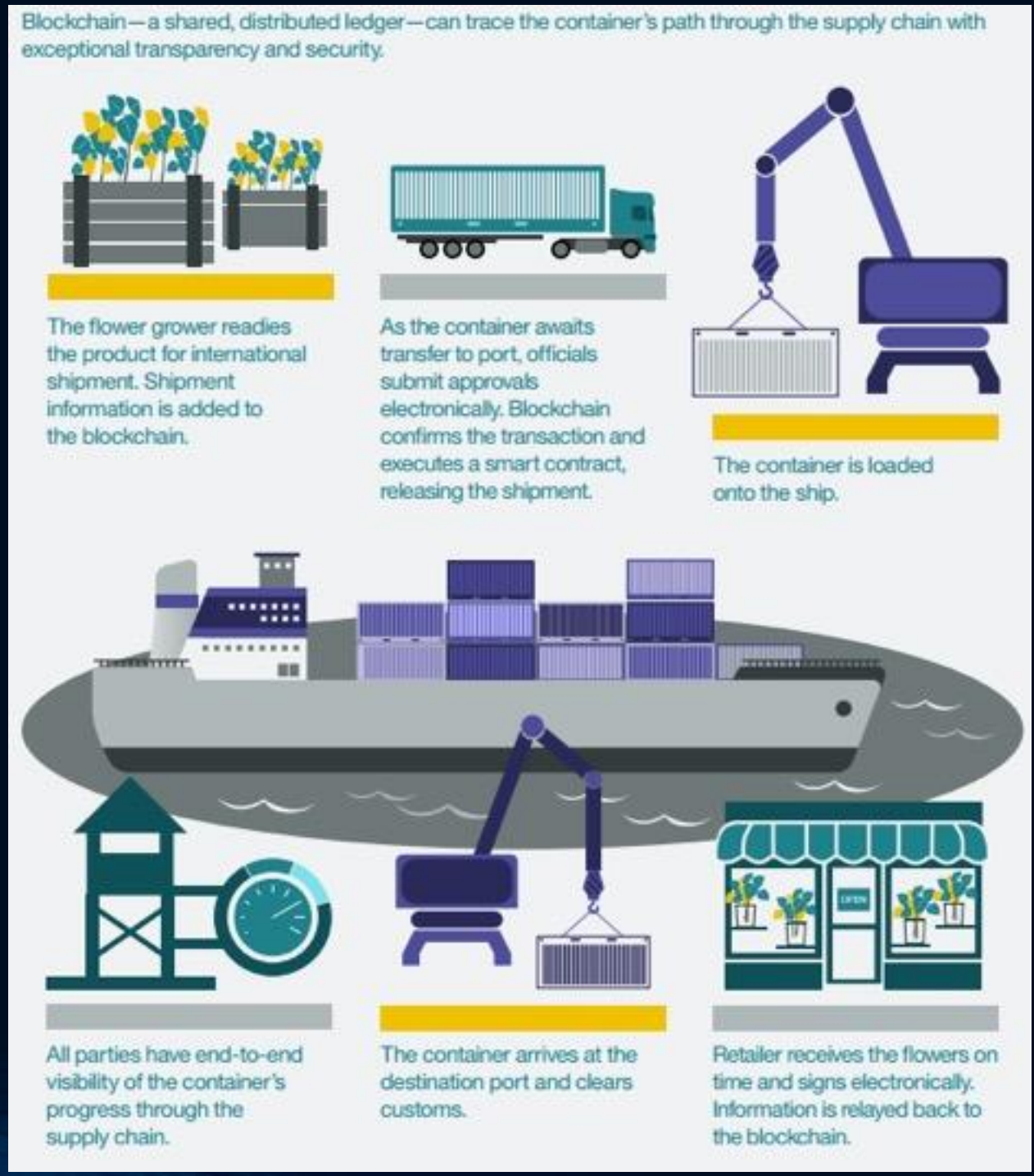
1. You want a gumball and agree to pay 25¢
2. You insert the quarter and turn the knob
3. The machine follows its engineered design
   a) *A gumball shoots to the top of the track*
   b) *You watch it follow the winding track*
   c) *You wait for it to hit the retrieval slot*
4. You retrieve your gumball and enjoy!

Gumball Machines like smart contracts, perform specific, pre-engineered tasks when certain criteria are met.

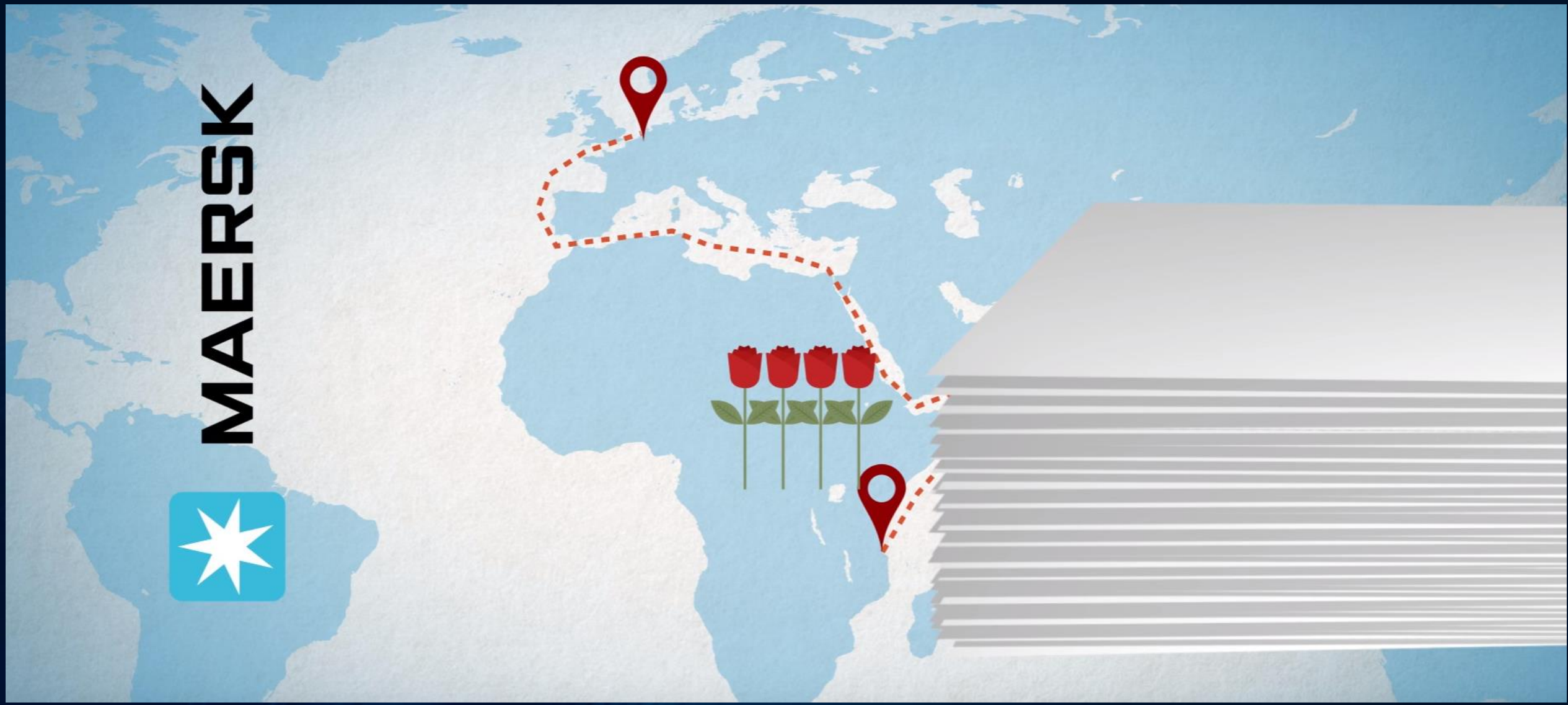
How is the shipping industry currently using blockchain and smart contracts?

- Numerous proof of concepts being experimented with internationally
  - Maersk & IBM, Walmart, Tokio Marine & Nichido Fire Insurance Co
- Companies are joining various blockchain consortiums and groups
  - Global Legal Blockchain Consortium, Enterprise Ethereum Alliance, BiTA
- Focus on blockchain as a service
  - Maersk & IBM Blockchain JV in NY, IBM Platform Starter Plan

- IBM & Maersk: Shipment of single container of flowers from Mombassa to Rotterdam

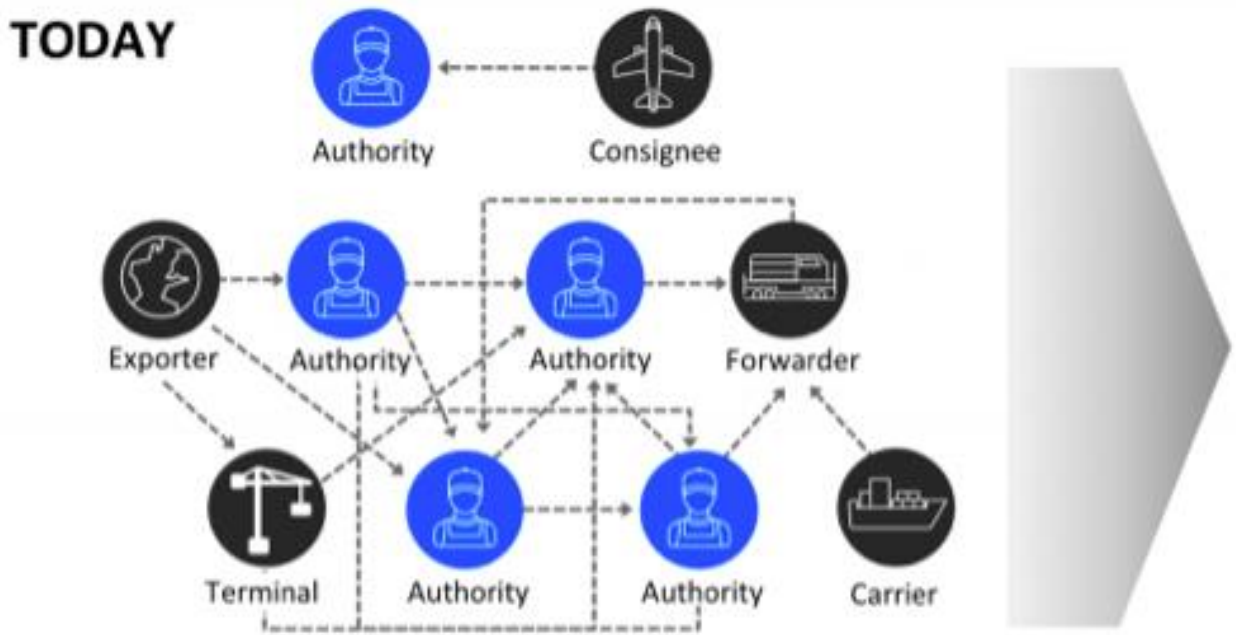


- IBM & Maersk: Shipment of single container of flowers from Mombassa to Rotterdam resulted in over 200 separate communications



Source: IBM and Maersk Demo: Cross-Border Supply Chain Solution on Blockchain- https://youtu.be/tdhpYQCWnC

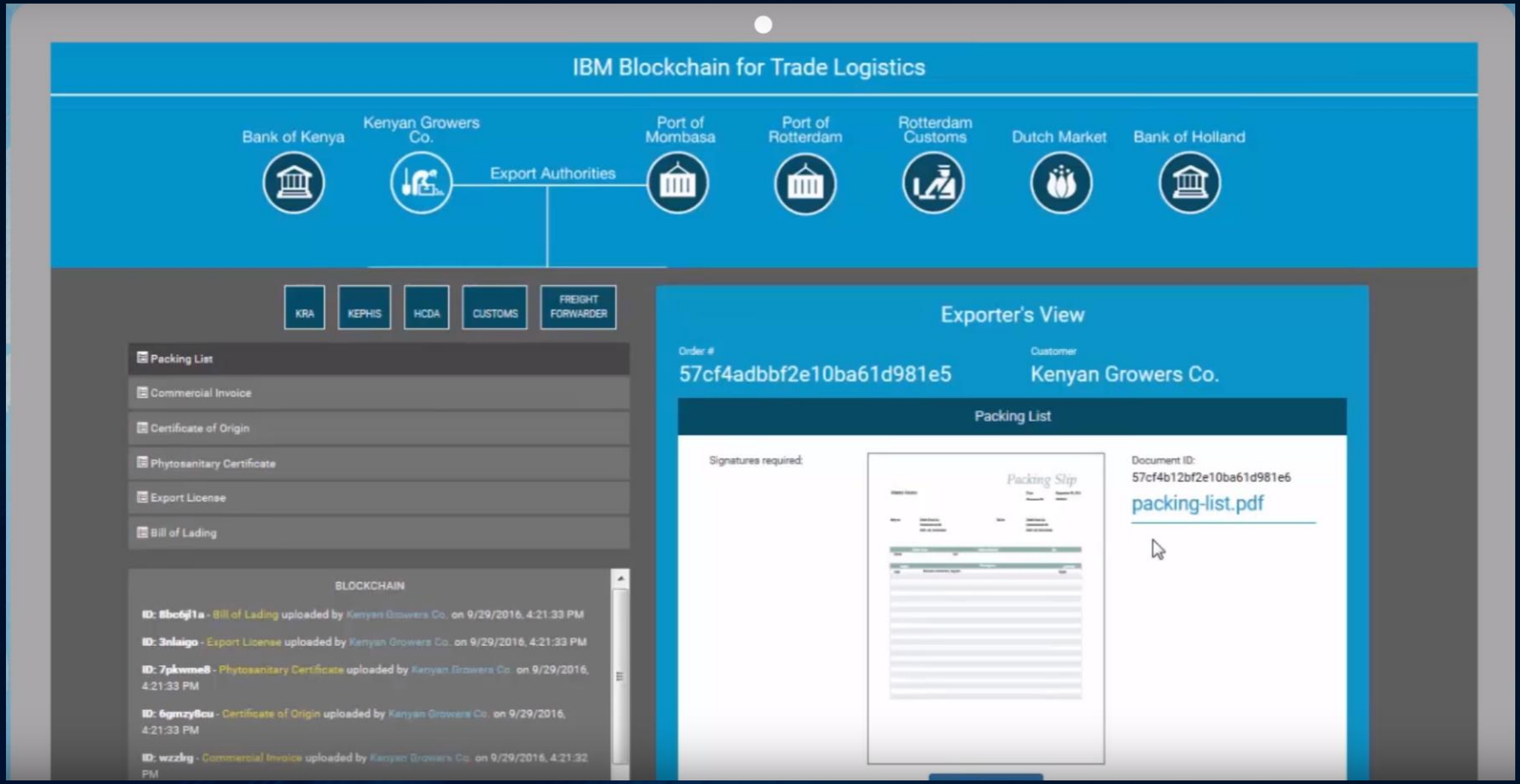
The case for a better way



- Inconsistent information across organizational boundaries and "blind spots" throughout the supply chain hinder the efficient flow of goods
- Complex, cumbersome, and costly peer-to-peer messaging
- Manual, time-consuming, paper-based processes
- Risk assessments often lack sufficient information; clearance processes subject to fraud
- The administrative cost of handling a container shipment is comparable to the cost of the actual physical transport

- Fast, secure access to end-to-end supply chain information; single source of the truth
- Verifiable authenticity and immutability of digital documents
- Trusted cross-organizational workflows
- Better risk assessments and fewer unnecessary interventions
- Far lower administrative expenses and elimination of costs to move physical paper across international borders

Source: https://www.ibm.com/blogs/blockchain/2018/01/digitizing-global-trade-maersk-ibm/



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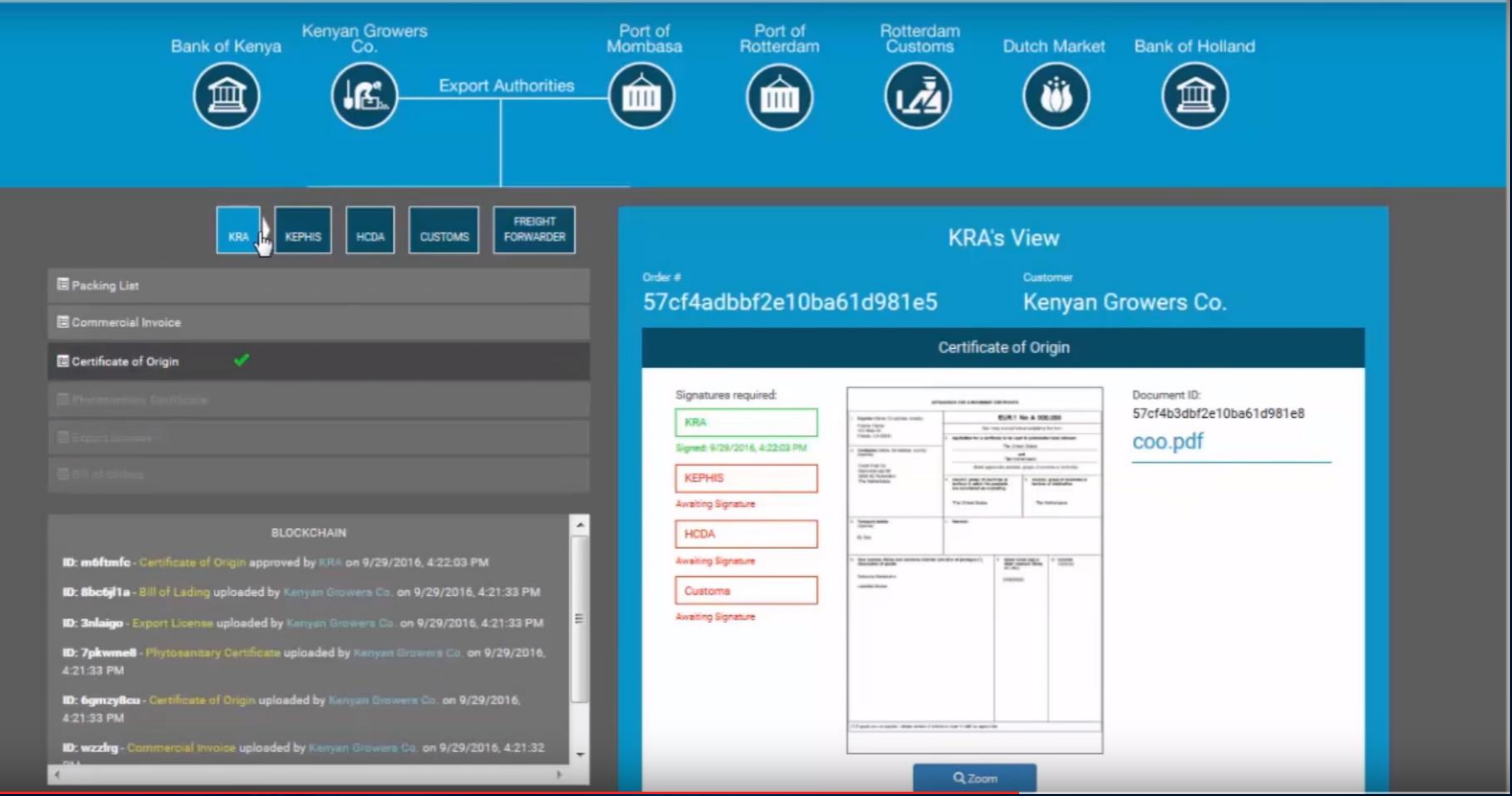


Source: IBM and Maersk Demo: Cross-Border Supply Chain Solution on Blockchain - https://youtu.be/tdhpYQCWnCw

MSKU0234214

959430256

Flower bulbs

40-Thermal Refrigerated/Heated
VGM: 1670 KG

Kenya	Warehouse Address	KEMBA	OMSLV	NLRTM	Netherland
		ARR 15-Feb-2016 23:00	ARR 22-Feb-2016 04:39	ARR 04-Mar-2016 13:01	
DEP 17-Feb-2017 04:52		DEP 25-Feb-2016 03:22	DEP 28-Feb-2016 15:43		

Container Type	Empty Container Picked Up	ETA empty container at warehouse	ATA empty container at warehouse	Verified Gross Ma
2017-02-20 14:34:42.0	2017-02-20 14:49:00.0	2017-02-20 14:51:57.0	2017-02-20 15:00:44.0	2017-02-20 15:03:

Kenya

Source: IBM and Maersk Demo: Cross-Border Supply Chain Solution on Blockchain- https://youtu.be/tdhpYQCWnCw

	23:00	04:39	13:01
DEP	17-Feb-2017 04:52	DEP 25-Feb-2016 03:22	DEP 28-Feb-2016 15:43

ıer at
ł4.0

Verified Gross Mass
2017-02-20 15:03:23.0

Container stuffed
2017-02-20 15:15:44.0

Estimated gate in
2017-02-20 15:25:59.0

Kenya

2017-02-20 13:03:04.0	Start Container Tracking		Damco
2017-02-20 13:06:49.0	Commercial invoice available	Commercial Invoice Available	
2017-02-20 13:07:11.0	Packing list available	Packaging List Available	
2017-02-20 14:28:15.0	Full container picked up from warehouse	BE-314-ZK	Damco
2017-02-20 14:31:07.0	Empty container ready for pick up		Damco

Source: IBM and Maersk Demo: Cross-Border Supply Chain Solution on Blockchain- https://youtu.be/tdhpYQCWnCw

2017-02-20 13:07:11.0	Packing list available	Packaging List Available	
2017-02-20 14:28:15.0	Full container picked up from warehouse	BE-314-ZK	
2017-02-20 14:31:07.0	Empty container ready for pick up		
2017-02-20 14:34:42.0	Container Type	40-Thermal Refrigerated/Heated	
2017-02-20 14:49:00.0	Empty Container Picked Up	AV-865-XV	
2017-02-20 14:51:57.0	ETA empty container at warehouse	2017-02-20 14:49:00	
2017-02-20 15:00:44.0	ATA empty container at warehouse	AV-865-XV	
2017-02-20 15:03:23.0	Verified Gross Mass	1670 KG	
2017-02-20 15:15:44.0	Container stuffed		

Source: IBM and Maersk Demo: Cross-Border Supply Chain Solution on Blockchain- https://youtu.be/tdhpYQCWnCw

 **Ports and Terminals**	**Provide** information about the disposition of shipments within the boundaries of the port / terminal **Benefit from** pre-built connections to shipping lines and other actors, end-to-end visibility across shipping corridors, and real-time access to more information to enrich port collaboration and improve terminal planning
 **Ocean Carriers**	**Provide** information about the disposition of shipments across the ocean leg **Benefit from** pre-built connections to customers and ports / terminals around the world and real-time access to end-to-end supply chain events
 **Customs Authorities**	**Provide** information about the export and import clearance status for shipments into and out of the country **Benefit from** more informed risk assessments, better information sharing, less manual paperwork, and easier connections to national single window platforms
 **Freight Forwarders / 3PL**	**Provide** the transportation plan, inland transportation events, information on intermodal handoffs, and document filings **Benefit from** pre-built connections to the ecosystem, improved tools for customs clearance brokerage function, and real-time access to the end–to-end supply chain data to improve effectiveness of track-and-trace tools
 **Intermodal Transport**	**Provide** information on the disposition of shipments carried on trucks, rail, barges, etc. **Benefit from** improved planning and utilization of assets (e.g., less queuing) given real-time access to end-to-end supply chain events for shipments
 **Shippers**	**Engage** with the solution as a consumer of the shipping information events and paperless trade capabilities **Benefit from** a streamlined and improved supply chain allowing for greater predictability, early notification of issues, full transparency to validate fees and surcharges, and less safety stock inventory

Source: https://www.ibm.com/blogs/blockchain/2018/01/digitizing-global-trade-maersk-ibm/

Walmart Use Case

Frank Yiannas – Vice President of Food Safety at Walmart

Walmart Use Case

- Tracking Mangoes – Frank Yiannas, Walmart's VP of Food Safety
  - Picked up a package of sliced mangoes and asked his team to find out where the mangoes came from. He set a timer.
  - It took his team six days, 18 hours and 26 minutes.
  - A week is a long time in the event of an outbreak of foodborne illness
  - Walmart would have had to pull every mango product off its shelves as a precaution
    - Walmart, farmers, and distributors would take the hit.
  - Yiannas was looking for a technology that can track and catalog a product's status across the supply chain.

Walmart Use Case

- Tracking Mangoes – Frank Yiannas, Walmart's VP of Food Safety
  - Walmart, like Maersk, teamed up with IBM for a trial run using the Hyperledger Fabric
    - Part of the Linux Foundation's Hyperledger group which is where some companies are collaborating on blockchain research and development.
  - Food shipments were then tracked and digitally recorded via a blockchain
  - Pallets of mangoes were tagged with numeric identifiers
  - Every time they crossed another checkpoint, the mangoes status was signed and logged.

Walmart Use Case

- In demo, Walmart would have access to all of a particular mangoes details from when it was harvested to when an importer received the shipment, when it passes Customs and Border Protection, entering a US processing plant where they were sliced to where they were taken for a particular store
- Can pull up safety inspection certificates
- All this took approximately two seconds
- Difference between 7 days and 2 seconds makes a serious difference
- Since last August, other Industries have gotten onboard such as Kroger, McCormick and Co., McLane Company, Driscoll's, Tyson Foods, Unilever, Nestle, Dole, and Golden State Foods and are part of IBM's Food Trust.

Blockchain's Popularity

- US Government (both Federal and States) Receptive to Blockchain
  - Dept. Homeland Security financing and testing blockchain initiatives
    - DHS and U.S. Customs working with Maersk and IBM on Hyperledger proof of concept
    - DHS exploring further development through investing in small companies by way of their Small Business Innovation Research projects
  - Delaware passed amendments to state law that permit right to trade stocks on a blockchain (July 2016)
  - Vermont enacted law on validity and admissibility of, and presumptions relating to, records created with blockchain technology (potential "block 1" issues) (June 2016)
    - Recorded first real estate deed on March 8, 2018.
  - Arizona enacted law affirming blockchain-secured signatures to be "electronic signatures," validating smart contracts (March 2017)
  - Florida legislature actively exploring ways for the state to be "blockchain friendly"
  - California has advanced a bill to allow companies to store data, including stock information, on blockchain (April 2018)

Blockchain's Popularity

- Large Global Governmental and Private Sector Interest in Blockchain
  - Commonwealth Bank of Australia, Wells Fargo & Co. and the trading firm Brighann Cotton shipped cotton as an experimental implementation of blockchain and smart contract technology in 2016.
  - The Danish Maritime Authority launches an innovative pilot project to examine the value of blockchain technology (May 2017)
  - The People's Bank of China has tested a blockchain-based digital currency, and begun pushing for blockchain securities rules and publishing research papers on its efforts. They are also rumored to be focusing on blockchain in its upcoming 5 year plan
  - Samsung SDS, the IT and tech provider for Samsung undertook a 7-month pilot of “Nexledger”, a blockchain project for Korea’s shipping & logistics industry, and is looking to expand their platform to cross-border trade.

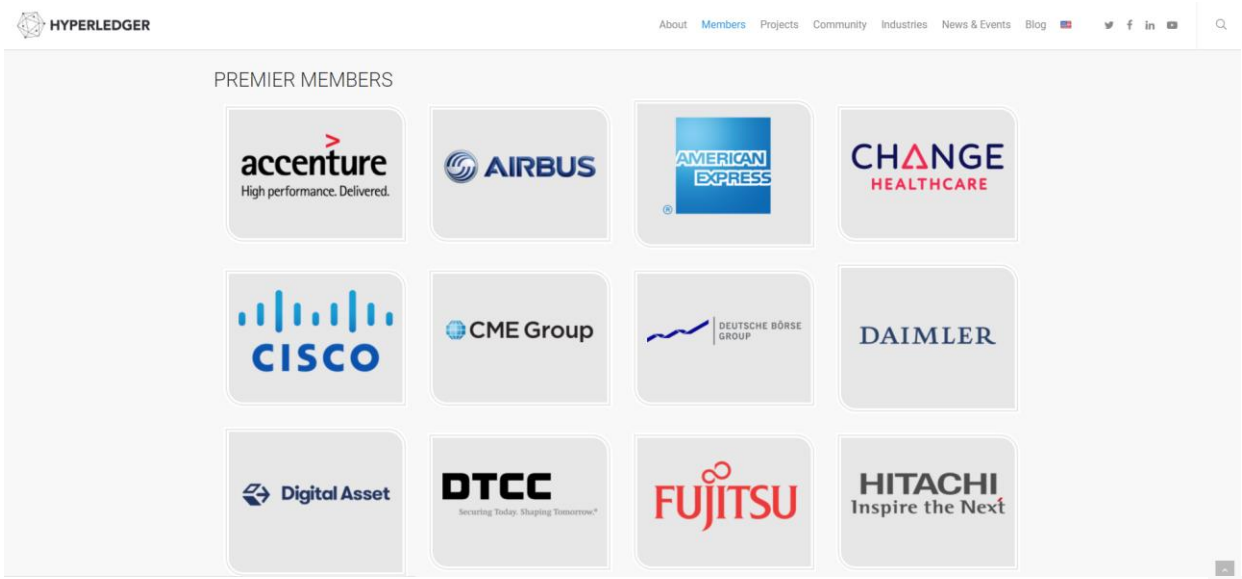
Blockchain's Popularity

- Large Global Governmental and Private Sector Interest in Blockchain
  - Hyundai Merchant Marine (HMM) completed their first pilot voyage in Sept. 2017 with reefer containers from Busan, Korea to Qingdao, China and plan another for Oct. 2017
  - Marine insurance is getting onboard. The first marine insurance blockchain platform was launched recently and includes Microsoft, MS Amlin, Willis Towers Watson, XL Catlin, AP-Moller-Maersk, and ACORD.
  - Numerous start-ups and established companies moving into the tracking of containers, and freight transportation via blockchain (T-Mining, BiTA …etc)
  - IBM/Hyperledger collaborators include London Stock Exchange, Bank of Tokyo, American Express, Accenture, Cisco, JP Morgan, SAP, and many others

"The Customs Administration of the Netherlands sees this data pipeline as a tool supporting the balance between trade facilitation and enforcement, where information sharing in supply chains is optimized from a commercial perspective, and government authorities can re-use that information flow for supervision purposes."

- Frank Heijmann, Head of Trade Relations, Customs Administration of the Netherlands.

IBM Hyperledger Collaborators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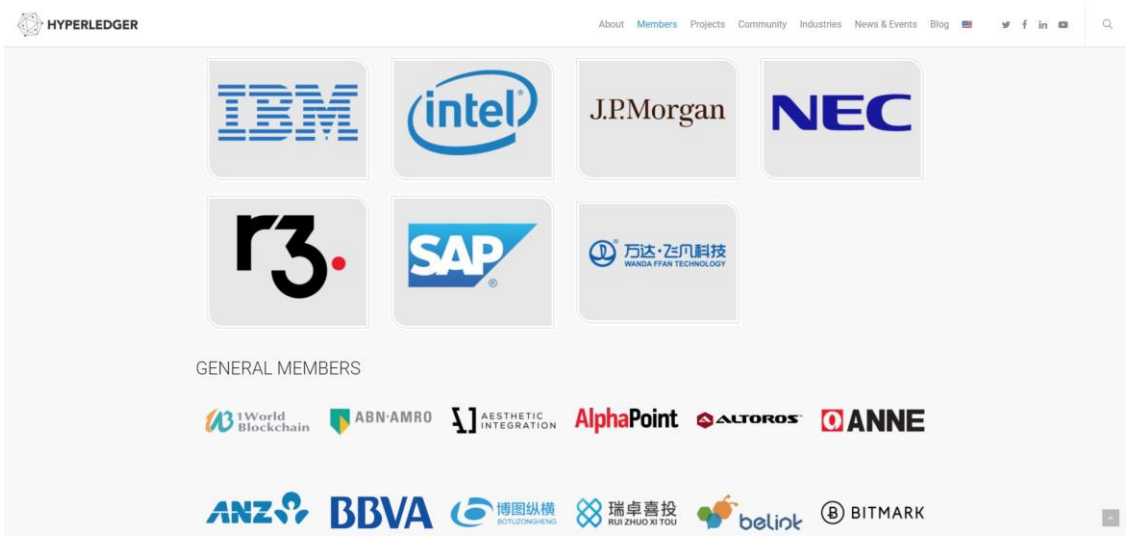
Inspire the Next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MonetaGo
ML
MOSCOW EXCHANGE
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京东物流 JD Logistics
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FREIGHT ROVER
ARGUS TRANSPORT CANADA
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CD CUSTOMS DIRECT
blockarray
UNIVAR
century
KSM KATZ SAPPER & MILLER
LIVINGSTON
MSTS
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Profit Tools Intermodal Trucking Optimized
IMC
SCOPELITIS GARVIN LIGHT HANSON & FEARY
TRINITY LOGISTICS TEAM MEMBER OWNED
ARCHER ATLANTIC GLOBAL LOGISTICS
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IRVING TRANSPORTATION AND LOGISTICS DIVISION
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Arke technology
SHIPCHAIN
FORERUNNING YOUR CASH - NOW! SAINT JOHN CAPITAL
LOADBLOCK
EAGLE Transportation
TransLytix
Velocity TRANSPORT
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LOADDELIVERED

Potential Future Uses

- Cargo Applications - Smart/Blockchain Bills of Lading
  - Reduction of Paperwork; Ease of access –blockchain bills of lading so all parties can see the transfer of title, transmit necessary shipping documents
    - IBM & Maersk - Shipping
    - Barclays and Wave – Banking
    - Insurance Covers
    - Government inspections and recordation
    - Company stock information
  - Reduction of Costs
    - Reduction of man hours searching and verifying information
    - Reduction of courier costs alone have been substantial (Barclays)
  - Reduction in documentation errors – Information is available to all necessary parties; no need to play telephone
    - Proper weight certification (SOLAS compliant)
    - Correct cargo declaration
    - Release verification

Potential Future Uses

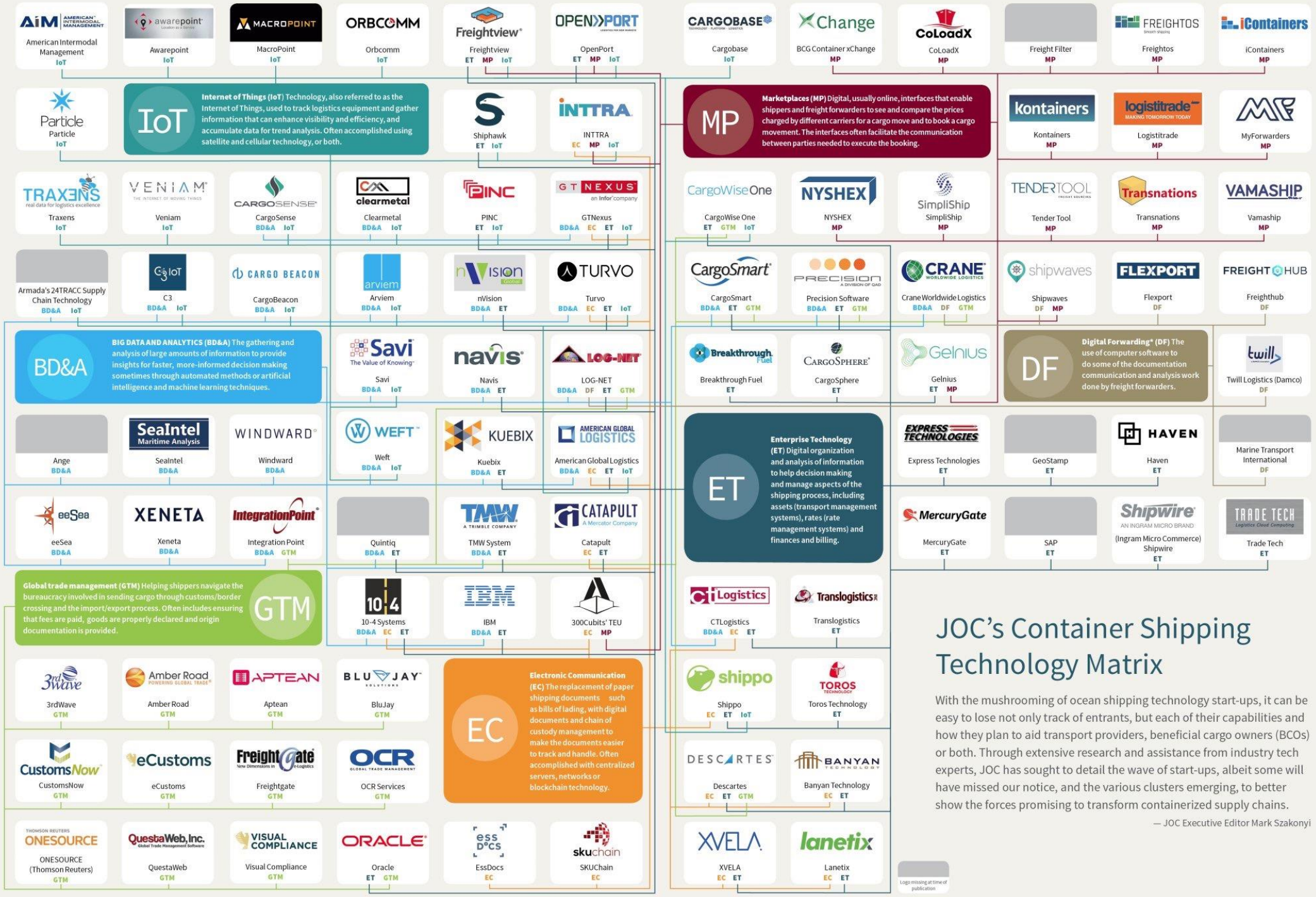
- Cargo Applications - Smart/Blockchain Bills of Lading
  - Reduction in time to complete transactions:
    - Oil cargo traded 3 times on the way from Africa to China and trade involved banks as well as an agent and an inspector, all performing their roles in the transaction directly on the platform. "All done in 25 mins compared to usual 3 hours."
  - Increased transparency
    - Cargo verification and proper declaration (Number of packages / hazardous)
    - Condition of cargo at various points in the shipment; goods inspection reports
  - Cargo Tracking
    - Real-time insurance premium adjustments
  - Smart Contracts

Potential Future Uses

- Insurance Applications
  - Parties have access to all necessary documentation
  - Real time vessel and container tracking
    - Risk of loss transfer timestamps
    - Real time insurance premium adjustments
    - Speed and fuel consumption considerations
    - Better access to collision data
  - Reduction in Letters of Indemnity
    - Lack of original bills, change of port ..etc
- Other
  - Ship registrations – Avoid Zombie Fleet
    - Ex. Republic of Congo, Federated States of Micronesia)

Potential Problems

- Practical implementation in a slow to change industry
  - Lack of proper back-end systems to feed into modern blockchain
  - Lack of motivation to change current systems
  - Lack of funds to make initial investment in new system
- Lack of platform dominance/current infrastructure
  - Hyperledger v. Ethereum vs. Corda vs. new entrants
  - Regulatory patchwork of governments and business
  - Consortiums working to solve this problem



JOC's Container Shipping Technology Matrix

With the mushrooming of ocean shipping technology start-ups, it can be easy to lose not only track of entrants, but each of their capabilities and how they plan to aid transport providers, beneficial cargo owners (BCOs) or both. Through extensive research and assistance from industry tech experts, JOC has sought to detail the wave of start-ups, albeit some will have missed our notice, and the various clusters emerging, to better show the forces promising to transform containerized supply chains.

— JOC Executive Editor Mark Szakonyi

Potential Problems

- Human error
  - Mistake on initial paperwork may be more difficult to correct if recognized later in the process
  - Releasing to wrong party
- 51 % Problem
  - More of an issue w/ small, private/permissioned groups
- Internet Access

Regulatory Issues

- A single distributed ledger utilized by multiple parties across borders brings increased regulatory implications
  - Regulators will likely seek access to a full blockchain and all of its information.
  - Parties must consider varying global data privacy standards.
  - OFAC, international data transfer protocols and all other applicable regulatory laws must also be considered
- What to do?
  - Create a solution where regulators only view relevant parts of a blockchain OR
  - Understand that if regulators have access to the full blockchain participating parties may be exposed to unintended foreign regulations and obligations.

Regulatory Issues Cont.

- With smart contracts, what should be regulated and how?
  - Who has the appropriate technical expertise?
    - Third party / Independent audit?
    - Regulator examination?
  - How will copies of the blockchain be kept internationally?
    - No uniform standard at present
      - Example - BIMCO
    - Permission for agencies to keep a "copy" of the blockchain
      - The whole blockchain?
      - Just a portion?
      - For how long?
    - Some government regulators require records to be maintained in a manner in which they can be converted into clearly legible paper form within a reasonable time

Legal Issues

- Smart Contracts
  - Meeting of the minds: Failure to incorporate all contingencies → what happens?
    - Ex. Weather delays, berth congestion, vessel damages dock, quarantine, *force majeure*, lien rights, demurrage
    - Difficult to cancel or modify; even by a judge
    - Difficulty inspecting code; will CS degree be necessary?
  - Contract architecture
    - Multiple independent smart contracts or one all encompassing smart contract and how will they work together?
    - Difficult to build in flexibility
    - Which terms and conditions will apply?
  - Explaining to Judges & Juries

Legal Issues

- No Legal Precedent on Blockchain , yet!
  - Cross-border data privacy issues must be taken into consideration
  - Important to consult with individuals with adequate legal and information technology backgrounds who can assist in pre-empting problems and provide clear guidance as problems arise
  - Fresh legal topic for courts to explore

Legal Issues – Rotterdam Rules

- Blockchain could be viewed as "negotiable electronic transport records" per Article 9 of the Rotterdam Rules, opening the door for this technology to be used for electronic bills of lading

Article 9
Procedures for use of negotiable electronic transport records

1. The use of negotiable electronic transport record shall be subject to procedures that provide for:
(a) The method for the issuance and the transfer of that record to an intended holder;
(b) An assurance that the negotiable electronic transport record retains its integrity;

(c) The manner in which the holder is able to demonstrate that it is the holder; and

(d) The manner of providing confirmation that delivery to the holder has been effected, or that, pursuant to articles 10, paragraph 2, or 47, subparagraphs 1 (a) (ii) and (c), the electronic transport record has ceased to have any effect or validity.

2. The procedures in paragraph 1 of this article shall be referred to in the contract particulars and be readily ascertainable.

Takeaways

- This is a rapidly evolving technology gaining rapid acceptance.
- It is being utilized in the shipping industry now.
- The Rotterdam Rules can be read to support it.
- It is the most secure record keeping system that we have to date, and it is adding tremendous efficiencies to global trade.
- Perfect vehicle for implementing standardization in coding and in contracts.

Additional Resources

- U.N. Convention on Contracts for the International Carriage of Goods Wholly or Partly by Sea (The Rotterdam Rules) (Vienna 2009).
- H.R. Rep. No. 115-115-596 at 201, *Chapter 9: Building a Secure Future, One Blockchain at a Time* (2018).
- Zhang, Wenbin, et al., *Blockchain/DLT: A game-changer in managing MNCs intercompany transactions*, IBM Financial Services Research Whitepaper (2017).
- Bana, Anurag & Viertmann, Maxine, *The not-so-distant future: Blockchain and the legal profession*, The International Bar Association Legal Policy & Research Unit (February, 2017).

QUESTIONS?

DANIEL S. MALAND, ESQ.

Kozyak Tropin Throckmorton, LLP
2525 Ponce de Leon Blvd., 9th Floor
Miami, Florida 33134
(305) 372-1800
www.kttlaw.com

PETER F. BLACK, ESQ.

Flynn, Delich & Wise LLP
1 World Trade Center, Ste. 1800
Long Beach, California 90831
(562) 435-2626
www.fdw-law.com