



August 4th, 2020

Introducing Blockchain

An Introduction to Blockchain
and its Potential Benefits



Purpose of This Session

- In this session, we will introduce blockchain and its potential benefits for airports
- Specifically we will:
 - Introduce blockchain and describe how it works
 - Describe key blockchain concepts
 - Describe potential benefits of blockchain
 - Identify some issues and challenges with blockchain
 - Provide a brief overview of some use cases

Blockchain is a Simple Idea with Profound Implications



Blockchain

A decentralized database structure that enables parties to transfer value without intermediaries or middlemen

Transaction Costs and Payments Management

Blockchain dramatically reduces the cost of transferring assets while reducing fraud, theft, and hacking

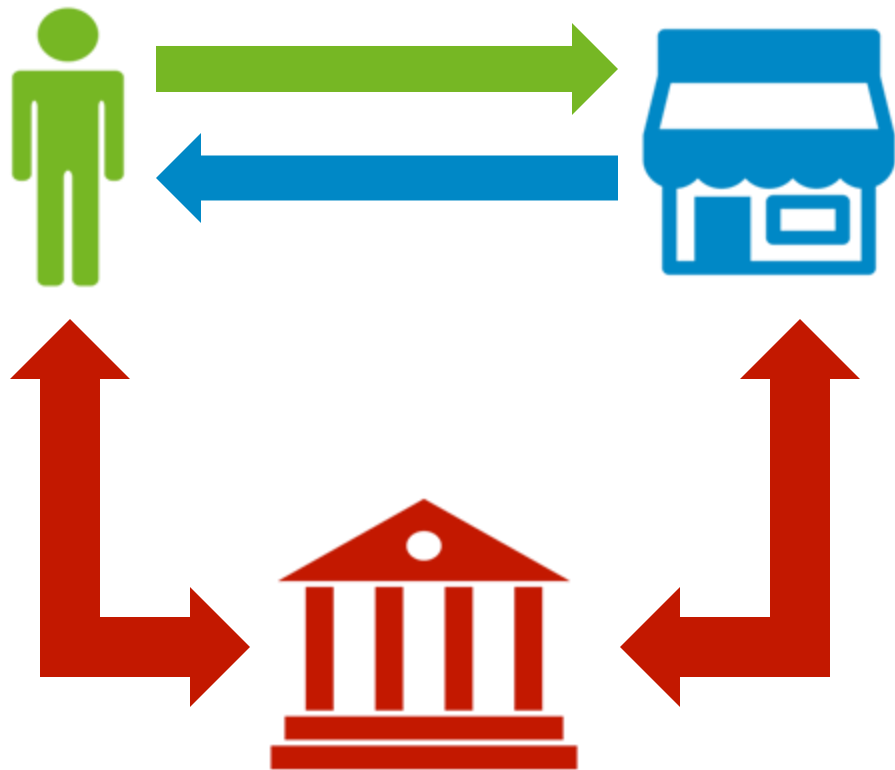
Privacy and Data Ownership

Blockchain gives individuals and organizations control over their data, breaks the data monopolies, eliminates data brokers, and creates transparency and auditability

New Business Models

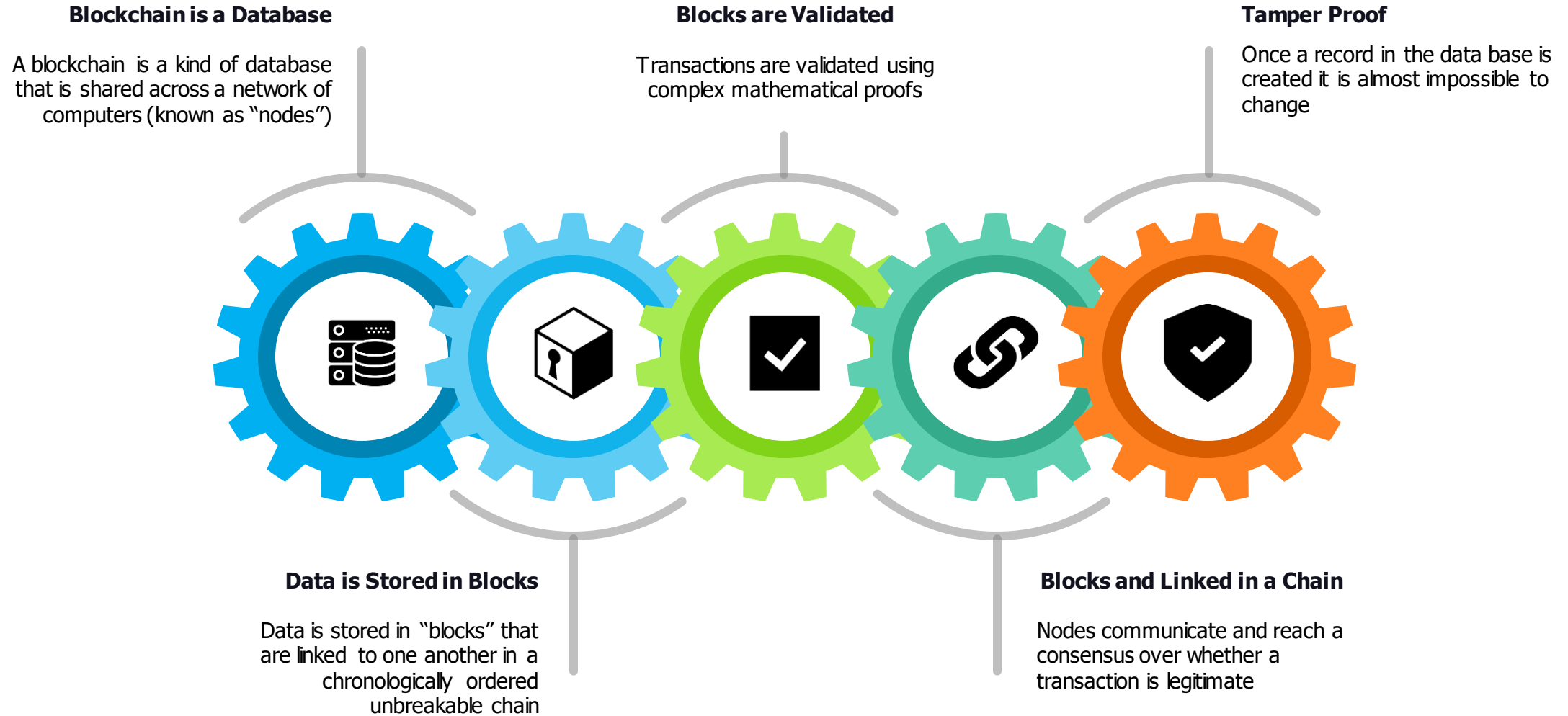
Blockchain allows previously competitive parties to cooperate in new business models while protecting data and IP assets and creating new incentive systems

The Traditional Exchange Model (TEM)

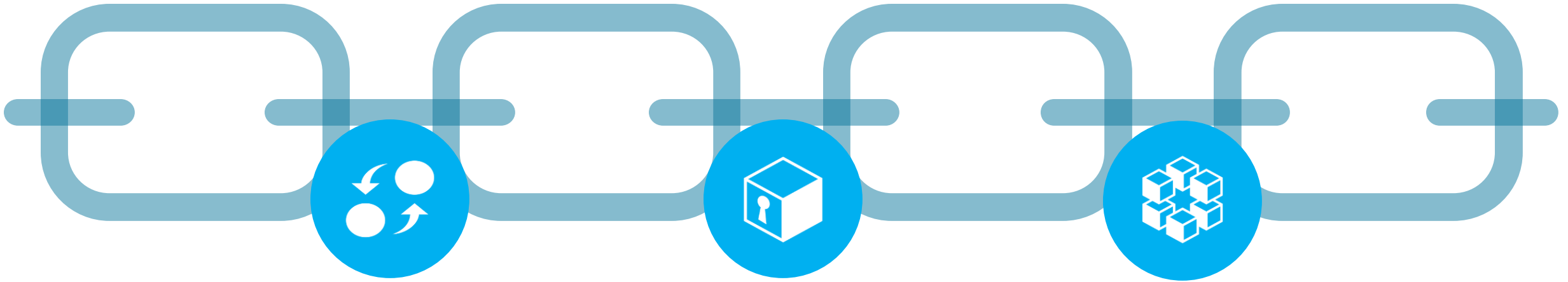


- All transactions or value exchanges (**i.e., any exchange of something of value – money, securities, data, access rights, ownership, and data access**) must go through a middleman or intermediary when parties do not trust each other (known as **“trustless parties”**)
- So what is wrong with that?
 - ✓ Cost and time involved in processing
 - ✓ Multiple ledgers inevitably become desynchronized – this leads to time and cost to reconcile
 - ✓ Creates **“honey pot”** for hackers and fraudsters
 - ✓ Fails if parties don’t trust the middleman or each other
 - ✓ Middlemen, data platforms, and data brokers control valuable data

What is Blockchain?



Basic Concepts



Transaction

- Any exchange of value
- Uses public-private key encryption just like conventional online transactions

Block

- A block is a data structure that contains data about many transactions (e.g., 500 transactions in a bitcoin block)
- Blocks store information about transactions like the date, time, and dollar amount of a transaction
- Blocks store information that distinguishes them from other blocks by using a unique code called a "hash"

Blockchain

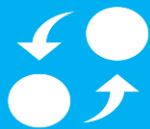
- A blockchain links the blocks together in a chronological sequence
- Each block is linked to the previous block in an unchangeable order
- There is no single blockchain – there are many blockchains (e.g., the Bitcoin blockchain, the Ethereum blockchain, the Hyperledger Fabric blockchain)

How Does Blockchain Work?

1

Transaction Occurs

- A transaction occurs and is digitally signed by both parties
- Transaction originators can be human or machine
- Parties to the transaction are "pseudo-anonymous"-they are identified only by their public key



2

Transaction is Validated

- The transaction is broadcast to the network
- The network uses a complex mathematical system to validate that it is legitimate
- Different blockchains use different rules to validate transactions



3

Consensus is Reached

- The network uses a variety of rules (depending on the blockchain) to come to a consensus that the transaction is legitimate



4

Transaction is Added to the Block

- If the network comes to a consensus that the transaction is complete, it is added to the current block
- The transaction is hashed and encrypted and can only be seen by using a private key



5

The Block is Added to the Chain

- Once the block is complete, it is added to the chain
- The contents of the blockchain cannot be changed without the nodes in the networks agreeing to alter the transaction



Other Key Concepts: Smart Contracts

What is a Smart Contract?



- A digital agreement is created and electronically signed



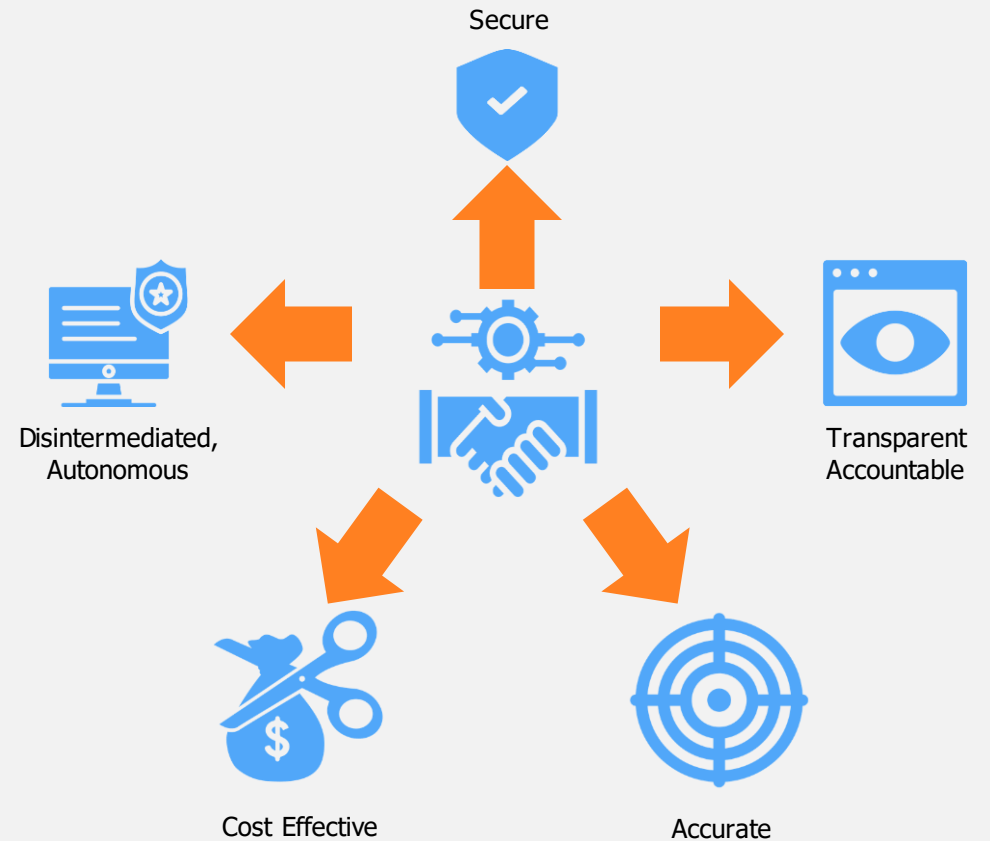
- The contract becomes embedded in a blockchain transaction



- A preidentified event triggers self-execution

Smart contracts are digital self-executing contracts stored on a blockchain. They are governed by the explicit terms and conditions laid out within them. They can facilitate the exchange of anything of value and by establishing self-executing rules for the exchange.

What are the benefits of Smart Contracts?



Other Key Concepts: Tokens and Incentivization



Blockchain tokens or coins can be traded or used according to a set of rules established in smart contracts

Because of blockchain's unique characteristics, token ownership, circulation, and spending is controlled (e.g., double-spending is impossible) without an overall authority who can tamper with ledgers, manipulate value, and change the quantity or distribution of tokens



Currency

Tokens can be used as a payment system or alternative currency (e.g., Bitcoin) – values can be "stable" or variable



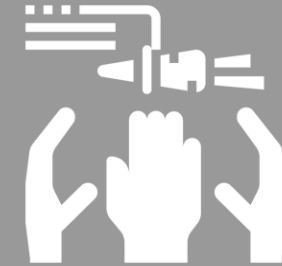
Investment

A token whose value is pegged to a commodity or currency that is used as an asset or investment



Utility

Tokens that are used to perform a function or access a service or good



When tokens are combined with smart contracts, they can create self-executing incentive and payments systems (e.g., "if Party A does X, they get 2 tokens")

These systems can be used to influence behavior and create new organizational and business models

Designing and understanding these systems is known as "cryptoeconomics"

Other Key Concepts: Public and Private Chains

Private

- Single Validator
- High-Trust Environments
- Not Decentralized
- Higher Throughput
- Selective Data Sharing
- Trusted Voting Systems



Pros:

- Provides efficiency and transaction privacy

Cons:

- A traditional centralized system with a degree of cryptographic auditability attached

Consortium

- Selected Validators
- Low-Trust Environments
- Partially Decentralized
- Higher Throughput
- Financial Settlement Platforms
- Supply Chain Finance



Pros:

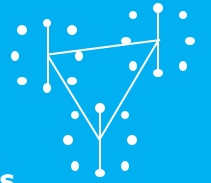
- Allows for greater efficiency - transactions are completed faster than on the public chain

Cons:

- Does not offer the same decentralized security as its public counterpart

Public

- Public Validators
- Trustless Environments
- Fully Decentralized
- Lower Throughput
- Digital Assets
- Very Secure Decentralized Ecosystems



Pros:

- Built-in economic incentives, flexibility, interoperability, and completely removes the need for a middleman

Cons:

- Throughput can be a challenge

Why is Blockchain Better than Current Data Systems?



Reduces Transaction Costs

- Eliminates middleman
- No reconciliation and easy audits
- Reduces fraud and theft



Improves Security and Eliminates "Honey Pots"

- Eliminates single data-rich target for hackers
- Large node networks are almost impossible to hack



Increases Trust Between All Parties

- Competitors can share information securely
- Individuals can share only the data they want/are legally required to



Eliminates Data Monopolies

- Organizations and individuals can share data or create IP and own them instead of data brokers or platforms



Create New Business Models and Incentive Systems

- Automatic incentive systems create new automated business models
- Dramatically reduces overhead in managing value transfers

Sample Impacts



Logistics:
Increases trust and auditability



Privacy:
Encourages individuals share information

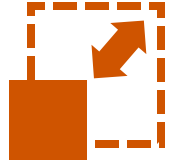


Legal and Contracts:
Automatic self-enforcing contracts can be created reducing costs



Payments and Finance:
Improves speed and tracking of payments and reduces costs

What are Some of the Issues With Blockchain?



Scalability

Many consensus algorithms (e.g., Proof-of-Work (PoW)) are not sustainable for a high volume of transaction



Latency

Current transaction speed and the time taken to resolve transactions represents a limit to adoption for some use cases



Privacy

Pseudonymity doesn't satisfy the privacy requirements for many use cases while permanent identity data storage may violate privacy regulations (e.g., GDPR)



Integration and Interoperability

Limited interoperability and integration between different blockchain protocols and with non-blockchain legacy systems makes implementation difficult



Governance Models

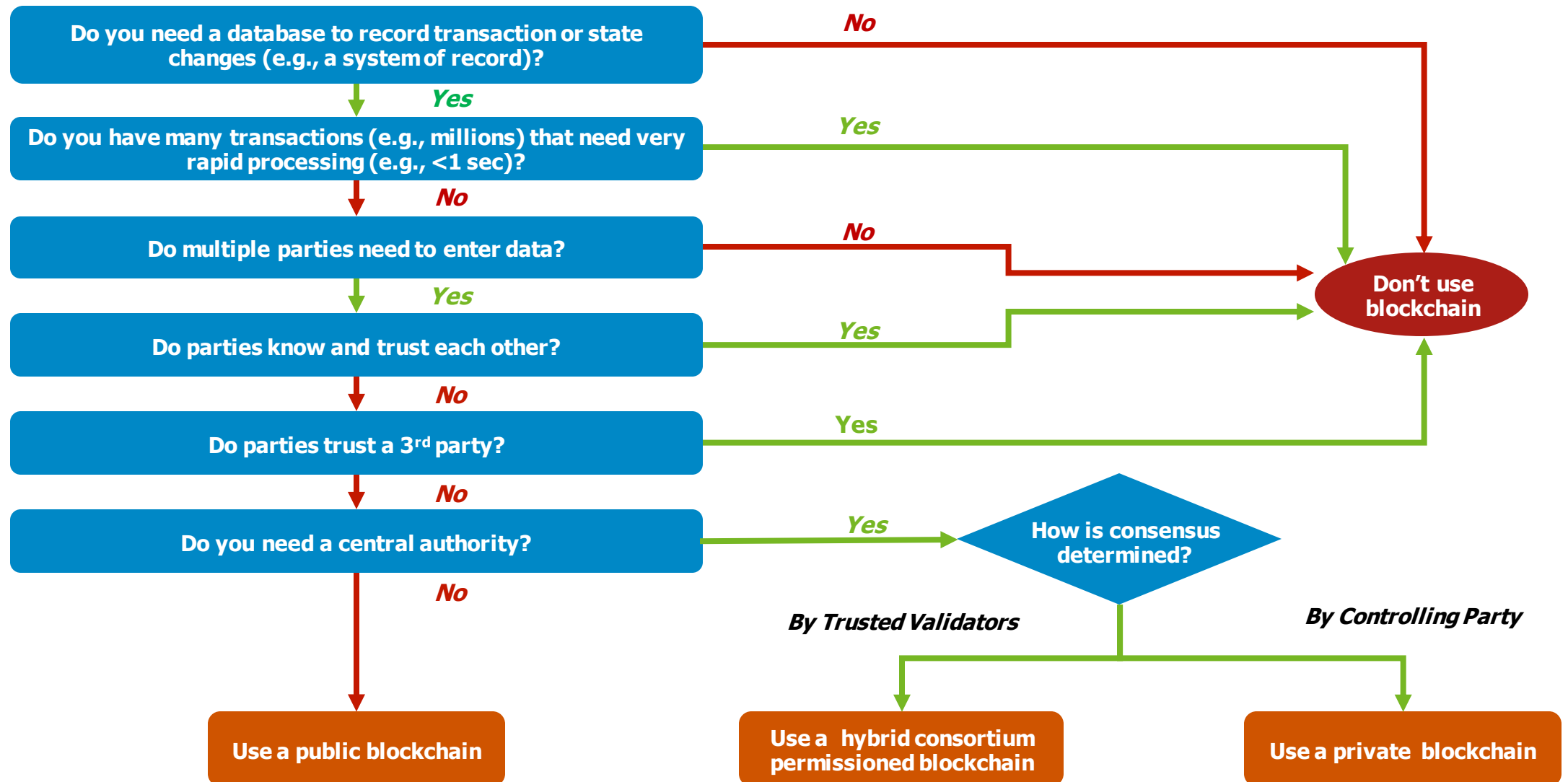
Blockchain requires new business models. Consortia require new governance models – these are difficult to gain agreement with internal and external stakeholders and may trigger additional regulatory oversight



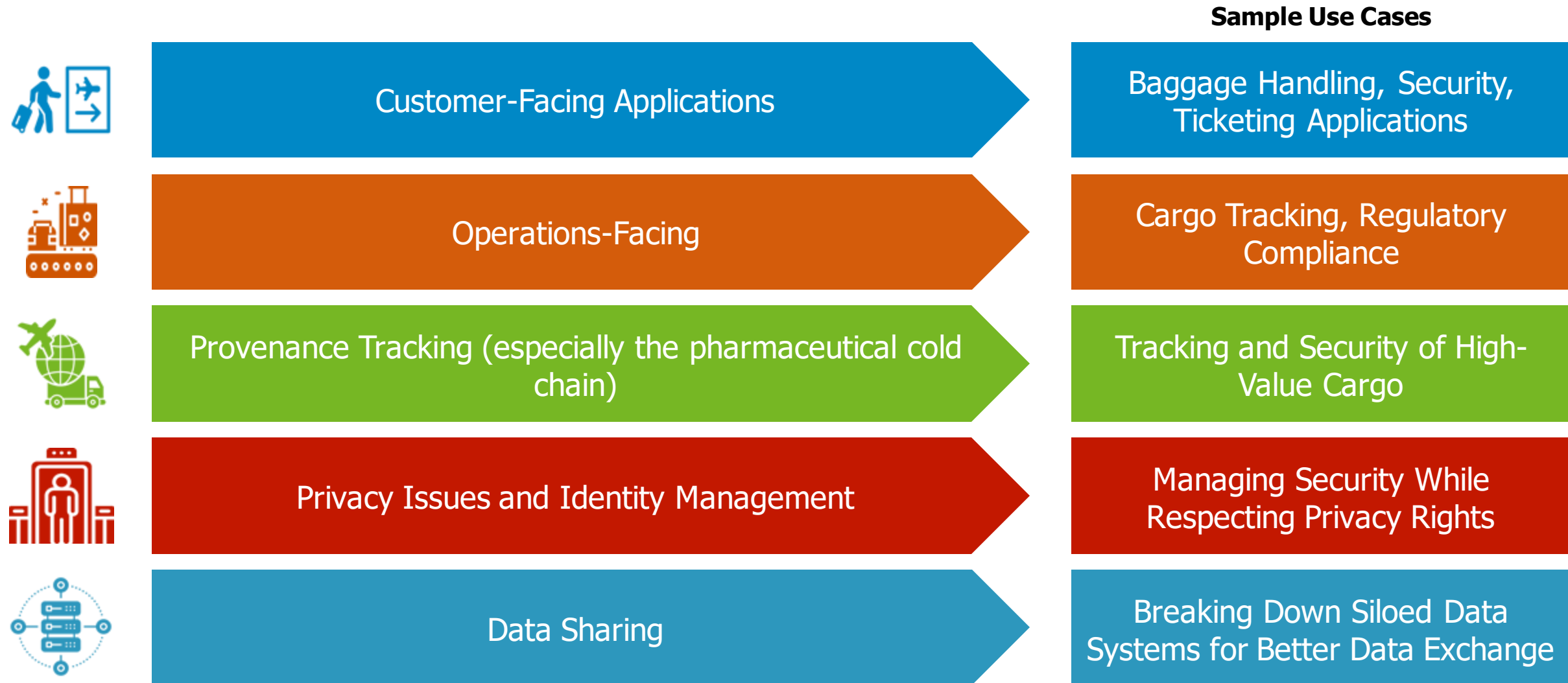
Regulations

The regulatory framework is still uncertain (e.g., privacy, financial issues), limiting institutional adoption

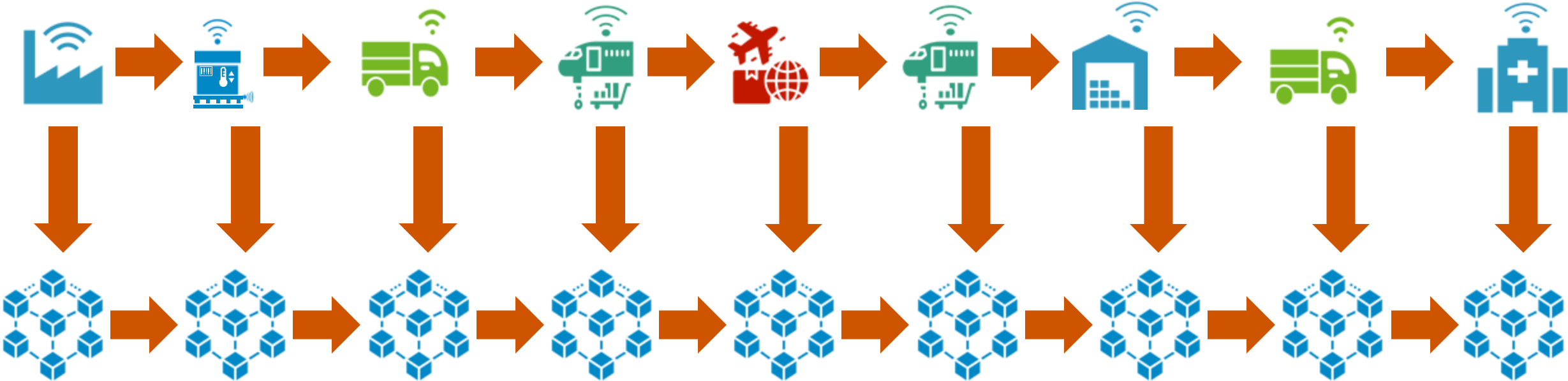
Should you Consider Blockchain?



Blockchain and Airports: Potential Use Cases



An Example of a Blockchain Use Case: Tracking Provenance



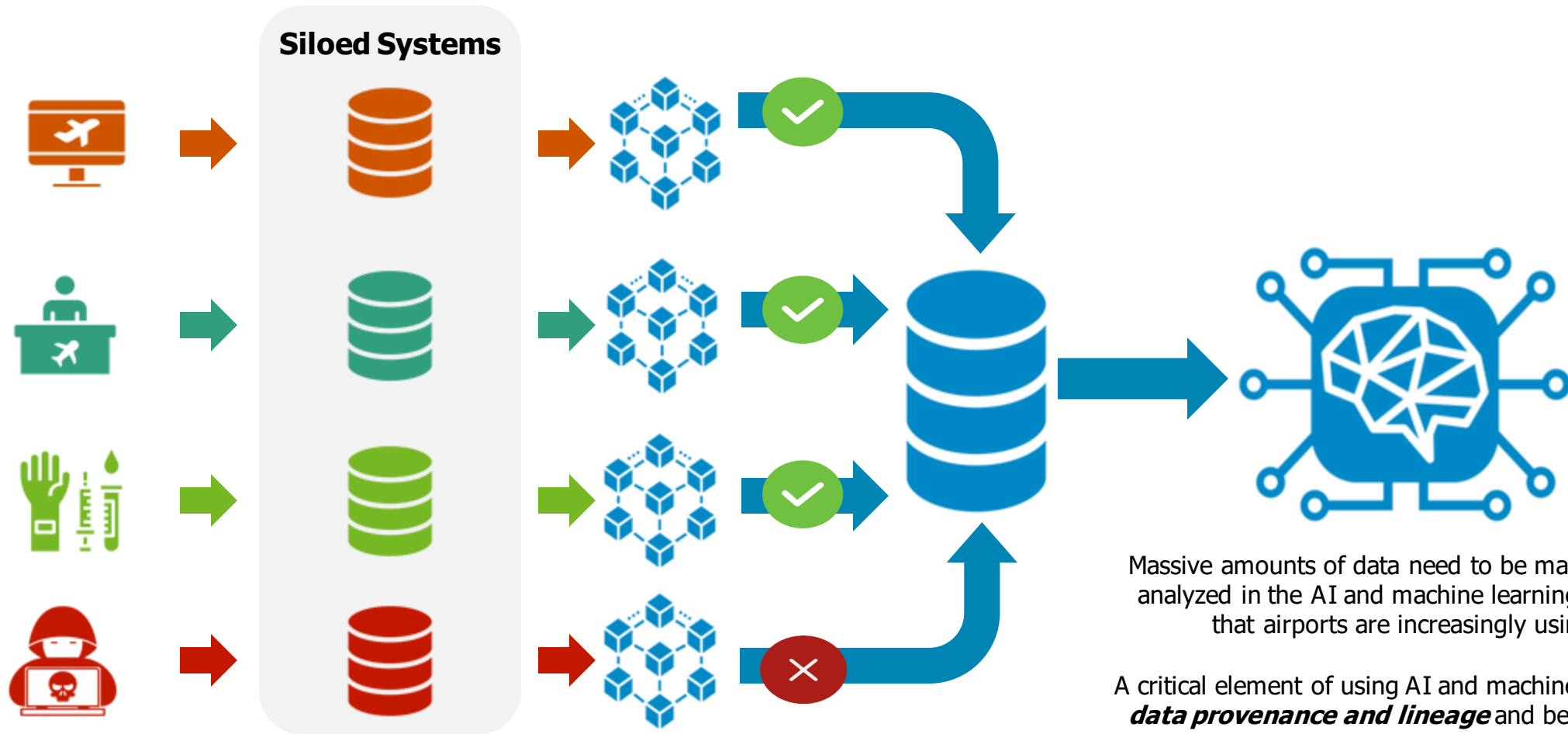
State-change data stored, secured, and tracked on a blockchain throughout the supply chain. Smart contracts notify all parties (e.g., manufacturers, shippers, regulators, and end recipient) of changes and if any issues arise (e.g., violation storage rules, unauthorized access and tampering)

Certificate of origin
Batch numbers
Order number
Bar code
Harmonized System (HS) code

← **Data Tracked and Recorded** →

Match supplier, order, invoice, shipment
Quality check against spec
Sensor data (e.g., temperature , weight)
Shipper staff identity
Pay shipper (as needed)

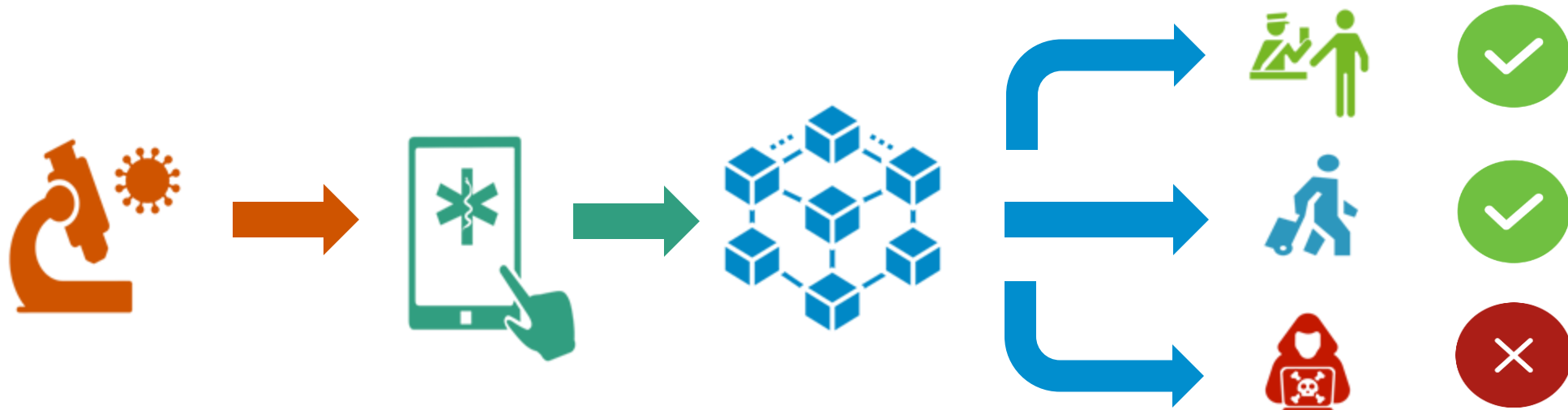
An Example of a Blockchain Use Case: Data Lineage and Provenance While Protecting Data Integrity



Massive amounts of data need to be managed and analyzed in the AI and machine learning systems that airports are increasingly using.

A critical element of using AI and machine learning is **data provenance and lineage** and being able to exclude unreliable or data with uncertain provenance.

An Example of a Blockchain Use Case: “Infection Passports”





- **Testing results can be stored and shared securely on the blockchain while protecting privacy and data rights**
- **Smart contracts can ensure that only authorized individuals can see data**
- **Individuals breaking quarantine regulation can be identified while protecting privacy**
- **Treatment and health records can be accessed securely with minimal delay and maintaining privacy rights**



Thank You

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