



Blockchain

*fundamentals, evolution-history,
uses, application areas*



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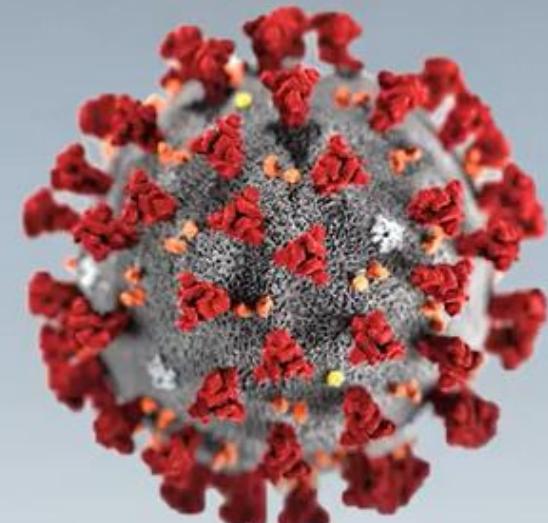




Oxford Nanopore
Sequence Virus Genome
in 7Hrs

Plotly, NVIDIA
Real-Time
Infection Rate Analysis

ORNL, Scripps
Screen
1B Drug Compounds in
1 Day vs 1 Year



Structura, NIH, UT Austin
CryoSPARC
1st 3D Structure of Virus Spike Protein



NIH, NVIDIA
AI COVID-19
Classification

Kiwibot
Robot Medical Supply
Delivery

Whiteboard Coordinator
AI Elevated Body Temp
Screening System

Containment

Mitigation

Treatment

Tracking & Monitoring



Agenda

- Database vs blockchain
- evolution of WWW – Web 3.0
- Blockchain fundamentals
- Evolution, history
- Uses, application areas

Blockchain Essentials

- [Day 1](#) - Blockchain fundamentals, evolution-history, uses, application areas
- [Day 2](#) - Concept of Public-Private key, Digital Signature and Hashing
- [Day 3](#) - Blockchain components, Blocks, transactions, DLT, mining, proof of work, consensus, mining, Public vs Private Blockchain
- [Day 4](#) - Introduction to Ethereum, Smart Contract, wallet, Solidity
- [Day 5](#) - Introduction to Decentralized Applications – DApps, Use Cases of blockchain

Several things you must know about Blockchain

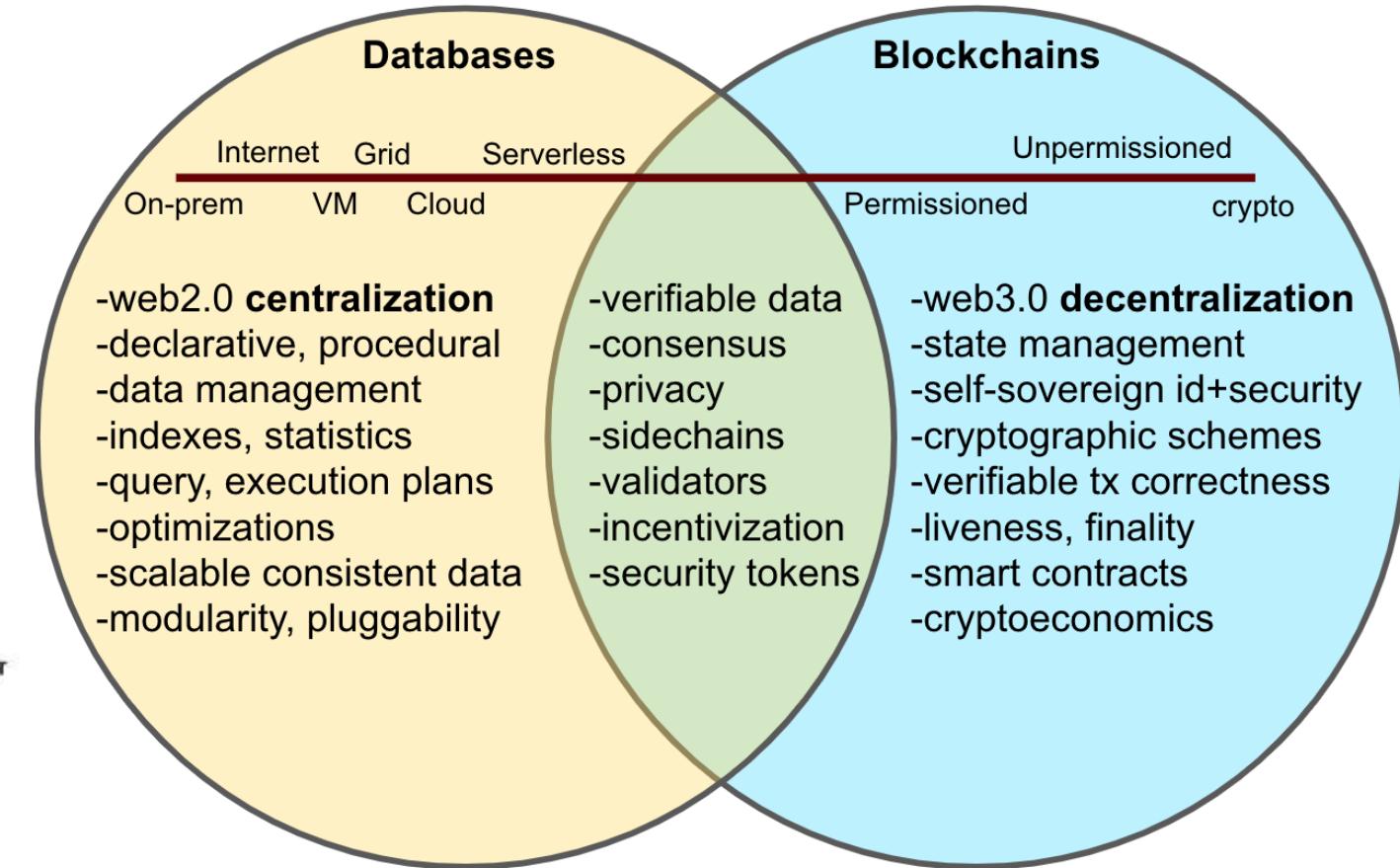
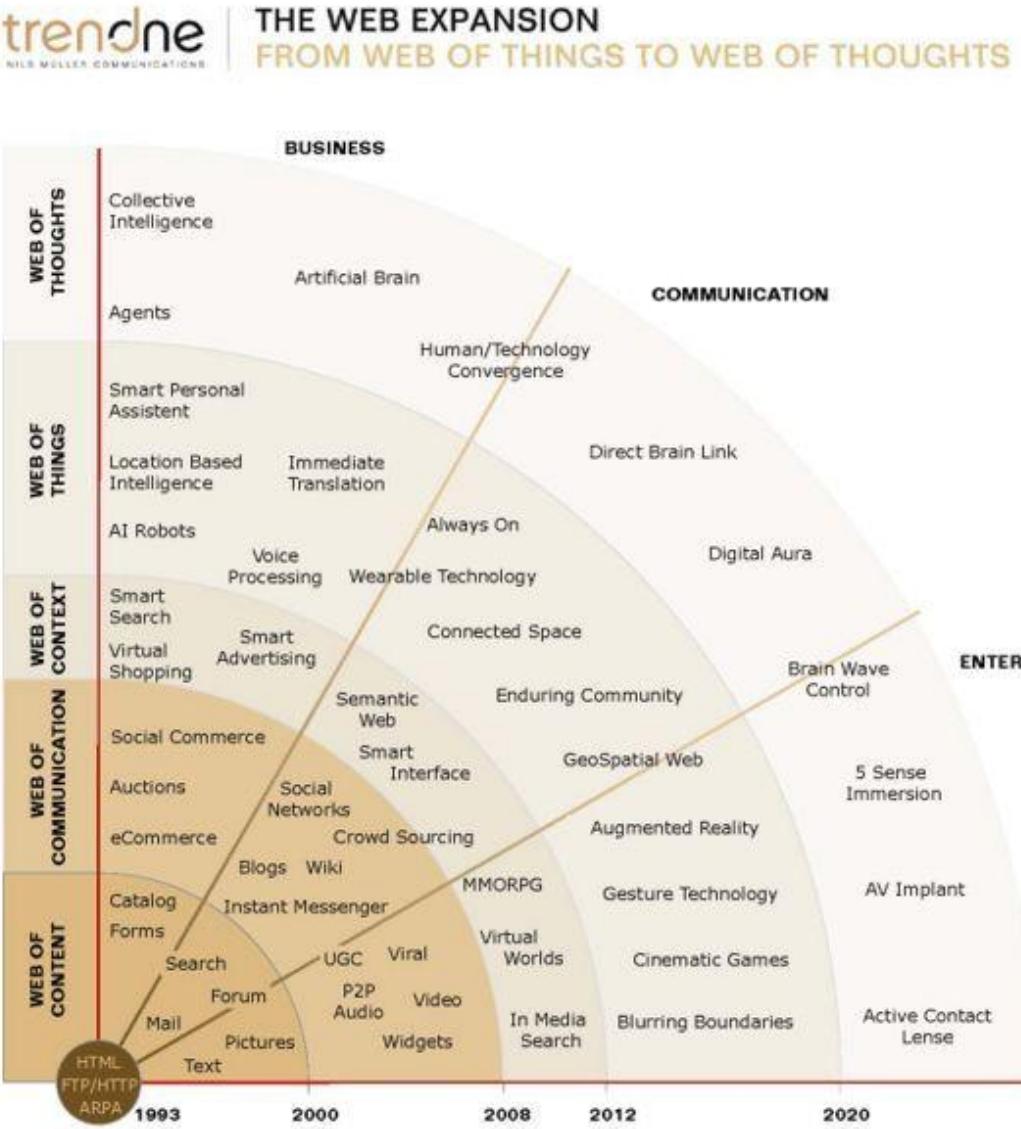


References

- Medium.com - Blockchain
- “*Blockchain Applications: A Hands-On Approach*”, Arshdeep Bahga, Vijay Madisetti
- Capgemini.com – Blockchain, databases vs blockchain
- consensys.net – Blockchain application areas, use-case
- flatworldbusiness.wordpress.com
- Evolution of the world wide web 1.0 to 4.0 aircmse.org - 3112ijwest01.pdf
- 101blockchains.com



Databases vs Blockchains





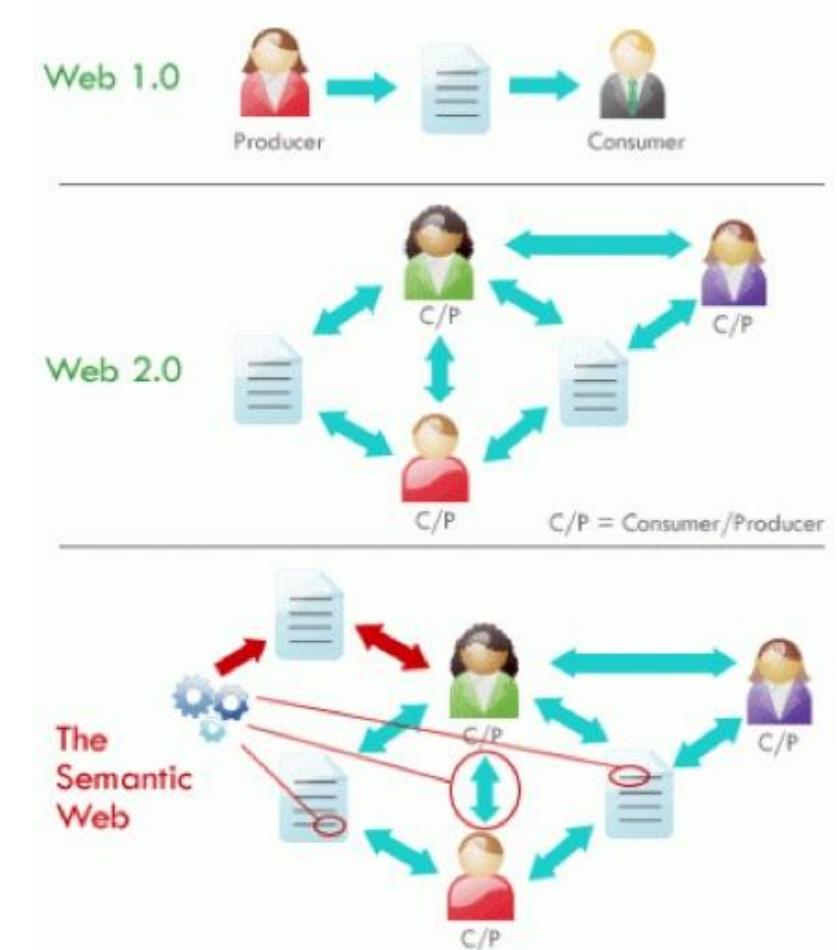
Database vs Blockchain

Blockchain	Database
No one is the admin or in-charge	Databases have admins & centralized control
Anyone can access (public) blockchain	Only entities with rights can access database
Anyone with right proof of work can write on blockchain	Only entities entitled to read or write can do so
Blockchains are slow	Databases are fast
History of records & ownership of digital records	No history of records & ownership of digital records
Append only	CRUD(create, read, update, delete)



Evolution of WWW

- Web 3.0 refers to a third generation of Internet-based services that collectively will allow the emergence of the intelligent **Semantic Web** (revolutionising knowledge discovery)
 - Ubiquitous
 - Individualized
 - Efficient
 - voice search
 - Linked data or hyperdata
 - Resource Description Framework
 - Web Ontology Language





Web 3.0 – from Database to Data**bank**

- Web 3.0 is more
 - connected,
 - open, and intelligent, with
 - semantic Web technologies,
 - distributed databases,
 - natural language processing,
 - machine learning,
 - machine reasoning, and
 - autonomous agents.

Web 1.0 / 2.0 / 3.0 Summary

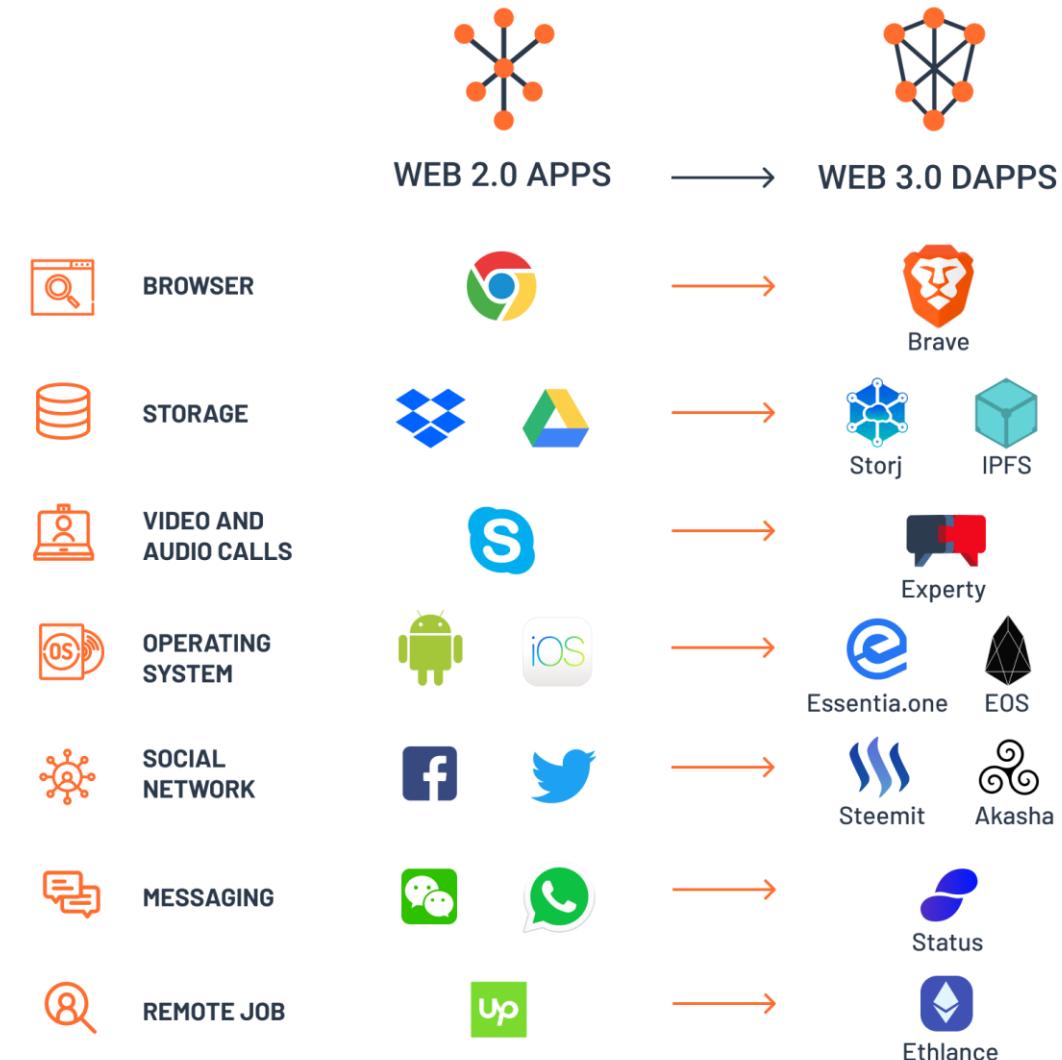
Crawl	Walk	Run
	Web 1.0	Web 2.0
Mostly Read-Only	Wildly Read-Write	Portable & Personal
Company Focus	Community Focus	Individual Focus
Home Pages	Blogs / Wikis	Lifestreams / Waves
Owning Content	Sharing Content	Consolidating Content
Web Forms	Web Applications	Smart Applications
Directories	Tagging	User Behavior
Page Views	Cost Per Click	User Engagement
Banner Advertising	Interactive Advertising	Behavioral Advertising
Britannica Online	Wikipedia	The Semantic Web
HTML / Portals	XML / RSS	RDF / RDFS / OWL



Web 3.0 – from Database to Data**bank**



- dApps – The Door To the Web 3.0
- Decentralized Social Network Web 3.0 Examples
 - Sapien, steemit, sola
- Decentralized Messenger
 - e-Chat, obsidian, ysign
- Decentralized Storage
 - Storj, Sia, Filecoin





✓ History Evolution

The image shows a Google search results page with the query "using blockchain". The results list various applications of blockchain technology. A blue rectangular callout box is positioned on the right side of the screen, containing the text "BaaS Blockchain as a Service".

using blockchain

using blockchain

using blockchain for voting

using blockchain to store data

using blockchain to protect personal data

using blockchain for data storage

using blockchain for identity management

using blockchain as a database

using blockchain for authentication

using blockchain for supply chain

using blockchain in healthcare

Google Search I'm Feeling Lucky

BaaS
Blockchain as a Service



Blockchain – *an introduction*

- Blockchain is a public ledger that automatically records and verifies transactions.
- This **Distributed Ledger Technology (DLT)** powers Bitcoin, Ethereum and other virtual currencies.
- Blockchain is game changer but not a silver bullet
- Blockchain is not magic, but it dramatically improves business processes rather **making transactions more secure and tamper-proof**.
- Increased Speed of Transactions

“Blockchain is an open, distributed ledger that can record transactions between two or more parties in a efficient, verifiable and permanent way”

-wiki



Blockchain – *History*

- History of cryptographically secured chain dates back 1991 (Stuart Haber and W. Scott Stornetta)
- The present Blockchain ecosystem was conceptualized by Satoshi Nakamoto in 2008



Satoshi Nakamoto



Stuart Haber

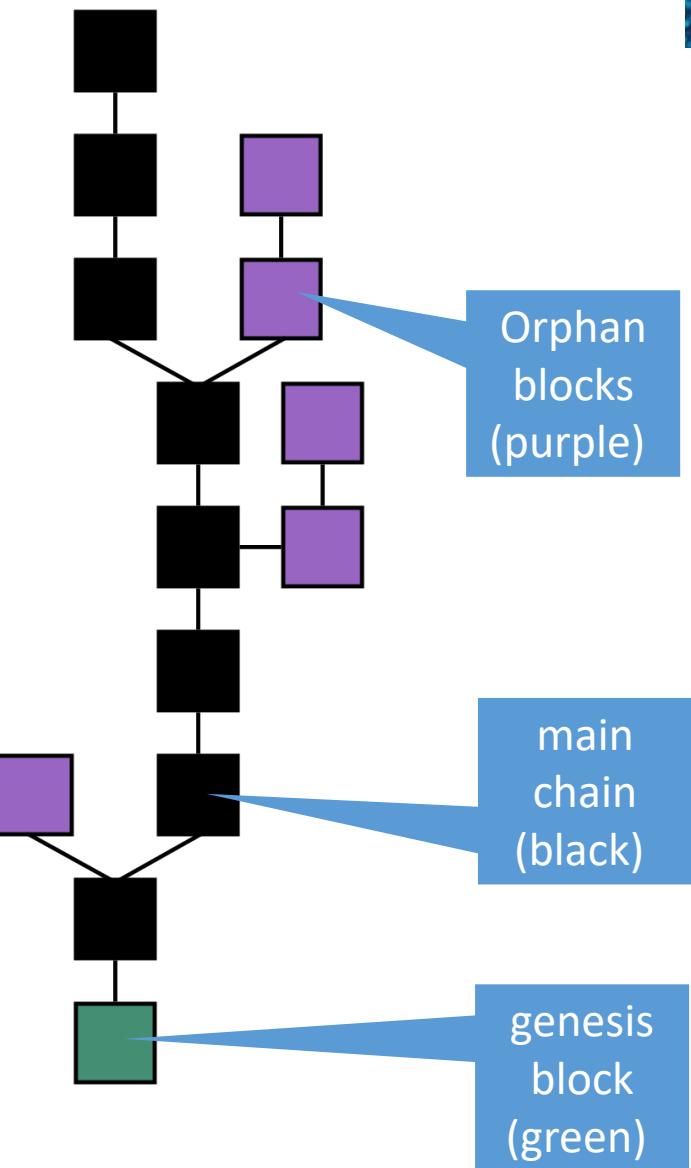


W. Scott Stornetta



Blockchain – *History*

- Main cause was to build secure public transaction ledger of the cryptocurrency bitcoin.
- Invention of the Blockchain for bitcoin solved the double-spending problem, for first digital currency.
- With Blockchain no central server or trusted authority is required.





What is Blockchain

- Blockchain technology comprises four main blocks that can lead to increased efficiency and cost reduction across the business network.

The features that make Blockchain trusted for business include :

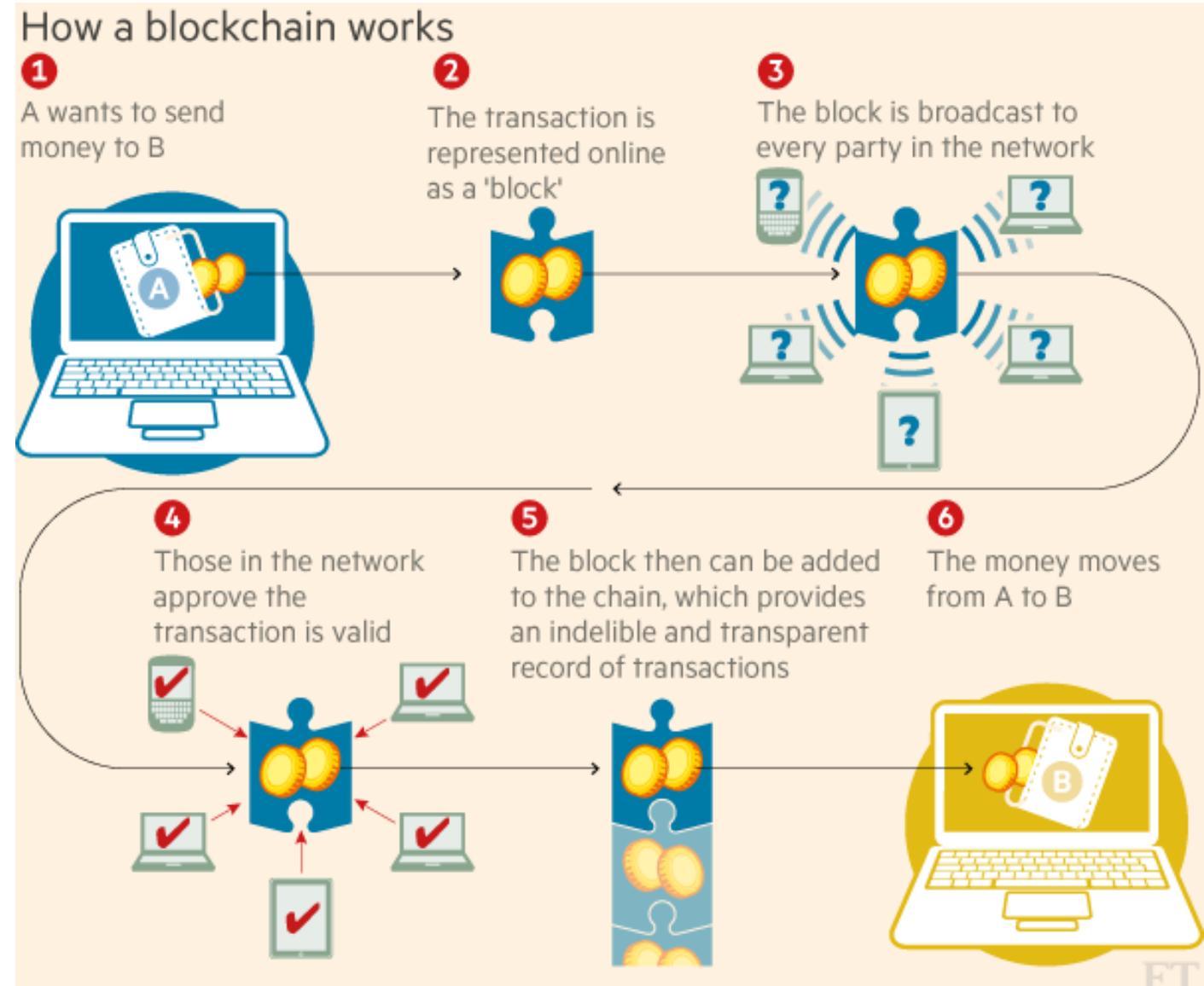
- ✓ **Consensus**, because all parties must agree to network verified transactions.
- ✓ **Immutability**, because anything written on the ledger cannot be altered.
- ✓ **Provenance (source)**, because there are records of where each asset has been.
- ✓ **Privacy**, because permissions & identity ensure appropriate visibility of transactions.



How Blockchain works



- Blockchain is a **decentralized database** shared among a network of computers, all of which must approve an exchange before it can be recorded.
- No need for a **trusted intermediary** like a bank
- Data is securely and transparently stored in a digital ledger across network





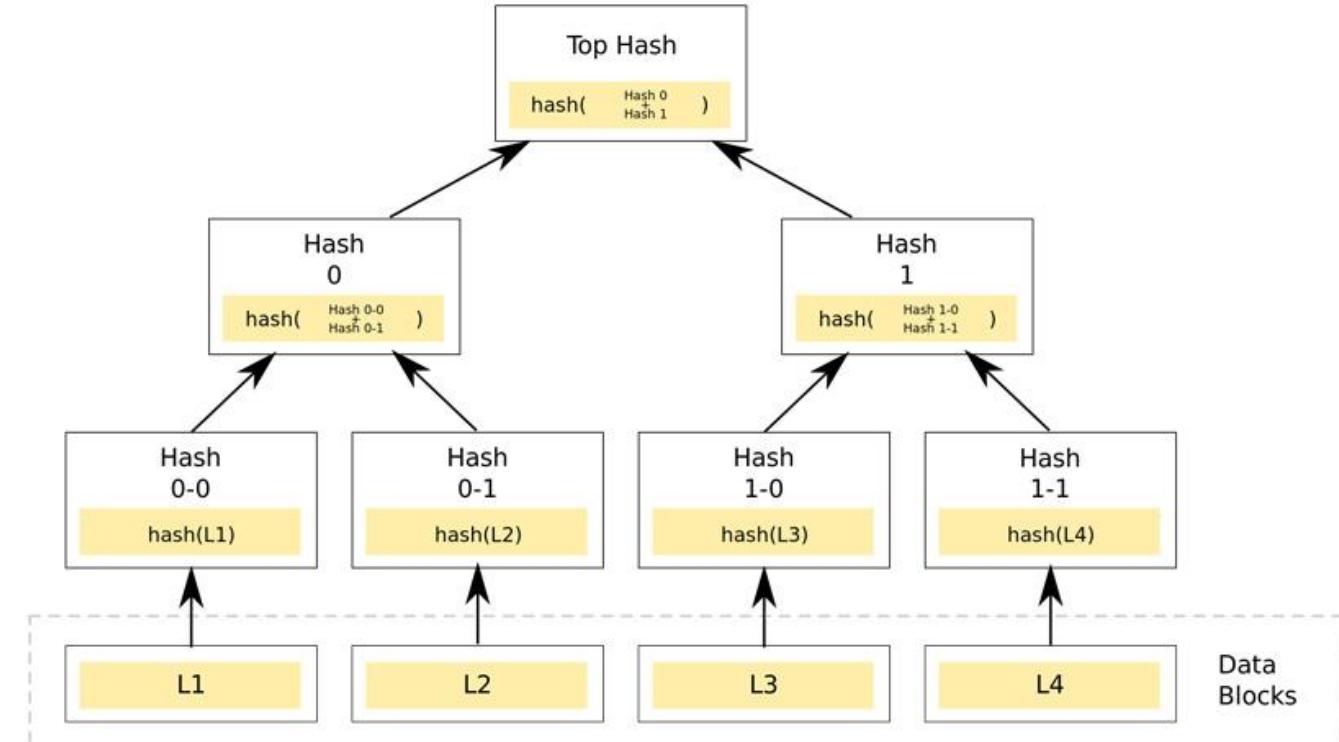
Blockchain - main goal

- To create an immutable public ledger to ensure integrity of transactions.
- The major classification is : public and private blockchain
- They both have similar characteristics whereas differ in their **application** and the **type of participation** they allow
- Public and private blockchains are both **decentralized, peer-to-peer networks** where each participant maintains a **replica** of a shared ledger that stores **digitally signed** transactions.
- ledger can **only be appended** to, but **not edited**



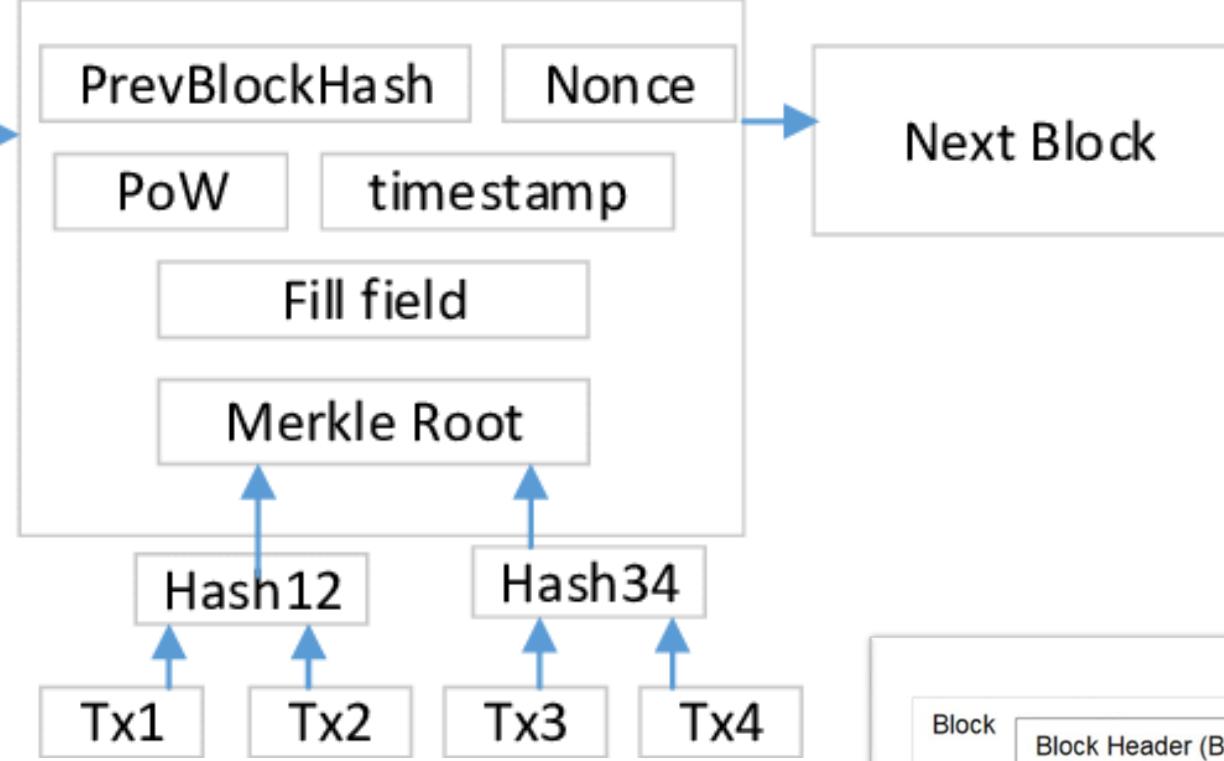
Merkle Trees and Merkle Proofs

- Named after Ralph Merkle, who patented the concept in 1979,
- Merkle trees fundamentally are data structure trees where each non-leaf node is a hash of its respective child nodes.
- The leaf nodes are the lowest tier of nodes in the tree.

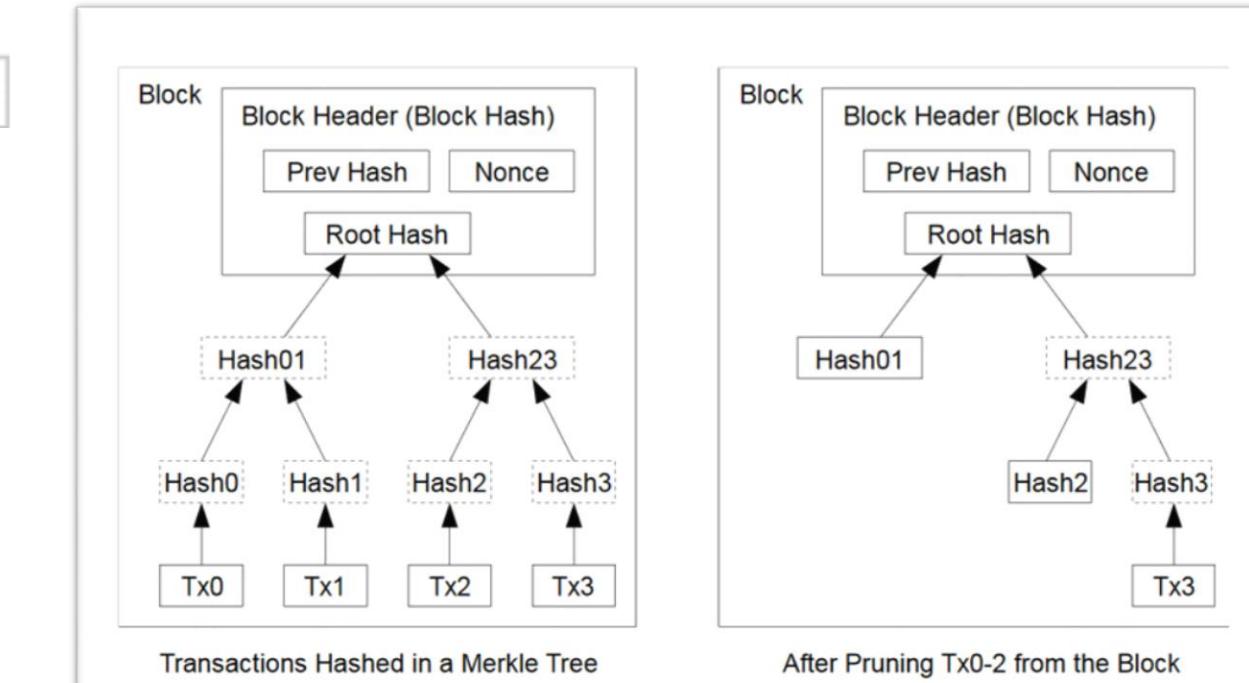




Previous Block



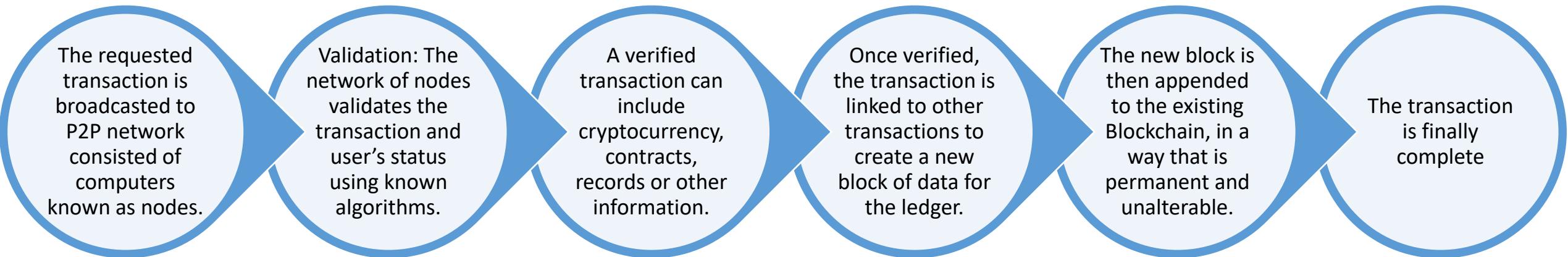
Next Block





Blockchain - working

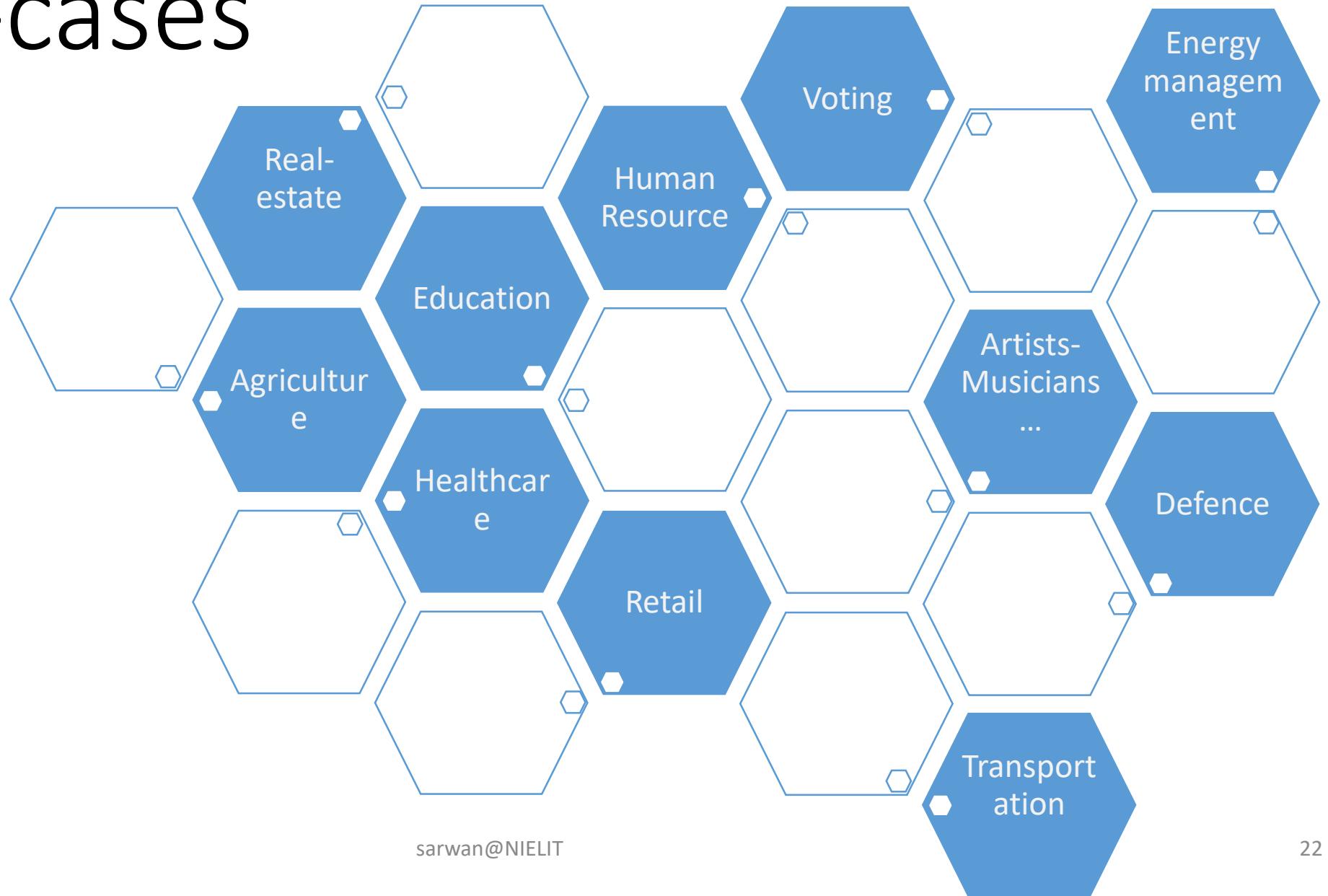
- Participants in a blockchain keep this ledger in sync through a **consensus protocol**.
- This creates a guarantee on the **immutability** of the ledger which cannot be corrupted even if there are some malicious participants on the blockchain.





✓ Use-cases

...Apart from
cryptocurrency





Blockchain/DLT use-cases

- *"Microsoft is working on using Blockchain to create a secure identity system"*
Preventing Human Trafficking.
 - 1.5 billion people (mostly in Asia-Africa) in the world have no formal ID
- *"Kimberley Process is hoping to use Blockchain to track where diamonds come from"*
- *"Everledger, is already using Blockchain to certify and track diamonds"*
Tracking blood diamonds.



Blockchain/DLT use-cases in Education

- “Academic credentials must be universally recognized and verifiable. In kindergarten, junior, secondary school verification of academic credentials remains largely a manual process and paper base. DLT solutions could streamline verification procedures and reduce fraudulent claims of unearned educational credits.”
- ✓ Transcripts –
MIT Media Lab collaborated [Blockcerts](#) toolset, which provides an open infrastructure for creating, issuing, viewing and verifying Blockchain-based certificates.
- “Indorse is using Blockchain to verify e-portfolios. Users upload claims with a link to verification and other users verify that claim.”
- ✓ Digital Badge
- “Sony Global Education developed a educational platform in partnership with IBM that uses Blockchain to secure and share student records.”
- ✓ Student Record

Pittinsky predicted, DLT may just be used as a directory rather than a data warehouse



Blockchain/DLT use-cases

- ✓ Infrastructure security
- “As schools add more security cameras and sensors, they need to protect their networks from hackers. Companies like [Xage](#) are using Blockchain’s tamper-proof ledgers to sharing security data across device networks.”

- ✓ RideSharing Blockchain is bringing new options in rideshare oligopoly

- “With a distributed ledger(DLT), drivers and riders could create a more user-driven, value-oriented marketplace”

pupil transportation (e.g., special needs, isolated students, work-based learning).



Navya, tested a self-driving van in Las Vegas in January & also 15 passenger vans shuttle students on the University of Michigan campus

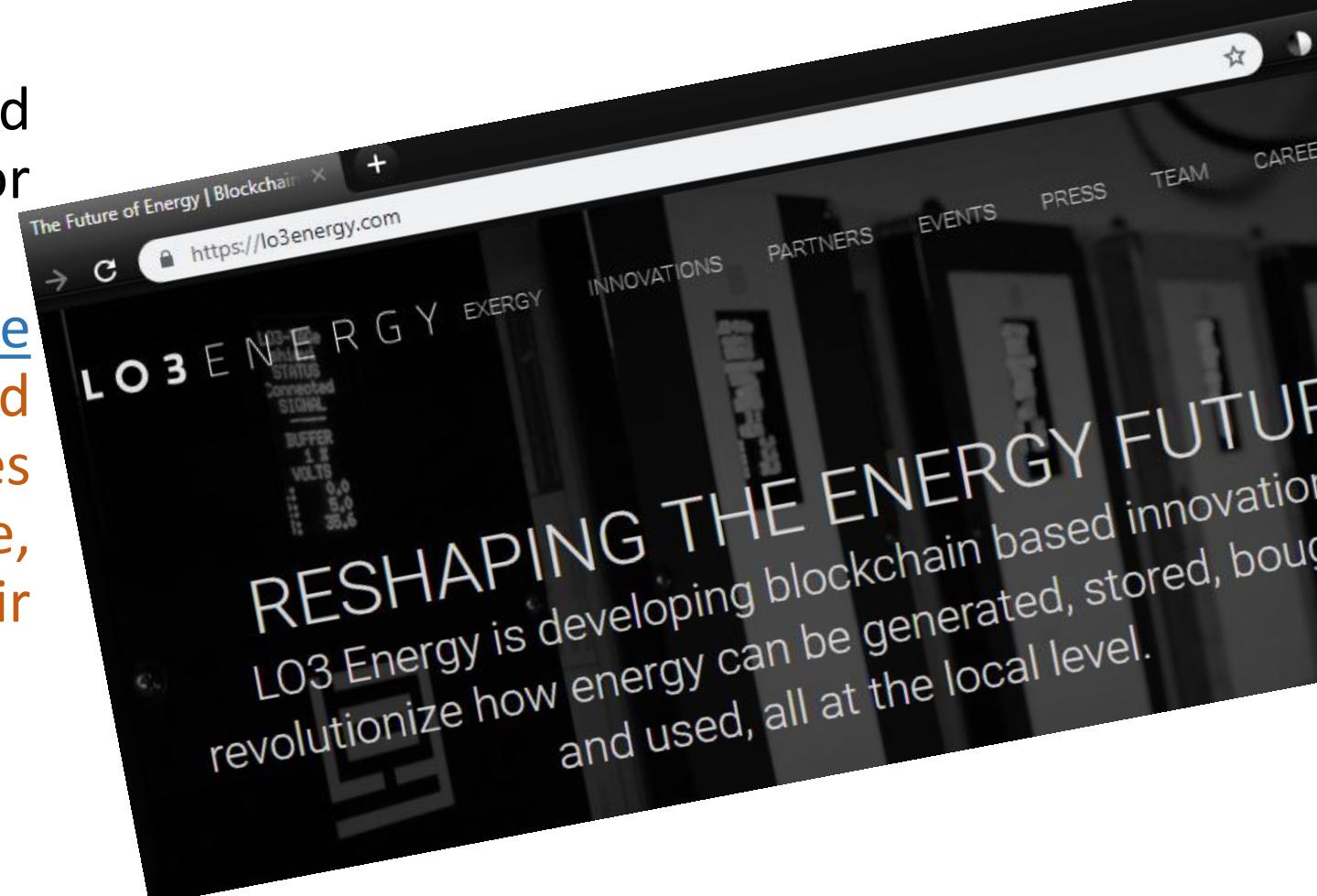
EZ10 is a driverless electric shuttle from Easymile, @France





Blockchain/DLT use-cases

- ✓ Energy Management - DLT could reduce the need for intermediaries.
- “Brooklyn startup [Transactive Grid](#) enables decentralized energy generation schemes allowing entities to generate, buy, and sell energy to their neighbours”



The screenshot shows a dark-themed website for LO3 Energy. At the top, there's a navigation bar with links for HOME, STATUS, ENERGY, INNOVATIONS, PARTNERS, EVENTS, PRESS, TEAM, and CAREER. The main header features the LO3 ENERGY logo and the tagline "RESHAPING THE ENERGY FUTURE". Below the tagline, a sub-headline reads: "LO3 Energy is developing blockchain based innovations to revolutionize how energy can be generated, stored, bought and used, all at the local level." On the left side, there's a small inset window titled "The Future of Energy | Blockchain" showing a digital interface with "STATUS" and "ENERGY" tabs, displaying metrics like "Connected SIGNAL" and "BUFFER".



Blockchain/DLT use-cases

✓ Prepaid Cards

- “Blockchains can help retailers offer secure gift cards and loyalty programs without a middleman”
- gyft, looyal
- Prepaid cards could be used by cities, schools, and families to purchase out of school learning experiences (e.g., an [LRNG](#) card) and associated transportation

The screenshot shows the Gyft website homepage. At the top, there are links for "Buy Gift Cards", "Download App", "Corporate Gift Cards", and "Gift Solutions". A banner at the top right says "Buy Now". Below the banner, a call-to-action says "Get a \$50 Express Gift Card for \$40. Use code DRESSED at checkout. Click here for more details.". The main section features the text "Buy, Send, & Redeem Gift Cards" and a subtext: "Gyft makes it easy for you to give the perfect gift card and conveniently manage them from any device!!". To the right, there are images of several gift cards, including a Best Buy e-Gift Card and a Starbucks Card, resting on a smartphone.

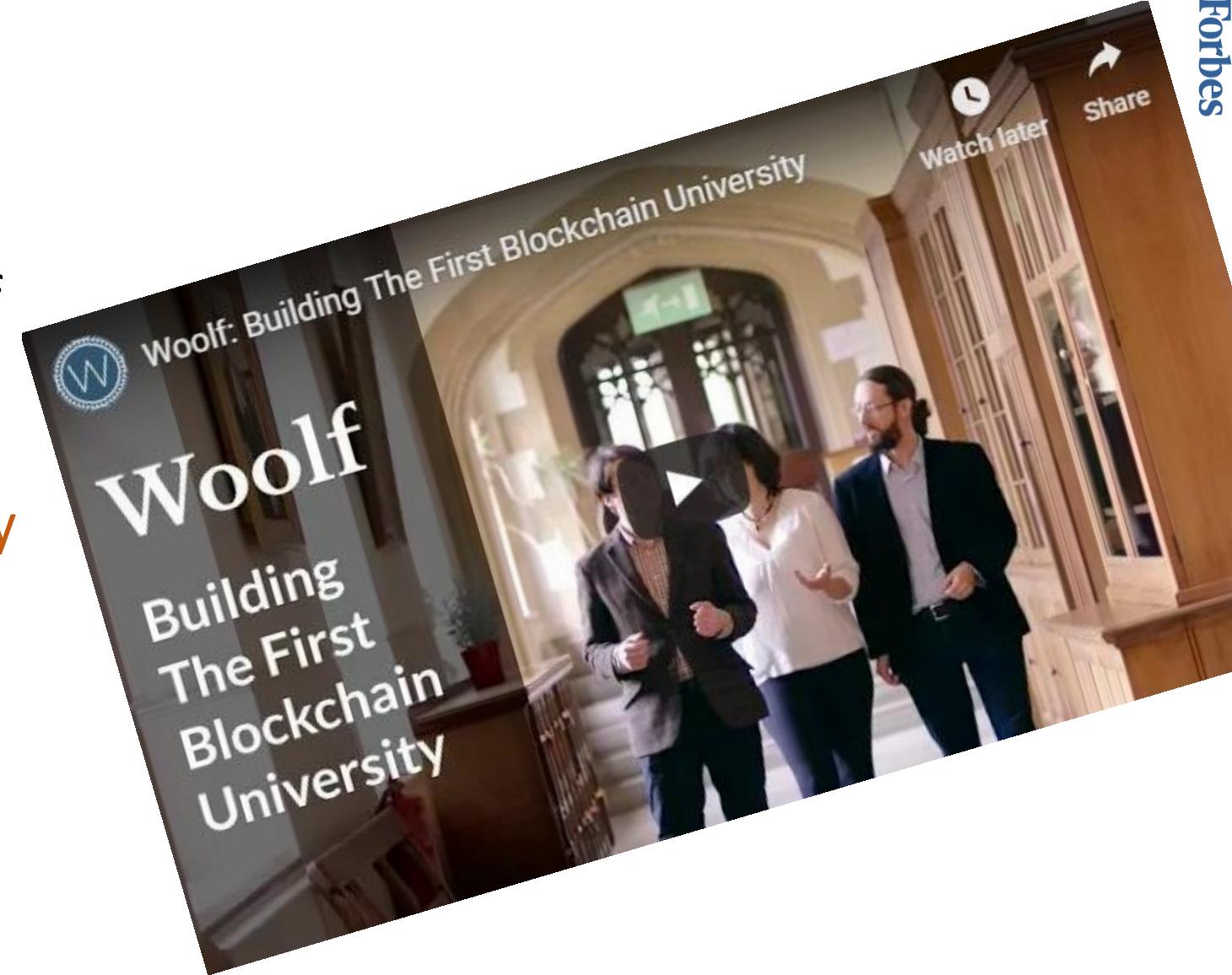
The screenshot shows the LRNG website. The header includes the LRNG logo, a "Networks" dropdown menu, a "Login" button, and a "Sign Up" button. The main title is "LRNG + snhu". Below the title, a message reads: "We are excited to announce our merger with Southern New Hampshire University to deploy Community-based education strategies across the nation." There is a "Read more →" link and a tagline "Learning redesigned for the Connected Age". The background of the page is a dark image of a city skyline.



Blockchain/DLT use-cases

✓ Smart contracts.

- DLT can be used to automatically execute agreements once a set of specified conditions are met.
- “[Woolf University](#), formed by Oxford professors, will use DLT to execute smart contracts.”





Blockchain/DLT use-cases



- ✓ Learning marketplace -
No middleman from test prep to surfing school
 - “TeachMePlease is Russian pilot on the Disciplina platform where teachers and students come together.”

The screenshot shows the homepage of Disciplina.io. At the top, there's a navigation bar with a magnifying glass icon, a search bar containing 'Blockchain', and a 'Sign In' button. To the right of the sign-in button are language selection ('EN') and social media sharing icons. The main title 'DISCIPLINA' is prominently displayed in large white letters. Below it, a subtitle reads: 'We are developing the first blockchain to create verified personal profiles based on academic and professional achievements'. A blue callout box in the center contains the text 'DISCIPLINA Alpha is available now' with a 'Try it' button. The background features a stylized illustration of a city skyline, books, a globe, and a smartphone, all set against a blue gradient.



Blockchain/DLT use-cases



✓ Retail -

No middleman

- “OpenBazaar operates as an open-source, peer-to-peer network that connects buyers and sellers without a middleman. Customers purchase goods using any of 50 cryptocurrencies and sellers are paid in Bitcoin”

The screenshot shows the OpenBazaar website at https://openbazaar.org. The main heading is "Sell Anything. Pay Zero Platform Fees." Below it, a sub-headline says "Create a store. Sell whatever you'd like. Reach a new audience. Get paid in cryptocurrency." On the left, there are six product thumbnails: 1. A band performing live with the title "Forever Tomorrow [EP]" and price "\$4.99". 2. A colorful mural of a face wearing sunglasses with the title "Summer Shades (original art)" and price "\$500.00". 3. A woman in a blue tank top with the title "Blue Tank Top" and price "\$0.00". 4. A bowl of paella with the title "Paella" and price "\$0.00". 5. A house with the title "House" and price "\$0.00". 6. A person's feet standing next to a quadcopter with the title "Quadcopter" and price "\$0.00". To the right of these thumbnails is a vertical list of features with checkmarks:

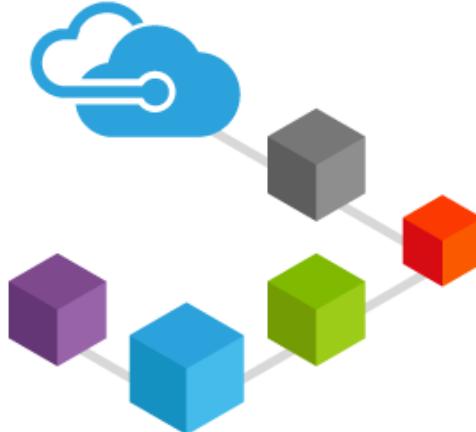
- ✓ No Platform Fees
- ✓ No Monthly Fees
- ✓ No Listing Fees
- ✓ No Bank / CC Required
- ✓ Live Chat with Customers
- ✓ Customize Your Store
- ✓ Peer to Peer (no middleman)



Blockchain/DLT use-cases

✓ BaaS- Blockchain as a service

- “Microsoft Azure created useful tool for Blockchain web developers. Its secure and cheaper environment that supports several chains, including Storj, MultiChain, Eris, and Augur.”



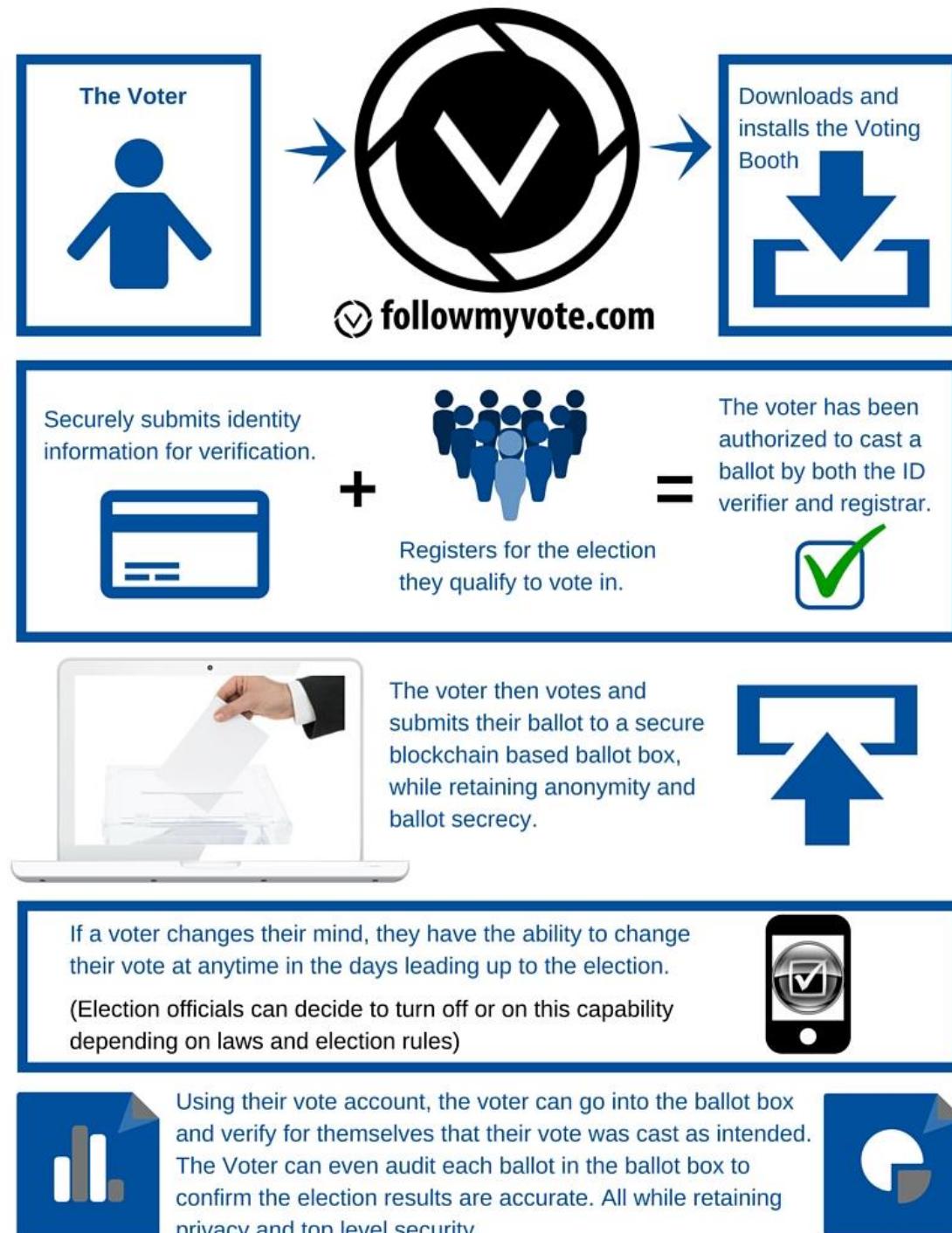
Microsoft Azure
Blockchain as a Service



Blockchain Voting

Blockchain helps to create a secure transaction database not only to log votes, also to audit the vote results in a more trustworthy manner.

- Blockchain technology ensures that the **ballot box** cannot be hacked.
- Vote from **any device** - no need to wait in long poll lines.
- Millions of dollars are saved.





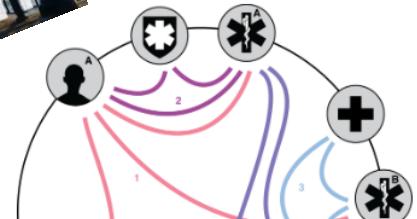
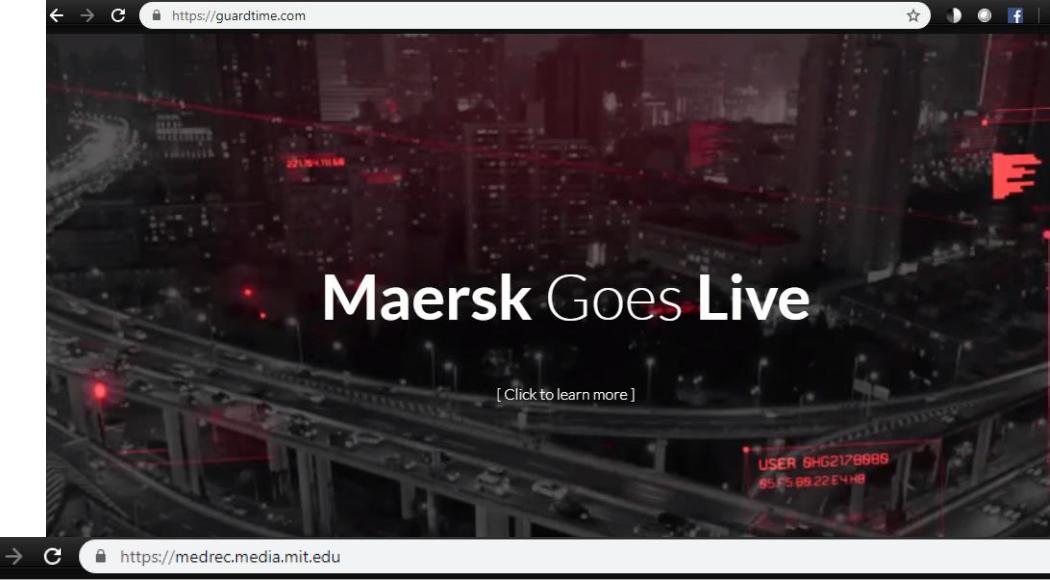
Blockchain in Healthcare

- Blockchain in healthcare examples include the following usage issues:
 - Drug traceability;
 - Data security in clinical trials; and,
 - Patient Data Management.
- Data managed by medical organizations includes:
 - Patient health information (PHI);
 - Electronic health records;
 - Data collected from IoT devices (Internet of Things) or monitoring systems; and,
 - Medical insurance claims.



Blockchain in Healthcare

- Guardtime's KSI® is a **Blockchain Platform** designed for enterprise solutions with security, scale and performance built-in
- China Food Safety Cloud selects KSI Blockchain for food supply chain track and trace
- **Consumed as a service**, Verizon's enterprise and government customers will be able to integrate proven Blockchain solutions into their existing business processes.
- **BlockCloud**: Re-inventing Cloud with Blockchains





Blockchain in Defence-Aerospace

- Lockheed Martin becomes the first U.S. defense contractor to incorporate Blockchain technology into its developmental processes, enabling more efficient and assured offerings to the federal government.

UPS announced they were going to join the Blockchain in Transport Alliance (BiTA), a forum for the development of Blockchain technology standards and education for the freight industry

LOCKHEED MARTIN





Blockchain in Agriculture

- Potential use cases

- Food safety
- Traceability
- Efficient and transparent supply chain with less transactional cost agridigital.io
- Opening new markets for farmer and their products AgriLedger's
- Logistics - Agricultural products having very short shelf life involves lot of money, hence more challenging is logistics.

