



COLORADO

Chief Technology Office

Governor's Office of Information Technology

Blockchain Solutions for Water Governance



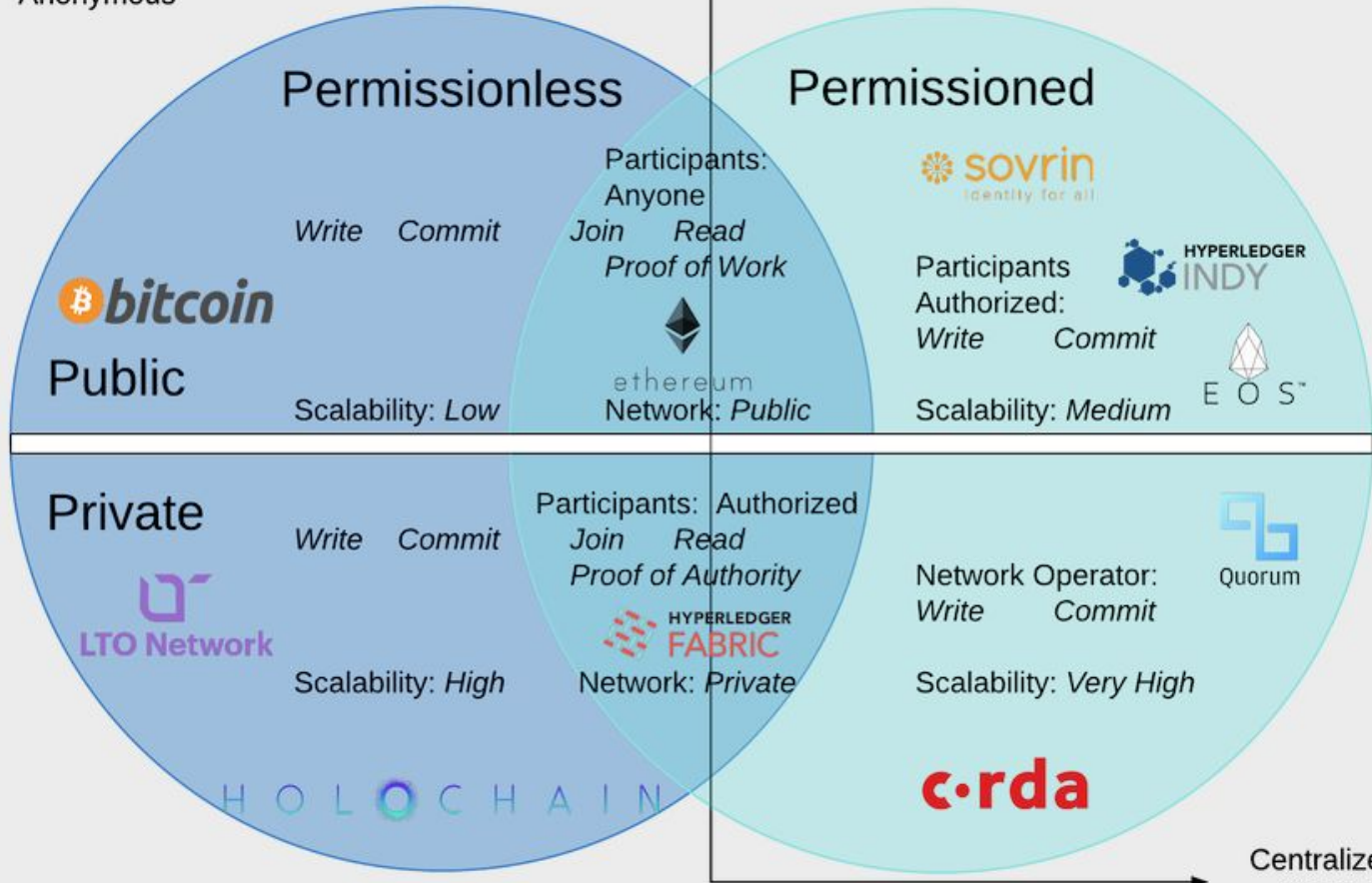
What's Blockchain?

Distributed Ledger Technology (“DLT”): a family of technologies that employs a shared database architecture to maintain multiple, identical copies of an auditable, up-to-date distributed or decentralized ledger of transactions or data.

Blockchain: a type of DLT and a method of organizing data in aggregated, ordered “blocks” that are “chained” together by a cryptographic hash function. New blocks are added to a blockchain after validation of the integrity of the blocks by a network of participants or “nodes” through a rules-based consensus mechanism. Blockchains are used to create and maintain a shared system of record and platform for tracking transactions or other data.



Decentralized
Anonymous



Centralized
Known



All Blockchains Need Nodes

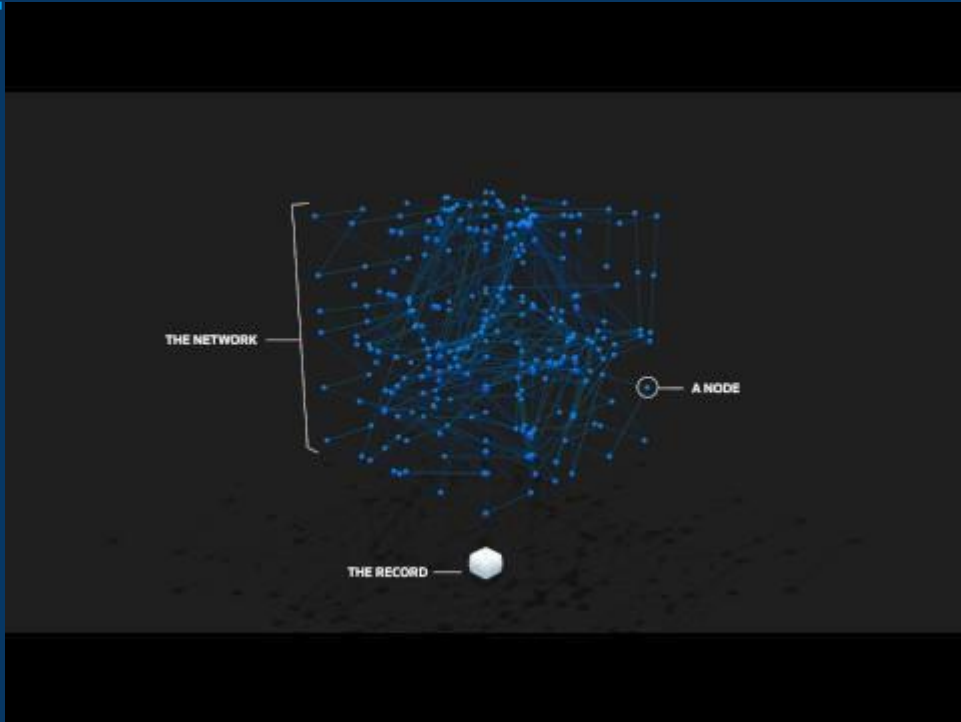
Nodes: Device that connects to a blockchain network to add or access data.

- a. **Full or Master Node:** maintains a complete copy of the blockchain ledger, participates in transaction confirmations, adds new blocks to the ledger.

- b. **Light Node:** connects to the network through full nodes to send and verify transactions and to request data. Maintains a local copy of the header data only.

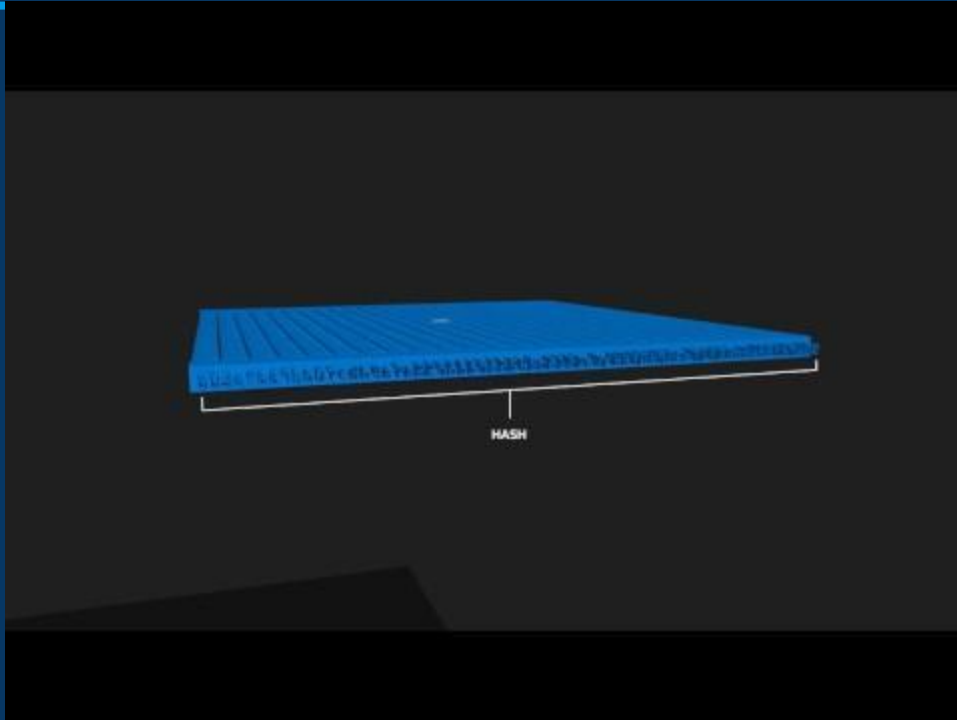


Nodes Confirm Transaction Details



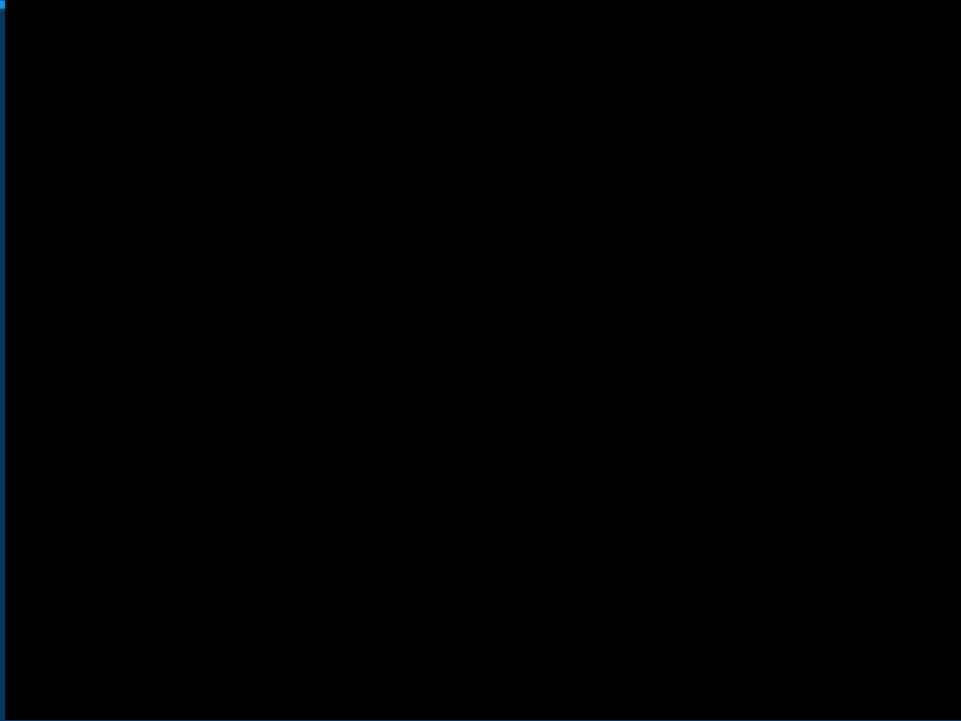


Transaction is Added to A Block & Joins Chain





Block Order Defined by Hash Codes





What's in it for Water?

Trusted digital access to secure, efficient, and accurate data - for Colorado's people, businesses, and agencies

- a. Solves for cross-agency data “ownership,” enables easy auditability, allows for baked in governance and automated workflows*.
- b. Encryption, redundancy, & hashing provide tamperproof security
- c. Standard API endpoints for existing, traditional, and mobile web apps
- d. Smart contracts, transaction bundling
- e. Run alongside existing apps to add value through security and trust
- f. Wherever fraud occurs, blockchain can help



Trusted Data for Informed Policy

DNR - Water Conservation Board & Div of Water Resources

Water Collection Monitoring and Reporting

- Transparent supply chain data - IoT reported - to inform real-time conservation decisions and long-term planning

Water Use Monitoring and Reporting

- Transparent usage data - IoT reported - transparency for customers, messaging for alerts, informed well permitting, water rights ownership

“Realtime transparent data on water quality and quantity could also inform conservation, dynamic pricing and trading, and identify illegal extraction or water tampering.” ~PwC, *Building Blockchains for a Better Planet*

Public Quality and Certification Data

CDPHE - Water Quality Control

Water Analysis Monitoring and Reporting

- Lab /IoT reported to blockchain - informs enforcement policy and provides public trust through data transparency
- Lab / IoT reported - Wastewater / Discharge pollutants to inform public and enforce regulations

Facilities Certifications

- Credentialing services for treatment plants, distribution systems, and wastewater collection systems



Water Rights and Trading

Places: Australia, New Zealand, South Africa, PRC, USA - California

IoT monitoring data and Smart Contracts used to de-risk and verify transactions

Stepped research approach:

- Map existing tx model and regs to DLT-based software model
- Determine Data ownership/access rules
- Economic and incentive model for consensus and consortium participation
- Define MVP, scope including data infrastructure & Off-grid applications
- C/B Analysis

WaterChain, Water Ledger, WaterIG, Blockchain Water : PwC, IBM, Deloitte

Private Sector BX Consortium

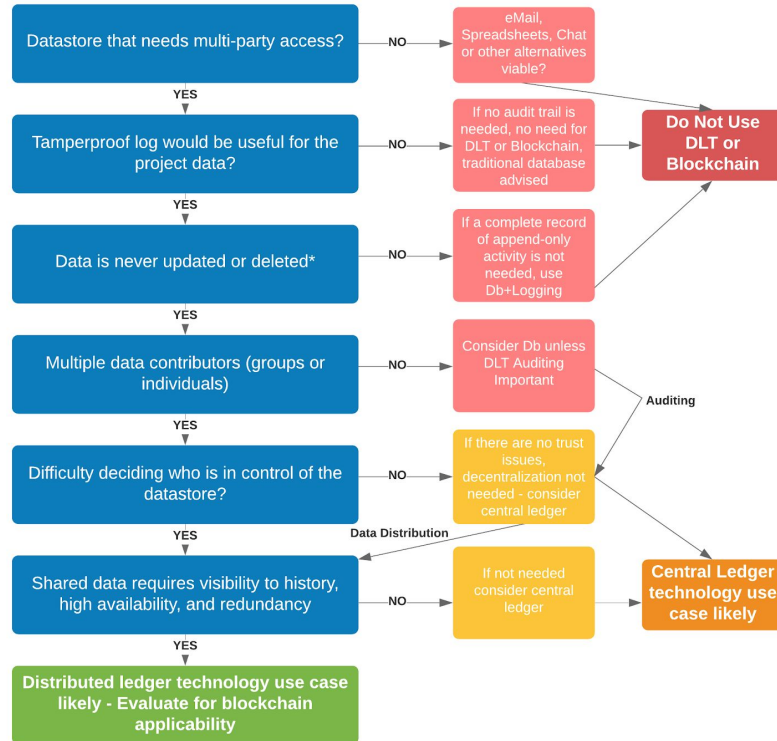
OOO Oil & Gas Blockchain Consortium

- Formed Feb 2019 - Chevron, ConocoPhillips, Exxon Mobil, Shell & Others to evaluate emerging tech solutions- first PoCis blockchain for water handling
- Data Gumbo contract for water handling in Bakken shale fields ND - Water haulage accounting, invoicing, payment automation, waste water disposal
- “We are expecting to save 25% in process costs related to salt water disposal” - *Equinor*



DLT_Decision_Tree

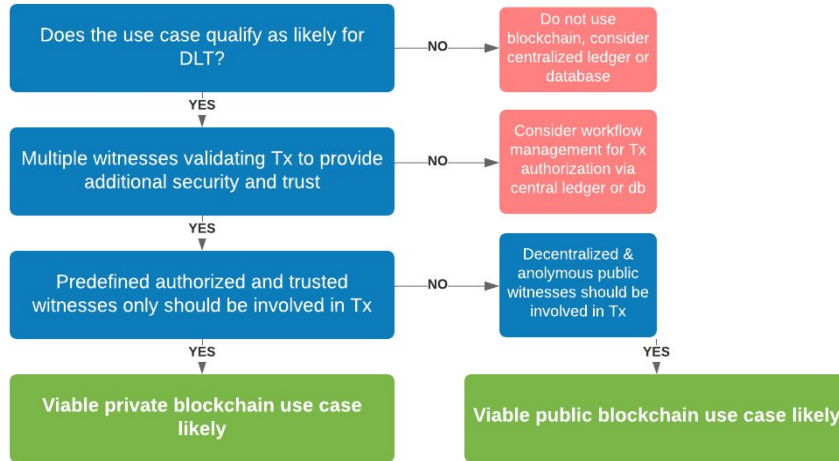
Thad Batt - OIT | September 9, 2019





Blockchain_Decision_Tree

Thad Batt - OIT | September 9, 2019





Blockchain has Issues

Scalability

- Choosing the right chainstack that's fit for purpose
- Right-sizing the network for transactional load
- Cost/benefit of encryption and proof system

Complexity

- Shield users through design thinking and UI/UX
- Taxonomy and requirements - Wallets, Key management



Blockchain Issues

Implementation

- Testing - Security and Load
- Costing - Dev and Hosting
- Assembling consortium

Processes and Skills

- Move to Modern DevSecOps, Automation, Containerization, and Cloud
- C++, C#, SQL, Java, Python, RoR, Solidity, Javascript, Typescript, Vyper, Php, Kotlin, Go, HTML+CSS, LevelDB, CouchDB



Web 3 - The Future will Happen

- Ubiquitous Internet - Mobile data availability - rural areas and remote communities - pushing 90% in CO - Also off-grid/edge-grid IoT model
- AI, Accessibility - APIs & UI/UX, iot, p2p, blockchain, dApps, crypto

Potential use cases in CO Gov are vast

- Modernization opportunities - replatforming, rebuilding, updating
- Provide people & business in the state with secure, efficient, and accurate interactions with government across all departments & agencies



Discussion & Resources

More than 35 Colorado-based companies focused on BX technologies!

Resources promoting the use and understanding of DLT and Blockchain

- [Colorado Blockchain](#) - Business, Students, Government supporting BX
- CO Blockchain Council - DORA, DOR, CDHE, OEDIT, OIT (CDA, DNR, CDPHE, HCPF, DOLA)
- [Government Blockchain Association](#)
- [Blockchain Training Alliance](#) - 12 people trained on BX architecture across OIT CTO & CISO offices.