

Accounting requires counting

Use Cases for Distributed Ledgers in the Public Sector

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You get
what you measure

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Introductions



Hi, I'm Ryan Wold

I work as an Innovation Specialist in the Data Analytics Portfolio, within the GSA's Technology Transformation Services division.

I primarily support **Customer Experience** and am the product lead for **Touchpoints**, a tool to help federal agencies deliver better services through the collection, reporting, and synthesis of customer feedback data.

I am not using DLTs at work. I am using (and developing software with) blockchain technologies, as research. I have consulted on DLT projects prior to the GSA (2017).

Related to DLTs and blockchain, I'm particularly interested in: triple-entry accounting, state machines, and digital identity.



Hello REE Community

TECHNOLOGY
TRANSFORMATION
SERVICES



The REE (Research, Education, and Economics) Mission Area is dedicated to the creation of a safe, sustainable, competitive U.S. food and fiber **system** and strong, healthy communities, families, and youth through **integrated** research, analysis and education.

Today's agenda



Goals

- Provide a general introduction to **distributed ledger technologies**
- Highlight **valuable qualities of blockchain**
- Share examples of promising **public sector use cases**
- Encourage pragmatic **action to improve data management** in your work

Topics

- About distributed ledgers
 - What a blockchain is and is not
 - History
 - Bitcoin, Ethereum, Hyperledger, Corda
 - Public vs. private ledgers
- Value of the blockchain ledgers
 - What can ledgers do for me?
 - How will software products change?
- Use Cases
 - Financial management
 - Supply chain & logistics
 - Digital identity & signatures
- Taking action
 - Account for data
 - Seek continuous improvement
 - Communicate the coordination costs of duplicative data

What is a Distributed Ledger?

- A distributed ledger is a database that exists across several computing devices, or nodes.
- Each node replicates and saves a copy of the ledger.
- Things to keep in mind:
 - Metcalfe's Law: how distributed is the ledger? Where does value accrue?
 - Organizational
 - Governance body
 - Industry
 - Society
 - Where does trust reside? Where is it verified?
 - In the network? In the transaction? In the human interaction?
 - Costs associated with writing to the ledger

INTRODUCTION

Blockchain is a data structure



What is a blockchain?

- A blockchain is a data structure
 - A Block contains many Transactions
 - A Transaction has many inputs *and* outputs
 - Data is “hashed” to form a chain of signatures
 - The result is data immutability, meaning (very) difficult to change data
- “Consensus” refers to the method in which a distributed ledger agrees on valid transactions
 - Proof of Work
 - Proof of Stake
 - Proof of Authority
 - Learn more by search for “consensus algorithms”

History of DLTs and blockchains

- 1991 - Haber and Stornetta - *How to timestamp a digital document*
- 1998 - Nick Szabo, BitGold
- 2002 - Sarbanes-Oxley - WORM (write once read many) storage
- 2002 - Adam Back, *HashCash- A Denial of Service Counter-Measure*
- 2005 - Ian Grigg, *Triple-entry Accounting*
- 2008 - Satoshi Nakamoto - *Bitcoin: A Peer-to-Peer Electronic Cash System*
- 2013 - Vitalik Buterin - *Ethereum: A Next-Generation Smart Contract and Decentralized Application Platform*
- 2021 - Currently
 - More than 5,000 crypto-coin projects exist
 - Corporations are using DLTs, and investing in cryptocurrencies
 - Governments have started to use blockchain ledgers (US Treasury, HHS, and others)

What is a hash?

- A hash is value computed based on the value of *some data*
- Thus, hashes are unique, like a fingerprint (disclaimer: for foreseen intents and purposes)

INPUT	HASH
This is a test	C7BE1ED902FB8DD4D48997C6452F5D7E509FBCDBE2808B16BCF4EDCE4C07D14E
this is a test	2E99758548972A8E8822AD47FA1017FF72F06F3FF6A016851F45C398732BC50C

- Each block uses the hash of a previous block to ensure data integrity

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Blockchain is a tool,
not a solution

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Ledger is a tool,
not a solution

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What a DLT and blockchain is not:

The term “DLT” is often associated with the “blockchain”, which is also overloaded. “Blockchain” can become a catch-all term for a lot of organizational and industry-wide challenges, like:

- Solution to long-standing IT problems
- Solution to long-standing data problems
- Organizational transformation
- An integration solution within itself
- Innovation, disruption
- Solutions to global finance
- A blockchain is a DLT, but a DLT doesn't necessary use a blockchain
- A blockchain is not cryptocurrency, though currencies can be accounted for using a blockchain

How do people use distributed ledgers?

- Organizations use the ledger to track events and respond to them
 - This pattern is called an “Event Bus”
 - Applications can write events to the ledger directly, and those events are broadcasted to systems that choose to listen in (and can decode specific events)
- Individuals use digital wallets to transact with digital currencies
 - These wallets use cryptography to help secure information
 - Some wallets support many currencies
 - Also, multiple wallets typically exist for each ledger

Popular distributed ledgers today

- Bitcoin
 - Public chain
 - Fixed coin supply (21 million)
 - Supports a scripting language called Script, based on Forth
 - Proof of work
- Ethereum
 - Public chain
 - Non-fixed coin supply
 - Smart contracts often written in javascript
 - Proof of stake
- Hyperledger
 - Private, or “permissioned” blockchain
 - No currency
 - Supports chaincodes in different languages
 - Proof of authority
- Corda
 - Private, or “permissioned” blockchain
 - No currency
 - API support and its own design language
 - Proof of (whatever-you-choose)

WHY DOES BLOCKCHAIN MATTER?

Valuable qualities



What does blockchain ledger offer?

- Distributed data storage
- Distributed computation
- Security
- Verifiability
 - Auditability
- Legal standing - transactions are written with a digital signature (and identity)
- An alternative system where data is associated with value

How will blockchains change software products?

- Tokens - can be used to represent anything
 - Fungible tokens
 - Non-fungible tokens
- Exchanges - to transact in new forms of value
- Secure communications
- Own your data
- Privacy, but not necessarily anonymity
- More workflow applications (supply chain tracking)
 - Escrows / smart contracts / data brokers
- Micropayments - transact in small amounts, like .001 cents or less.
- Data feeds available globally allowing applications to “tune-in”

WHAT CAN BLOCKCHAIN DO FOR ME?

Public sector use cases



Promising public sector Use Cases

- Treasury
 - Grant tracking
- HHS
 - Asset tracking
- Industry
 - Logistics: production, distribution, shipping
 - Digital identity, health records
 - Stamps, notarization, licensing, deeds
 - Smart contracts: more fluid, liquid market instruments
 - Backoffice automation and data management
 - *A long tail of use cases, when anything can be tokenized (verifiably split and tracked)*

More promising public sector Use Cases

- Artificial Intelligence
- Analytics
- Data Governance / Data trusts
- Organizational accounting
- Funds disbursement
- Asset allocation and usage
- Land registries
- Business registries
- Software supply chain

Challenges so far

- Security and compliance for blockchain software
- Privacy questions (across time)
- Governance of networks
- Data standards across silos (department, agency, industry)
- Consumer adoption
- Too many blockchain options: No network effect

Possible applications for REE



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- [Agricultural Research Service](#)
- [Economic Research Service](#)
- [National Agricultural Statistics Service](#)
- [National Institute of Food and Agriculture](#)

Where does blockchain fit?

- Research
 - Data provenance
 - Data sourcing
 - Derivative data sets
 - Incentives for data producers
- Operations
 - Increased market visibility
 - Increased market responsiveness
 - Greater transparency and accountability

Taking action

Develop a data-centric perspective

- To balance out a user-centered perspective, think about the lifecycle of any given object

Balance a big vision with next steps

- Blockchain ledgers have big implications, and the way forward is small steps

Seek continuous improvement

- Many small changes can equate to large process improvements

Communicate the coordination costs of duplicative data

- Literally, a math problem. And, data is an asset; account for it.

CONNECTING THE DOTS

Whole systems concepts



Systems Concepts

- [Triple-entry accounting](#)
- [Value-streams](#)
- [REA - Resources Events Actors](#)
- [Event bus](#) - a stream of events that others can tune into
 - [Reactive programming](#) - responding to events
- [State machines](#)

Concepts to be aware of

- Coordination costs
- Are private ledgers intranets?
- Data security
- Data trusts
 - Anonymizing data
- Disintermediation - due to peer-to-peer capabilities

Other topics

- Transaction volume - how many transactions do you plan to do per day?
- Transaction costs - what is the cost of a single transaction?
- Private vs Public Networks
 - Network governance - who governs these networks? What is the cost? Value?
- The concept of money as a protocol

Thank you

ryan.wold@gsa.gov



WHAT'S ON YOUR MIND?

Questions



References

- GBA Blockchain Group
- TTS Cloud COE (Center of Excellence)
- <https://sciencedistributed.com/talk/f/advancing-health-research-with-blockchain---an-excerpt>
- [ACT-IAC Blockchain group](#)