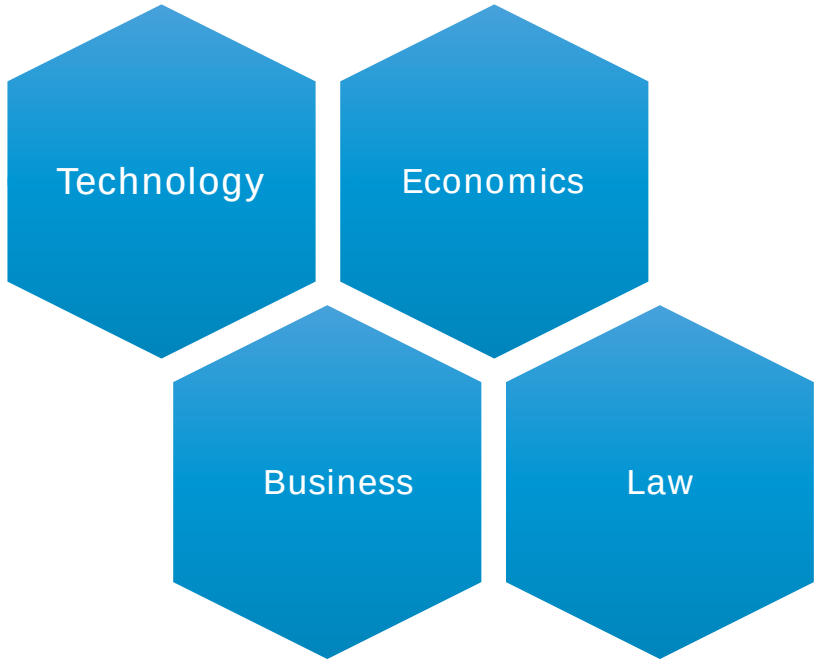
The next developments for the digital PA – Blockchain, AI & IoT

14th March 2019, 5th International EPSA Knowledge Transfer Conference

Evgeniia Filippova, Senior Scientist at Cryptoeconomics Institute WU Vienna

Research Institute for Cryptoeconomics

- Interdisciplinary research in technology, economics, business & law
- Cooperation with partners from industry
- Collaboration with other national & international Research Institutions



Research - Top Level Fields

WIRTSCHAFTS UNIVERSITÄT WIEN VIENNA UNIVERSITY OF ECONOMICS AND BUSINESS

Microeconomics Foundations of the Token Economy

- Game theoretical analysis
- Agent-based modelling
- Monetary theory
- Incentive design

Legal Aspects

- Information Privacy & Information Security
- Tax Law, Digital Tax Transformation
- Changes to the current contract paradigm

WU VIENNA | INTERDISCIPLINARY RESEARCH INSTITUTE FOR CRYPTOECONOMICS

Technical Aspects, Business Processes & Smart Contracts Security

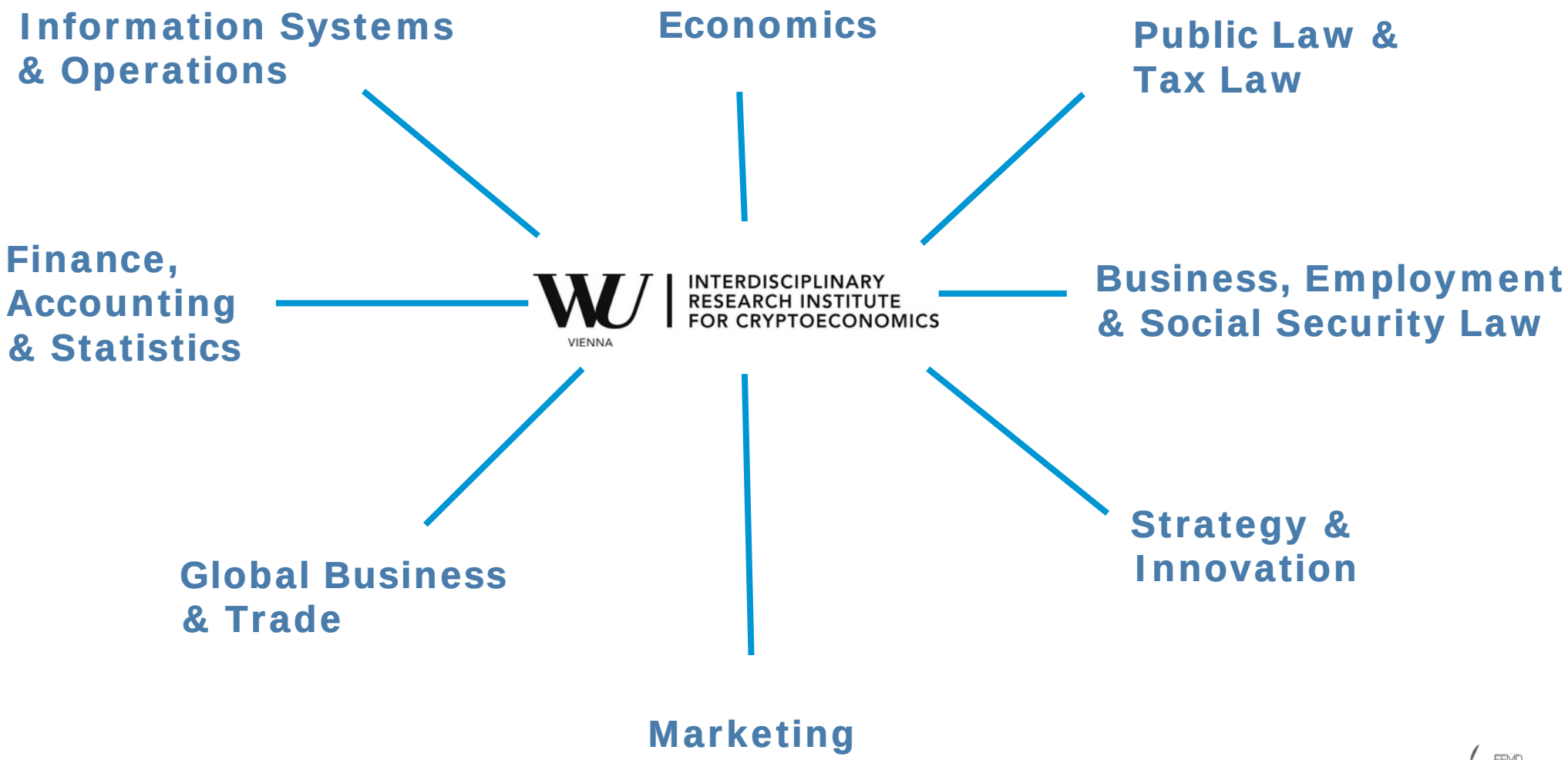
- Agent Based Systems
- Smart Contracts security and formal verification
- Smart-legal languages

Blockchain Applications

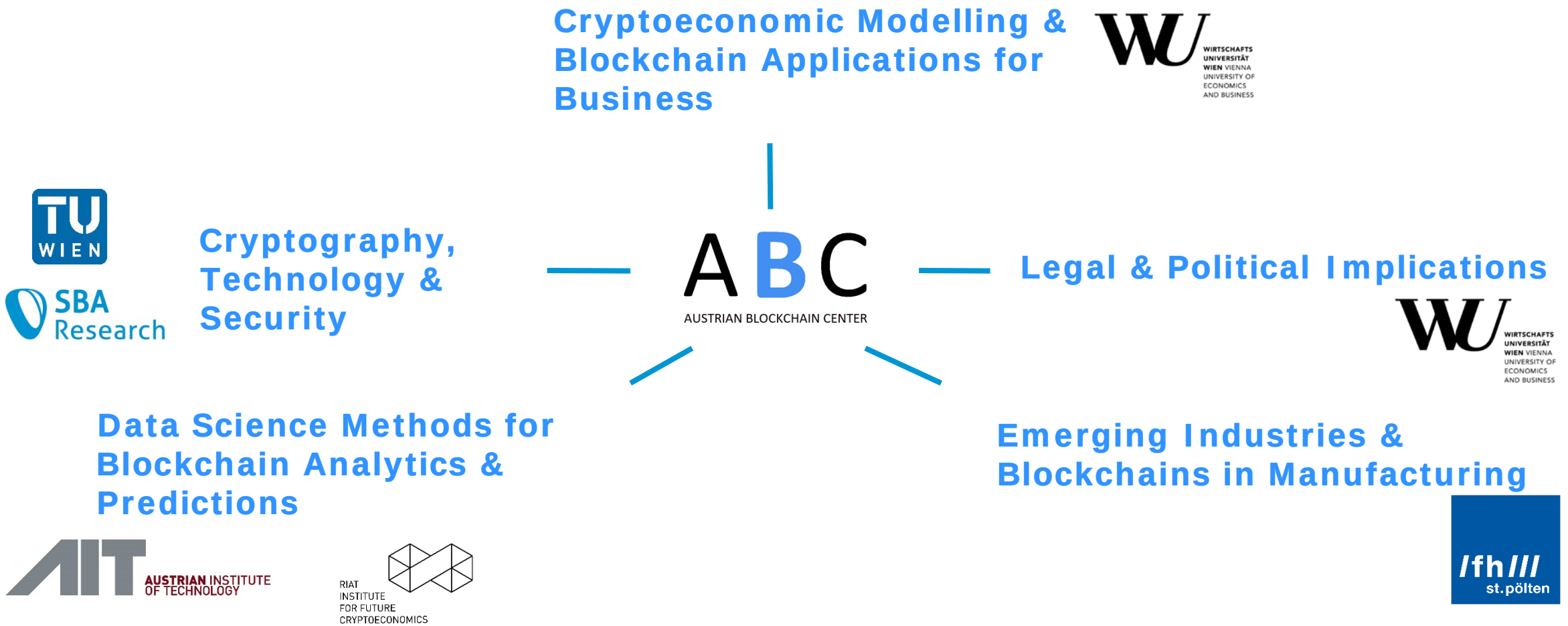
- Supply Chain & Trade Finance
- Sustainability
- Identity
- Business model research
- Limitations of blockchain-based solutions

EQUIS ACCREDITED AACSB ACCREDITED AMBA ACCREDITED

Interdisciplinarity is the Key!

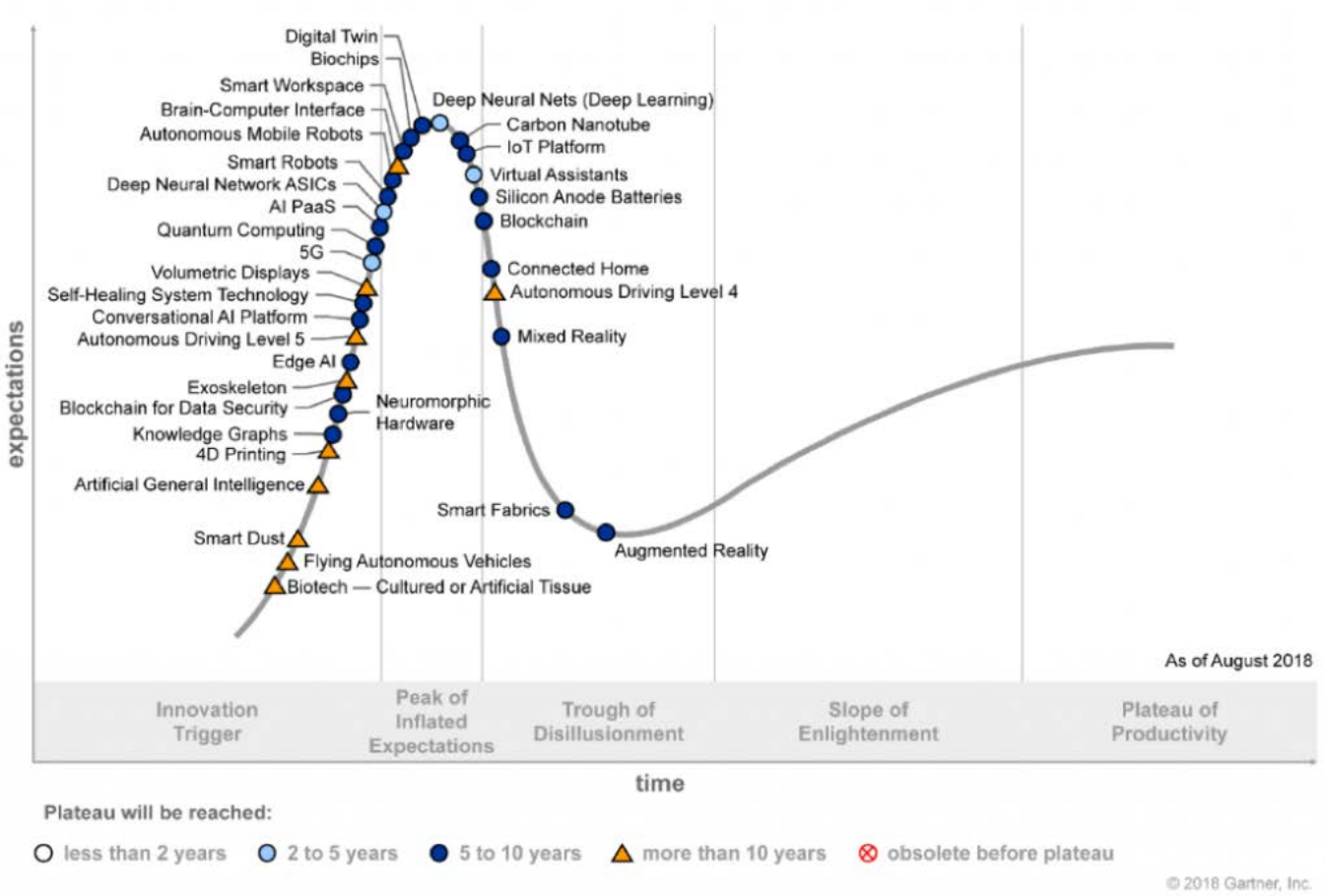


ABC - Austrian Blockchain Center



Emerging technologies

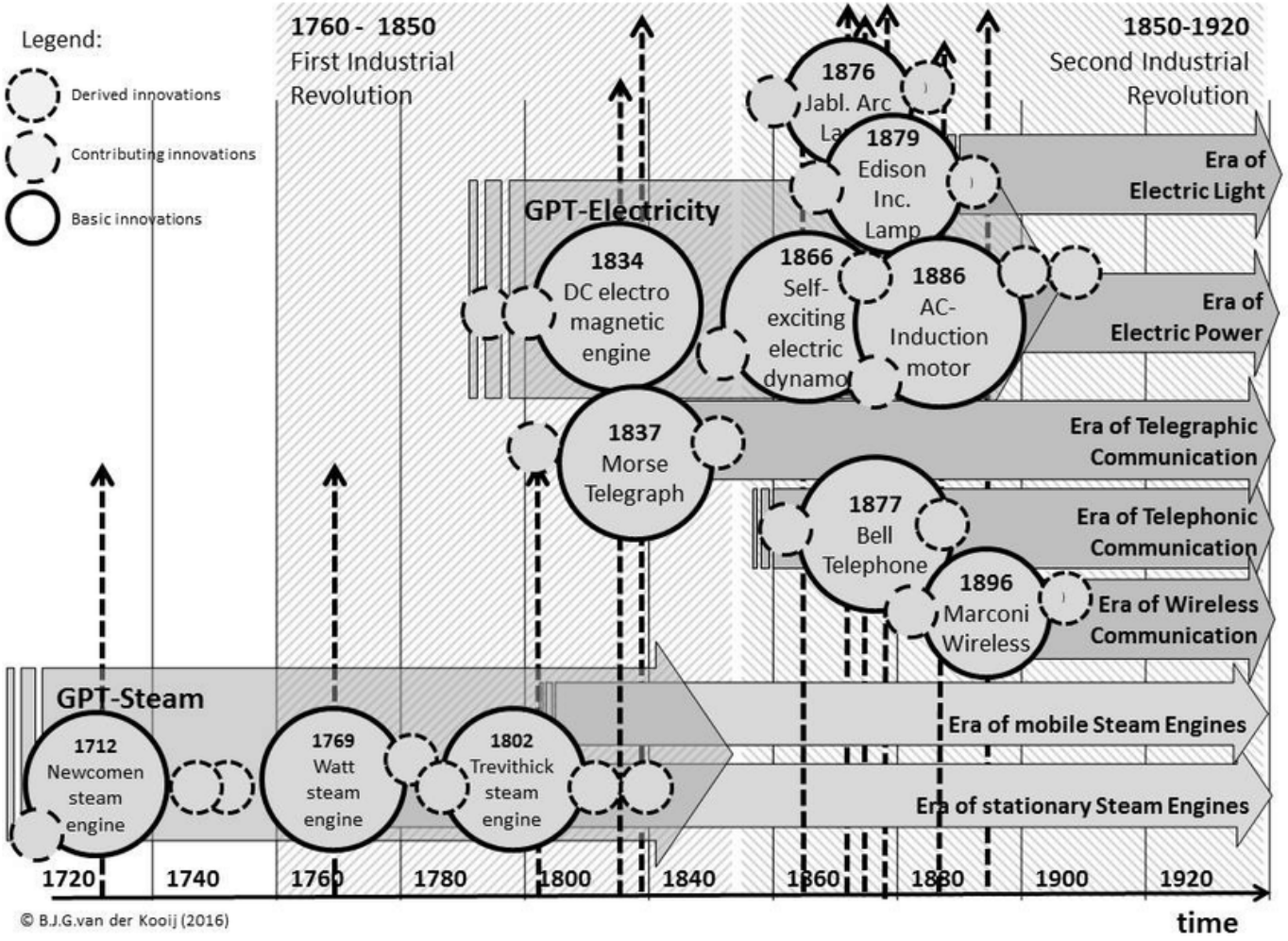
Emerging technology = a radically **novel** and relatively fast growing technology with the **potential** to exert a considerable impact on socio-economic domains



- Could emerging technologies create new ways of addressing social and environmental problems?
- Could these trends create new problems needed to be addressed?
- Will they offer new ways for existing organisations to run more effectively and efficiently?
- Could the technology trends disrupt existing governance structures?

General Purpose Technologies

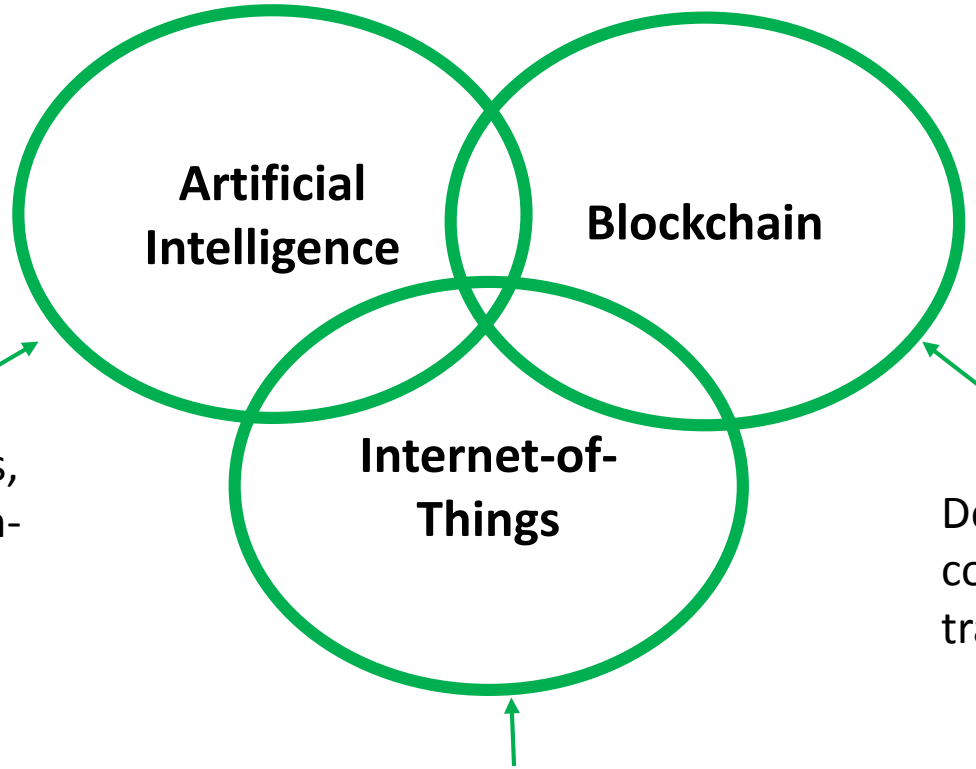
General purpose technology = a **key** technology that has **multiple usages** among industrial sectors and **causes changes** in economic, social and political structures



1) Pervasiveness
2) Innovation spawning effects
3) Scope for improvement

Next General Purpose Technologies

There is a large empirical evidence (mainly based on patents) that these 3 technologies are already GPTs:



Autonomous analysis, learning and decision-making capabilities

Decentralization of control, immutability and transparency of data

A network of smart, interconnected devices that can sense, analyze and act

TRUST

DATA ETHICS

PRIVACY

SECURITY

TRANSPARENCY

Next General Purpose Technologies

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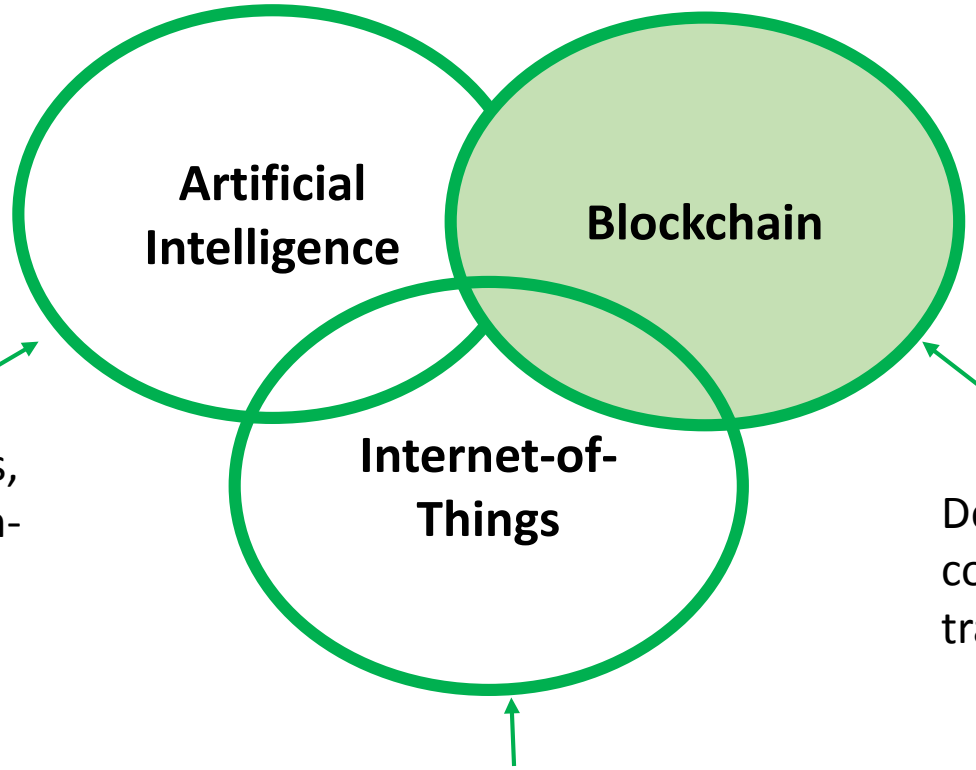

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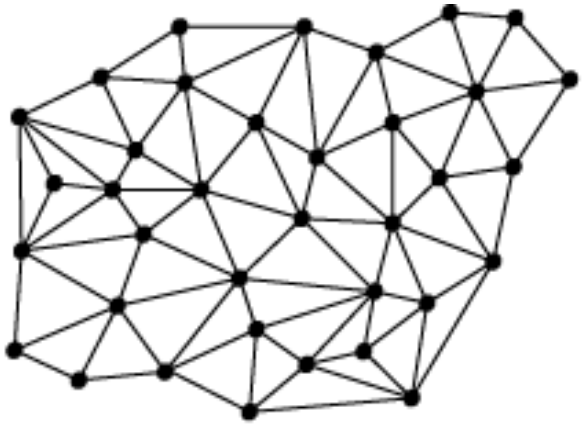
If you had to define Blockchain in 3 words?

A distributed ledger



distributed

Ledgers are used to:

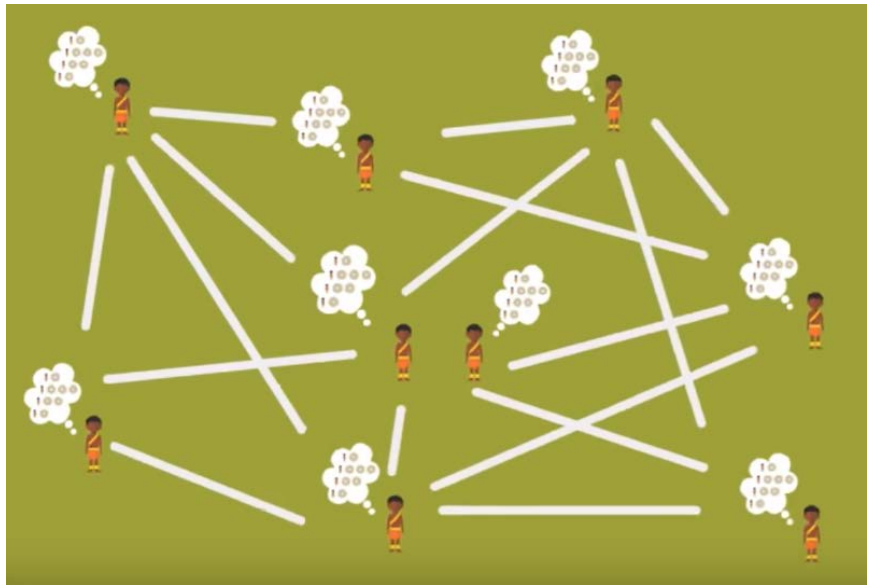
- record economic activities;
- prove the ownership;
- prove the transfer of value of assets *(tangible / intangible)* among various stakeholders

Curios case of the Rai Stones

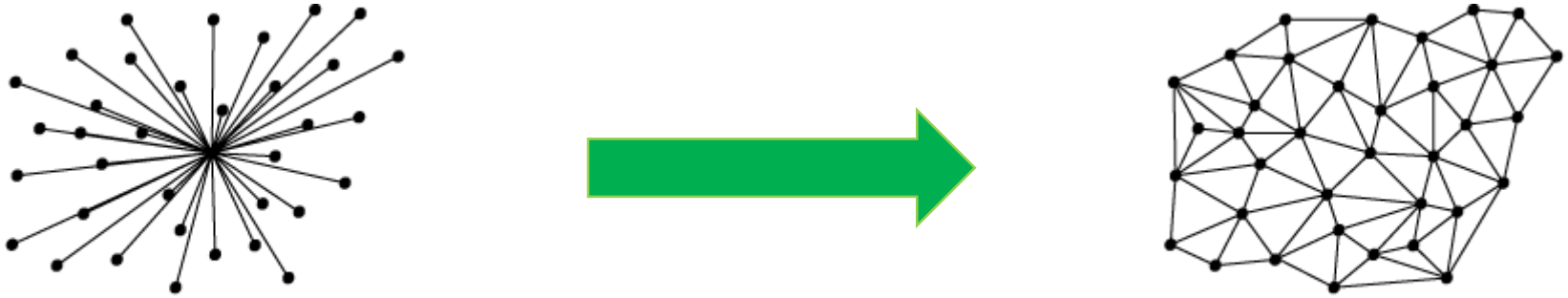
500 AD, Island of Yap (now Micronesia)
Yappies had a problem: a strange form of currency (fei stones)

Solution: Decentralized Ledger

- Distribution of Fei stone ownership across all Yappies
- When a Fei stone was spent, the new transaction was shared across everyone



Basic Idea Behind (Bitcoin) Blockchain



- **Peer-to-peer** electronic transactions and interactions
- **Without financial institution**
- **Cryptographic proof** instead of central trust
- **Put trust in the network** instead of in a central institution

So … What is Blockchain?

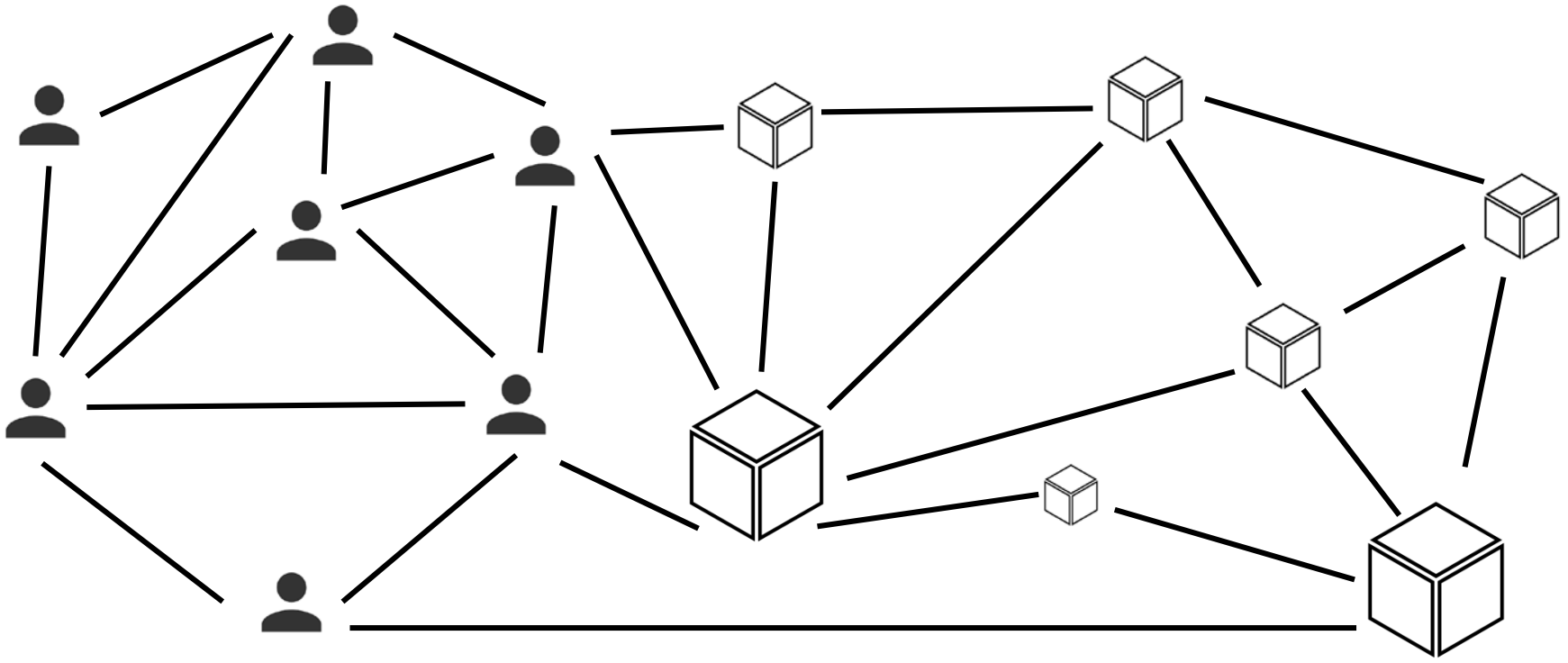
Blockchain is a bundle of **distributed ledger technologies** that can be programmed to record and track **anything of value without** involvement of the **third trusted party**

TECHNICAL	Back-end database that maintains a distributed ledger, openly
BUSINESS	Exchange network for moving value between peers
LEGAL	A transaction validation mechanism, not requiring intermediary assistance

What is Blockchain?

NETWORK Layer

DATABASE Layer



STATE Layer

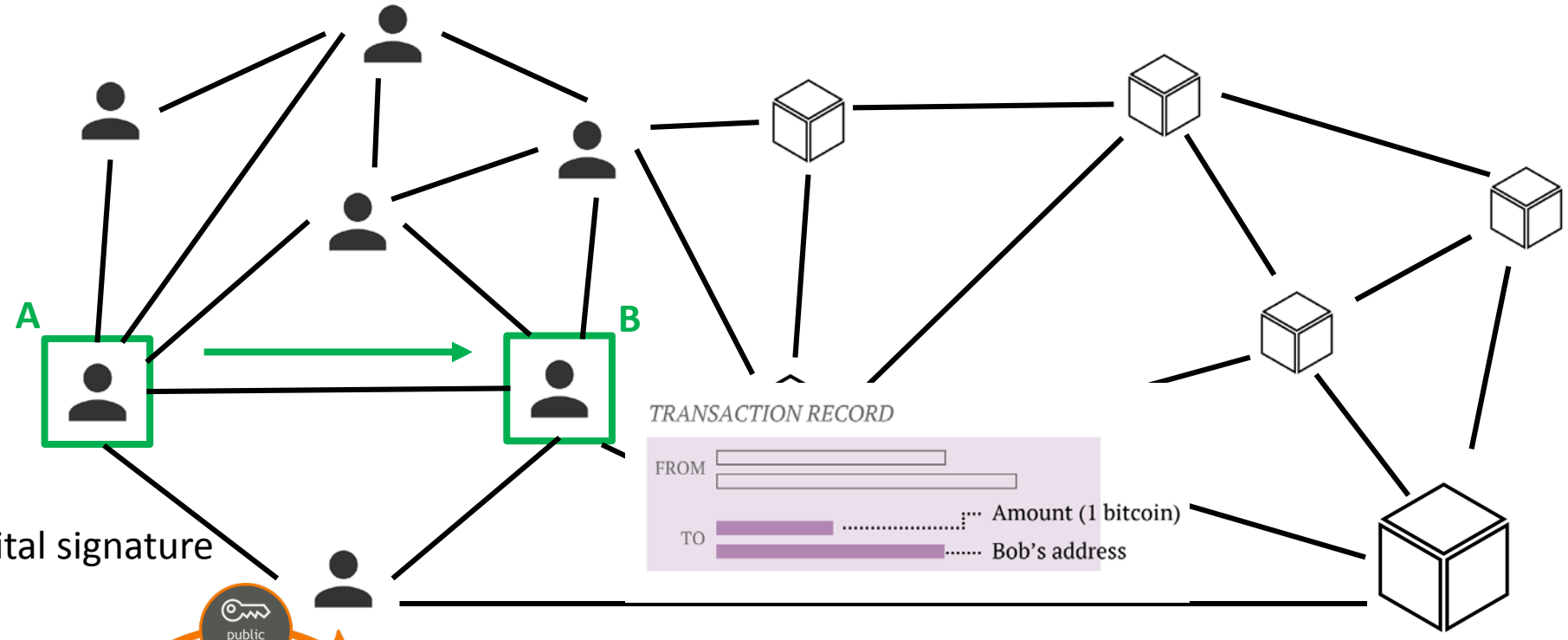
time

What is Blockchain?

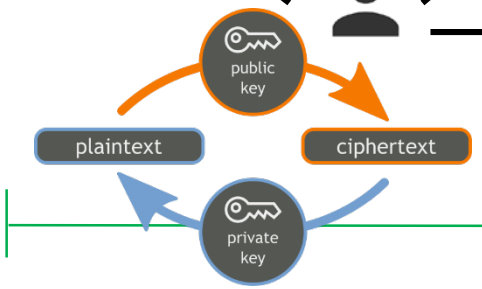
NETWORK Layer

DATABASE Layer

1. Transaction event



Digital signature



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What is Blockchain?

NETWORK Layer

DATABASE Layer

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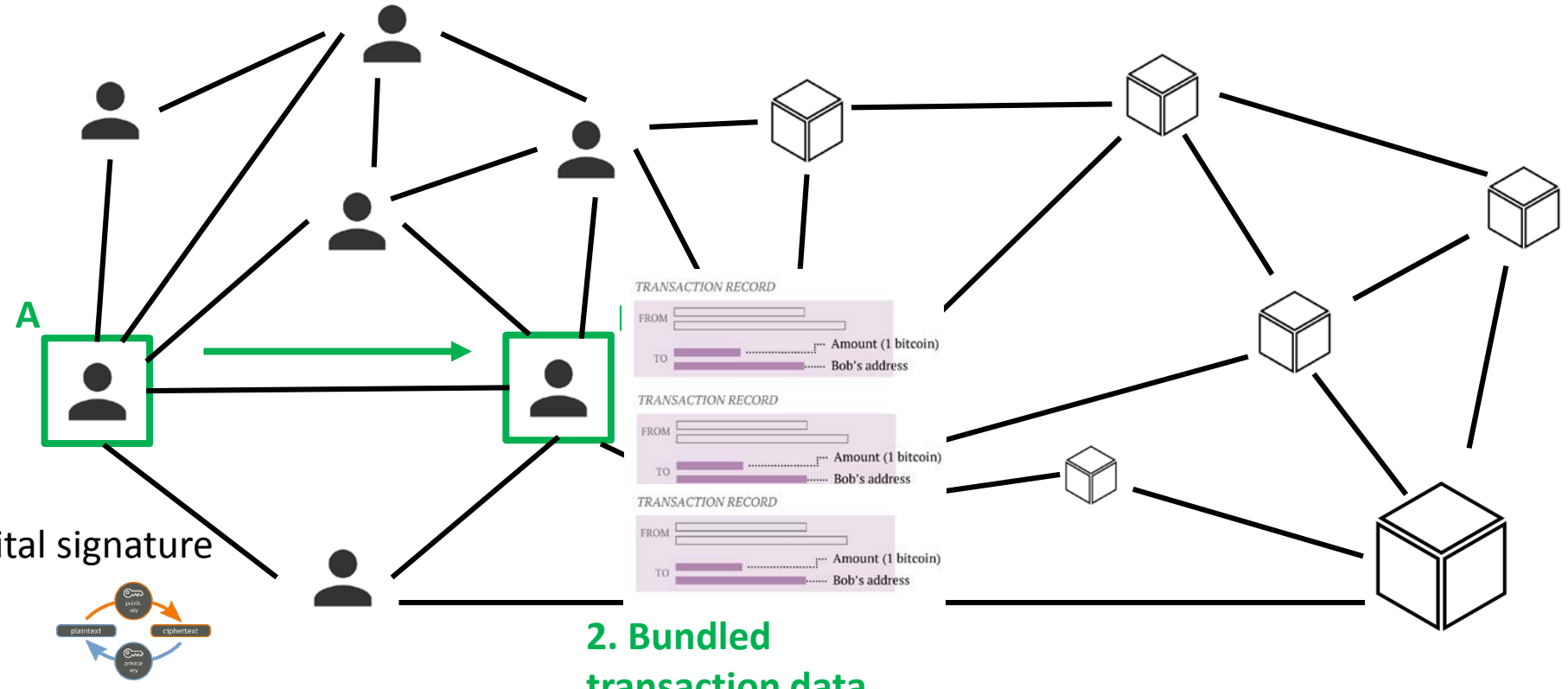

Digital signature

2. Bundled transaction data

STATE Layer

time

What is Blockchain?

NETWORK Layer

DATABASE Layer

1. Transaction event

3. Validation

Consensus algorithm

A

TRANSACTION RECORD
FROM
TO
Amount (1 bitcoin)
Bob's address

TRANSACTION RECORD
FROM
TO
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Bob's address

TRANSACTION RECORD
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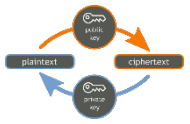
Digital signature



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STATE Layer

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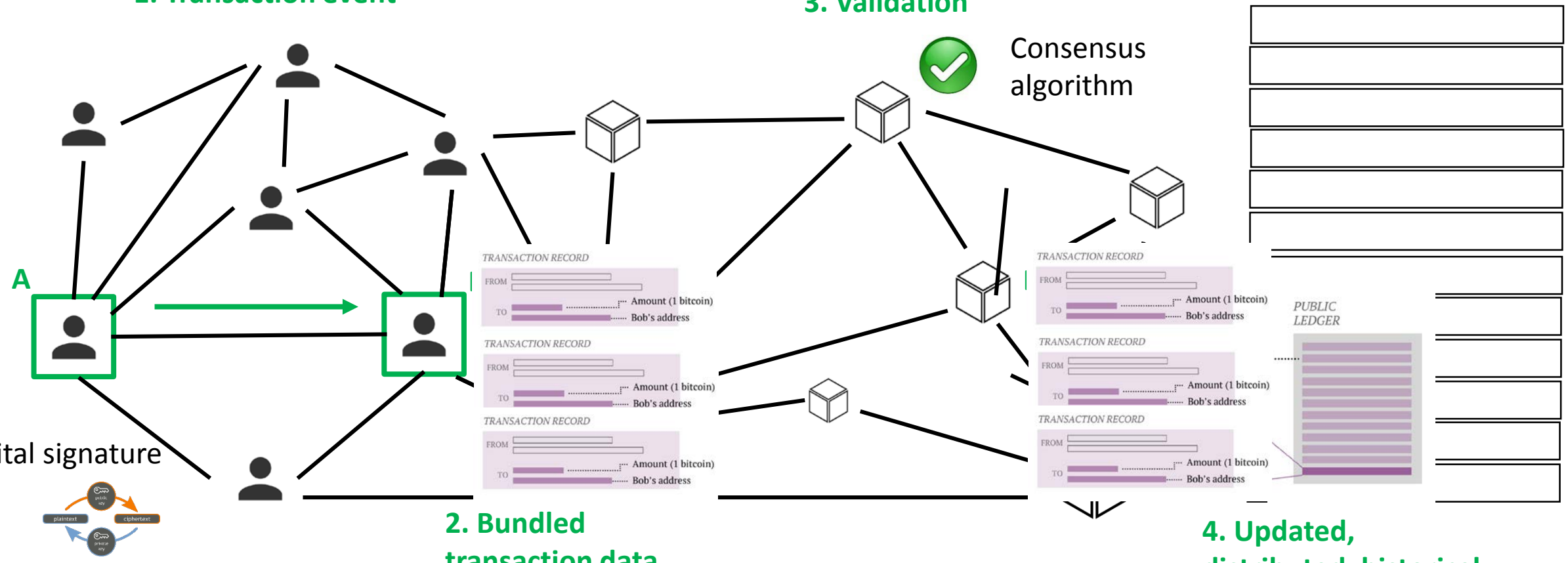


Digital signature

2. Bundled transaction data

4. Updated, distributed, historical ledger

STATE Layer

time

Types of Blockchains

	Level	Copies	Readers	Writers
Traditional	Centralised	One	One	One
Permissioned Private	De-centralised	Multiple	Multiple	Multiple
Permissioned Public	De-centralised	Multiple	Unlimited	Multiple
Unpermissioned Public	Distributed	Unlimited	Unlimited	Unlimited

Blockchain consortia

r3

HYPERLEDGER

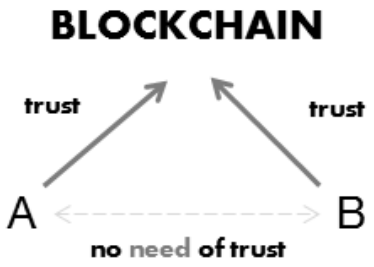
Digital Asset Holdings

ripple

ethereum

4 Disruptive Benefits of Blockchain

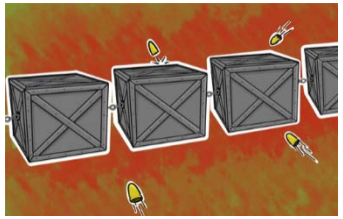
Disintermediation of Trust



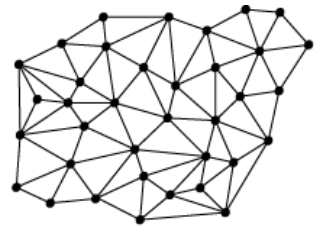
Smart Contracts

ethereum

Immutability of Record



Single source of truth



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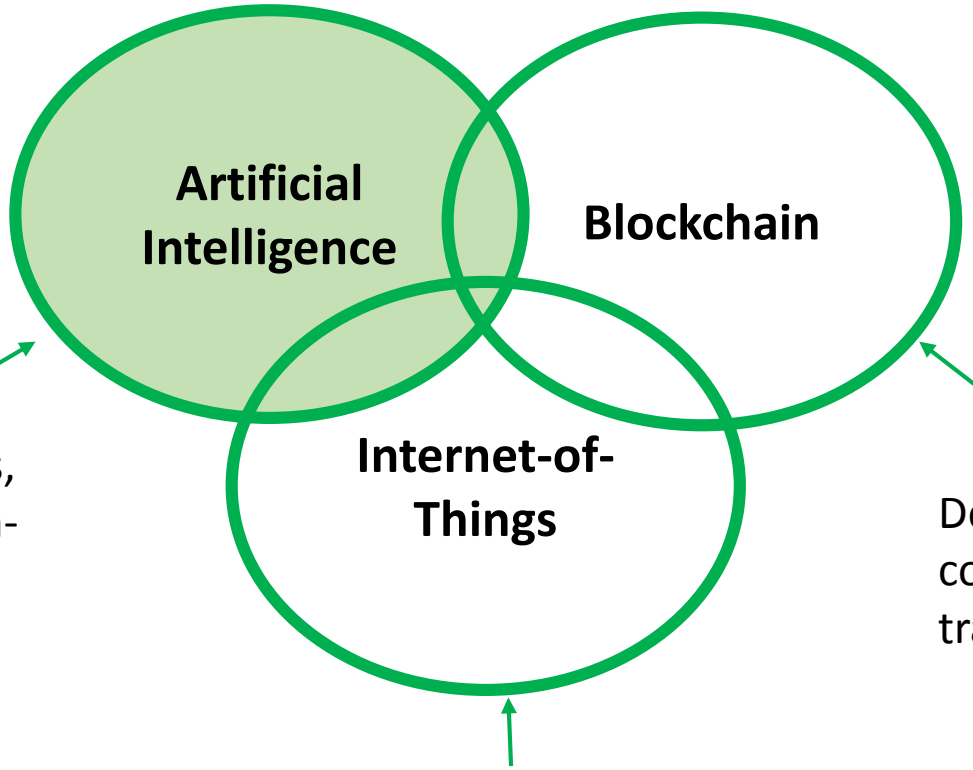

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Decentralization of control, immutability and transparency of data

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1) Pervasiveness
2) Innovation spawning effects
3) Scope for improvement

Artificial Intelligence

- AI = ‚science and engineering of making intelligent machines, especially intelligent computer programs“ (J.McCarthy, 1956)
- Goal: to create a technology that can genuinely complement (or even substitute) the human intellect.
- Approach: development of software and hardware capable of continuous and independent improvement in their decision-making

Machine Learning: field of study that gives computers the ability to learn without being explicitly programmed (goal: development of a prediction engine for a particular use case).

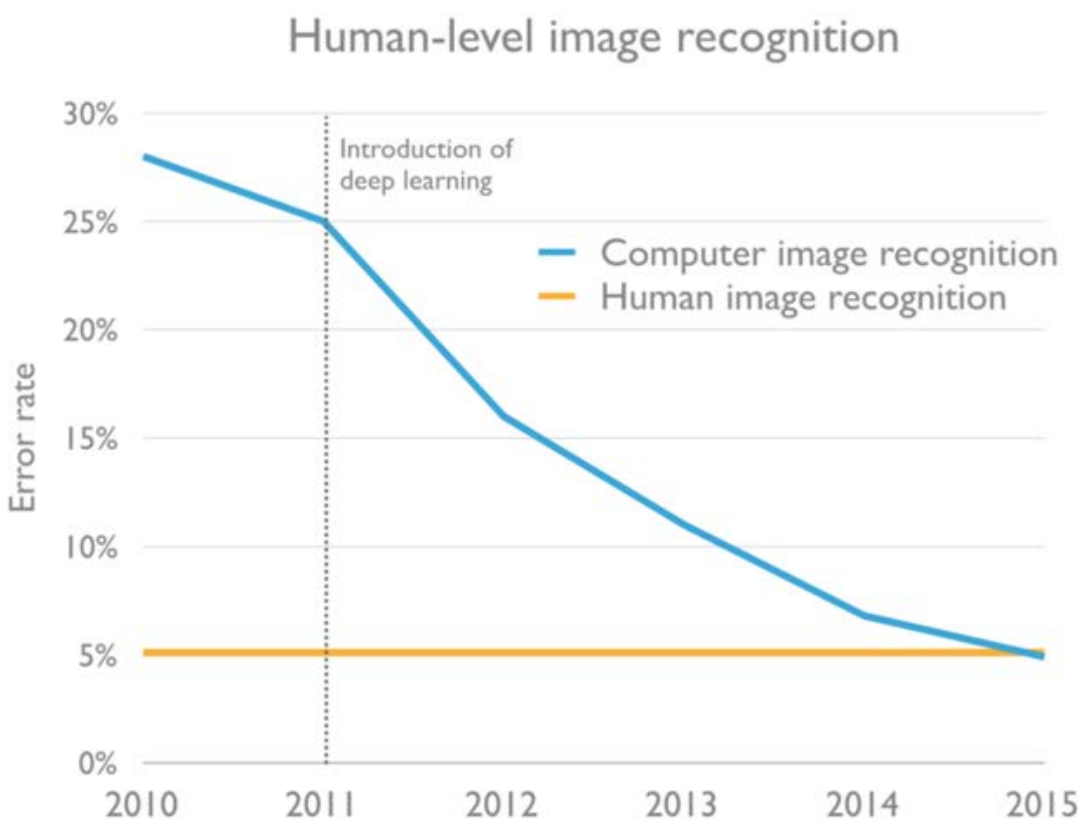
Deep Learning: these techniques use artificial, software-based,neural networks‘ to **replicate human neural processing methods** and, therefore, can not only generate predictions but also independently define certain features to analyse.

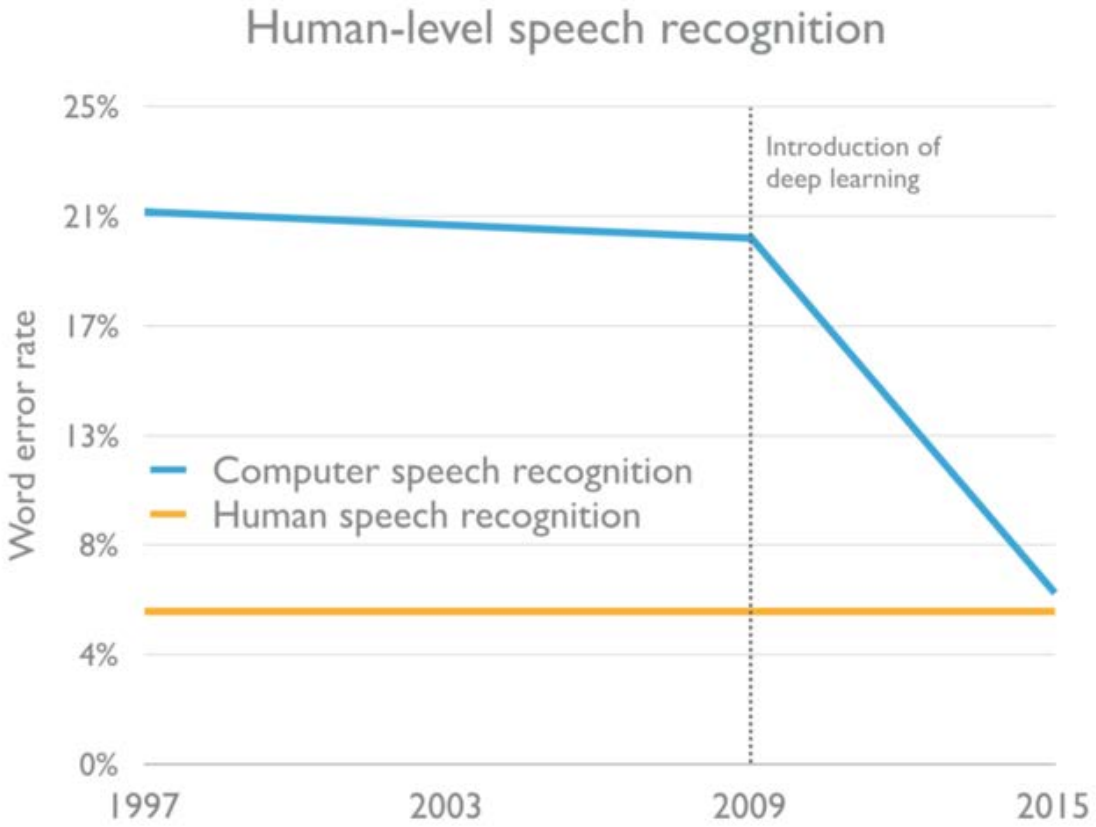
Random forests

Bayesian networks

Artificial Intelligence

Deep Learning mechanisms are now already better in some areas than humans





And this is just the beginning…

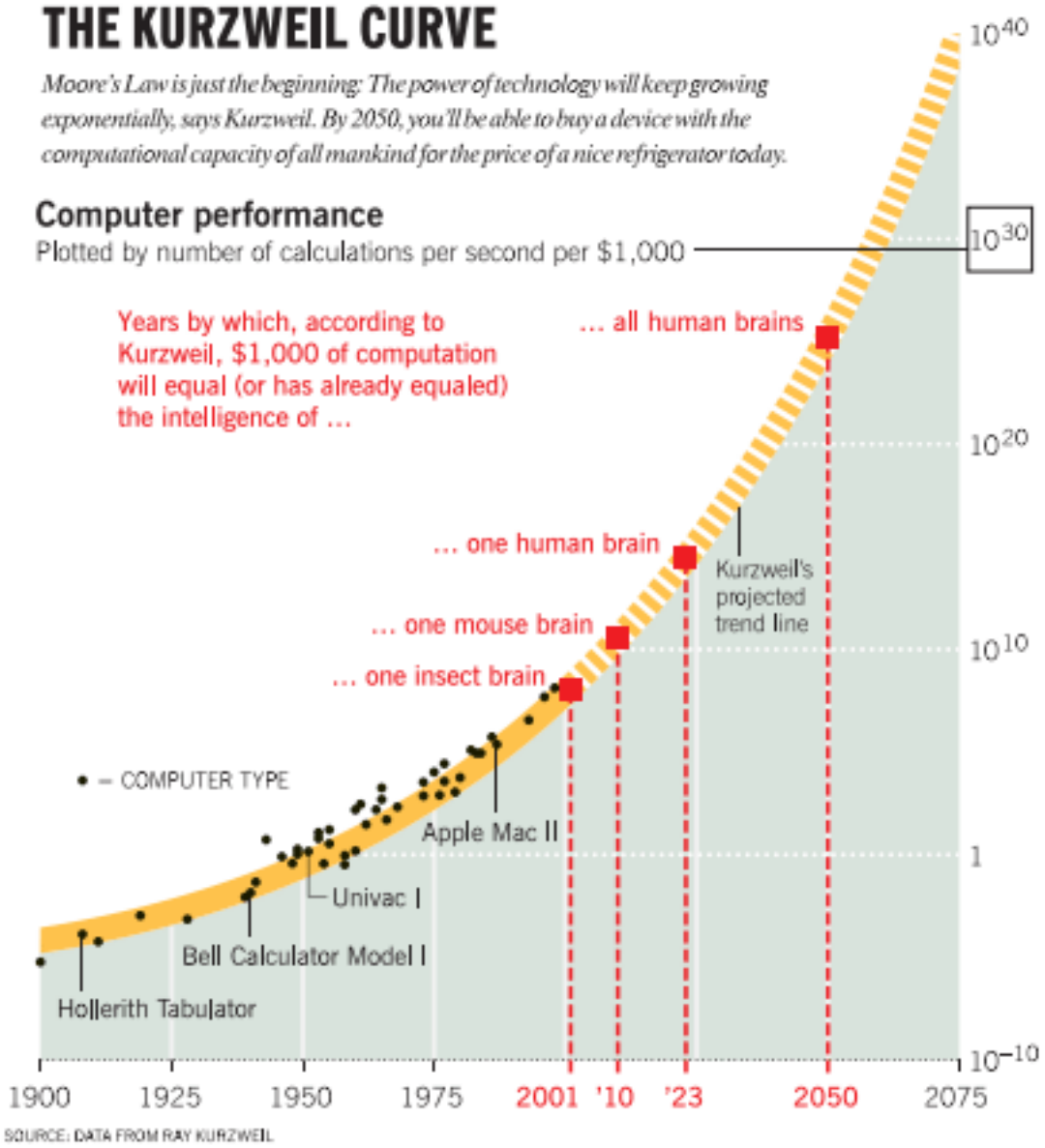
Technological Singularity

Intellect that is **much smarter** than the best human brains in practically **every field**, including scientific creativity, general wisdom and social skills

Super Intelligence

General Intelligence

Narrow Intelligence



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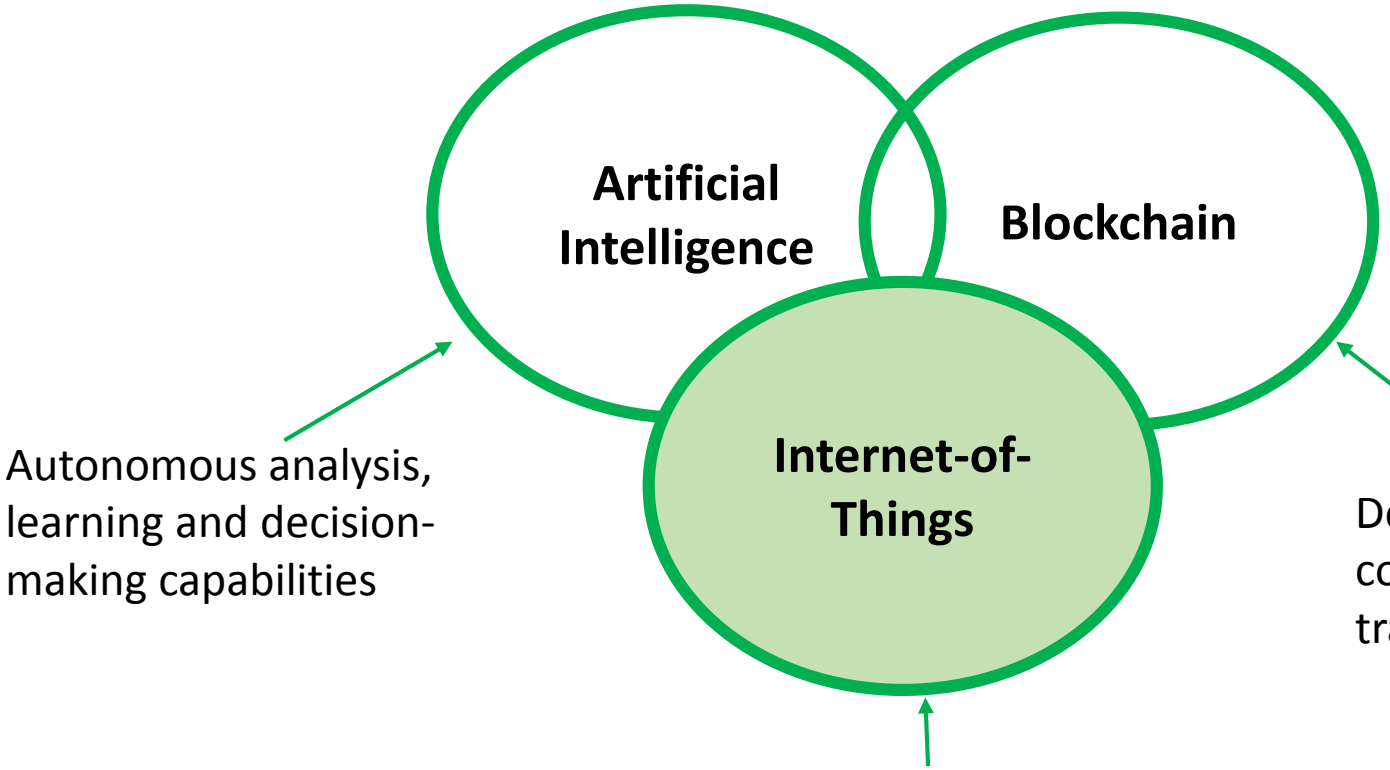

1) Pervasiveness
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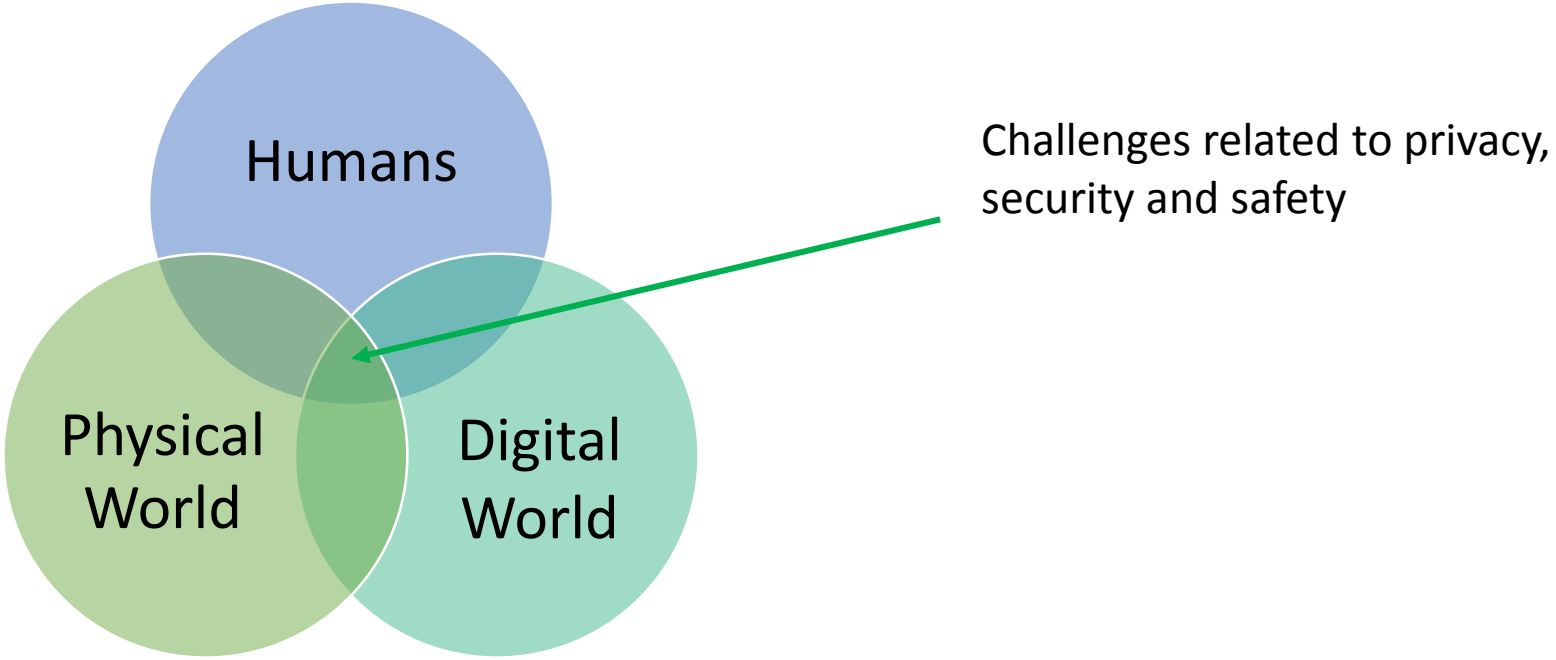
Internet-of-Things

- IoT = concept of inter-networking of physical smart devices, and other devices embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data
- With IoT the web is expanding its realm where everything becomes connected
- **Humans will increasingly interact with a cyber-physical object that borrows attributes from both (physical & digital) worlds**



Next General Purpose Technologies for Public Services

Identity management

Public Integrity

Education

Healthcare services

Smart Cities

Land registries

Sustainable Development Goals

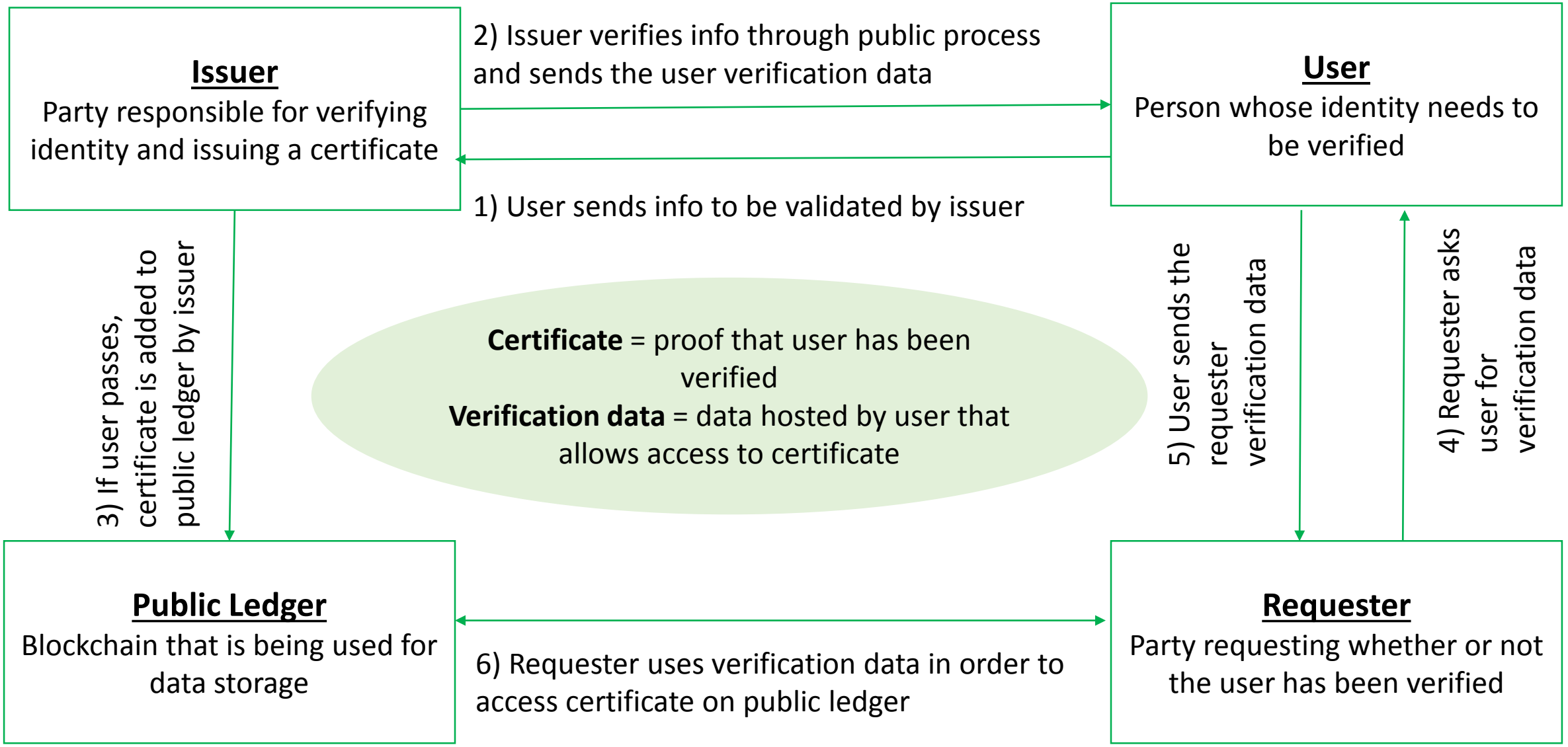
Citizens Engagement

Self-Sovereign Identity

- SSI = concepts of individuals having **sole ownership** of their digital and analog identities, and **control** over how their personal data is shared and used.
- Principles for a SSI system:

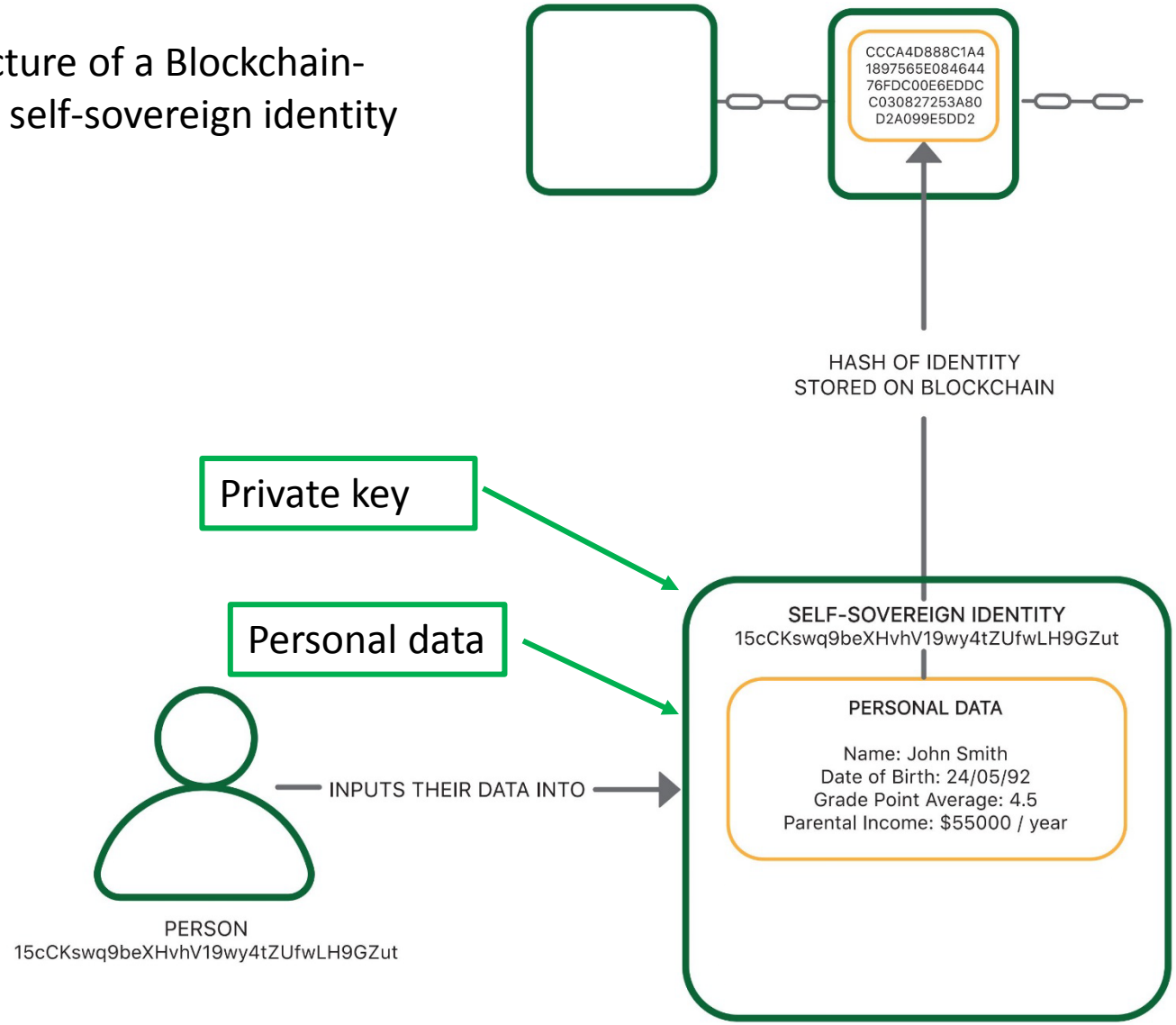
- Control: users must control their identities and use of personal data
- Access: users must have access to their own data
- Transparency: systems and algorithms must be transparent
- Interoperability: identities should be as widely usable as possible

Blockchain-based Self-Sovereign Identity



Blockchain-based Self-Sovereign Identity

Architecture of a Blockchain-secured self-sovereign identity



Source: https://figshare.com/articles/Architecture_of_a_Self-Sovereign_Identity/5371510/1

Land Registries on Blockchain

CHANCES

- Vulnerability in developing countries
- A large number of intermediaries (brokers, government property databases, notaries etc.)
- No single, centralized depository → more resilient recors (ex. Haiti 2010 earthquake)
- Immutable records

BUT: PREREQUISITES

1. Identity solutions (ex. SecureKey in Canada, uPort, Civic etc.)
2. Digitized records (you cannot hash a paper document)
3. Multiple signature wallets (what if you lost your pair of keys?)
4. Type of Blockchain (issue: storing a large amount of data)
5. Accurate data
6. Connectivity & a tech-aware population
7. A trained professional community

Healthcare Services

Test Bed Programme of the National Health Service UK = goal is to use potential of digital technologies to transform the way healthcare is delivered

- **Technology Integrated Health Management**

- IoT for dementia patients: patients are provided with sensors, wearables and other smart devices to monitor their health at home.

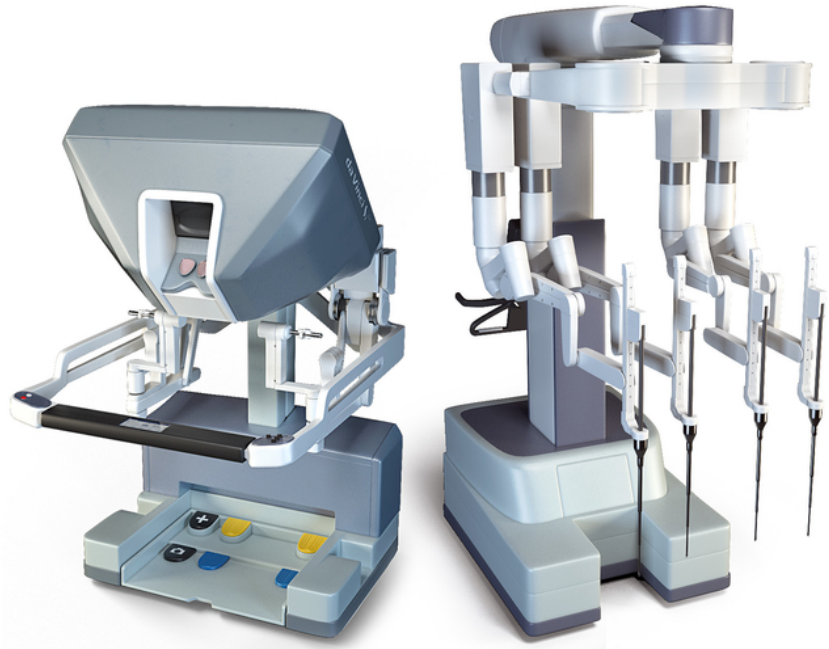
- Patients take more control over their health and wellbeing
- Prevention / delay for costly long term care in nursuing houses
- Reduction of unplanned hospital admissions
- More effective service delivery

Healthcare Services

Robot-assisted surgery → minimally invasive surgery

- Gynecologic surgery
- Heart surgery
- Endometriosis
- Urologic surgery

Numerous possibilities, but also challenges



Education: Academic Certificates

Paper certificates

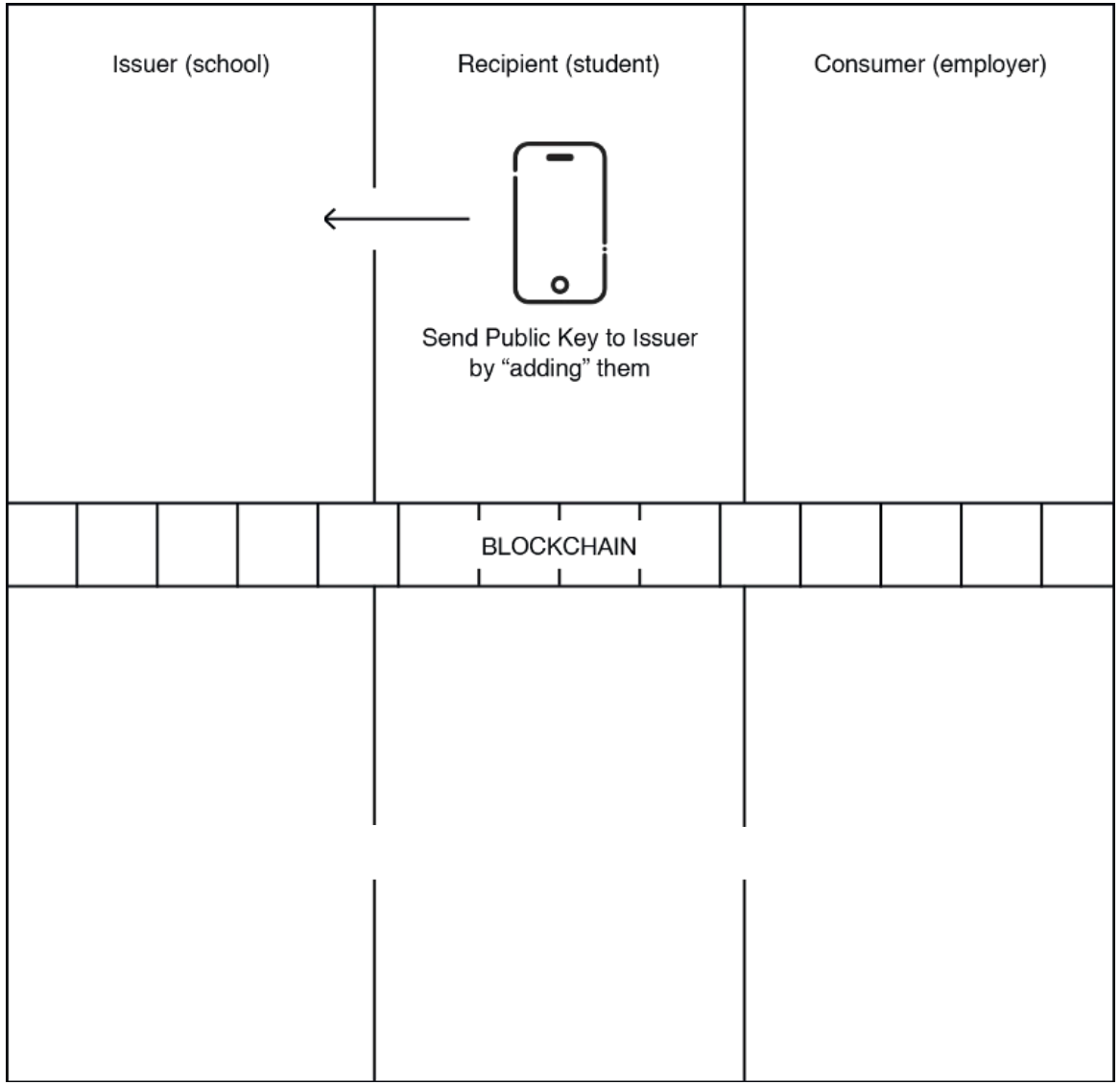
- Risk of forgery
- Certificate registries = single points of failure
- Significant costs for verification (each certificate is verified individually)
- Significant costs for production (more secure → more expensive)

Digital certificates

- In many countries no universally-used open standard for digital signatures → specific software
- Should the registry fail, certificates become worthless

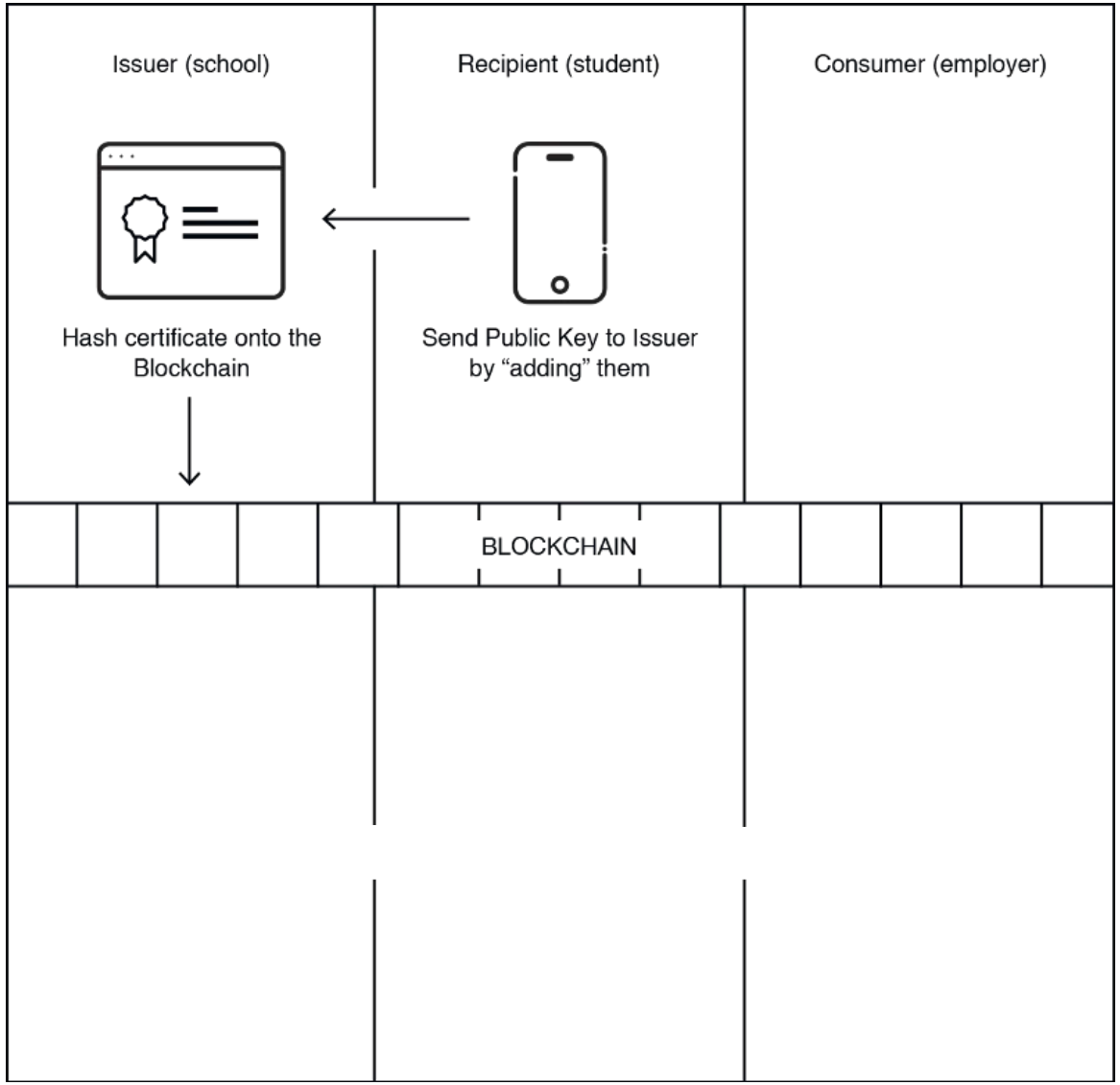
- Immutable records – Digital fingerprints (hashes) of the individual certificates issued are placed permanently in a blockchain transaction
- Ease and instant verification by interested third parties even if the application used or the institution‘s website no longer exists

Education: Blockchain-based academic certificates



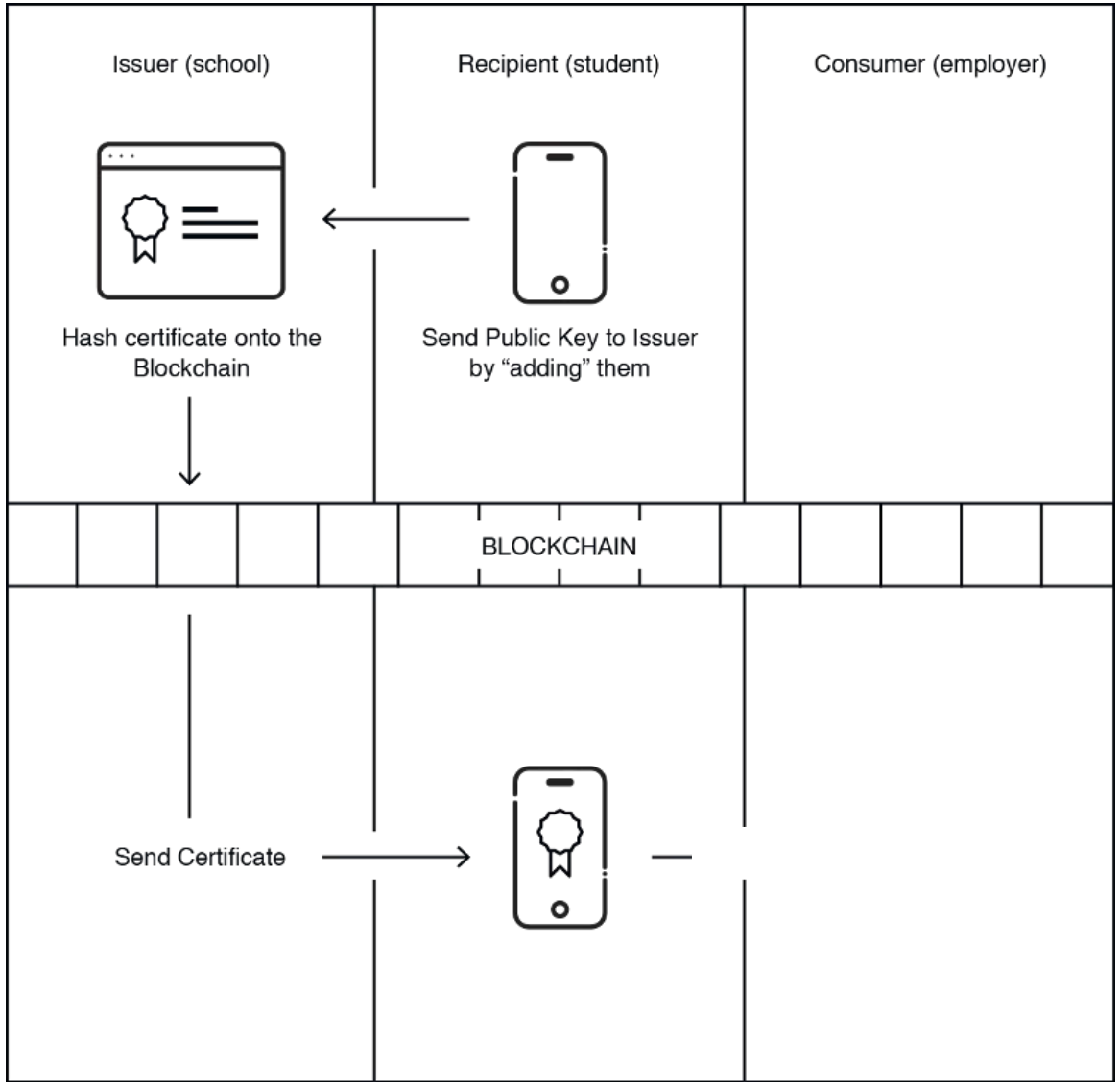
1. Student sends the school his name, email and Public key

Education: Blockchain-based academic certificates



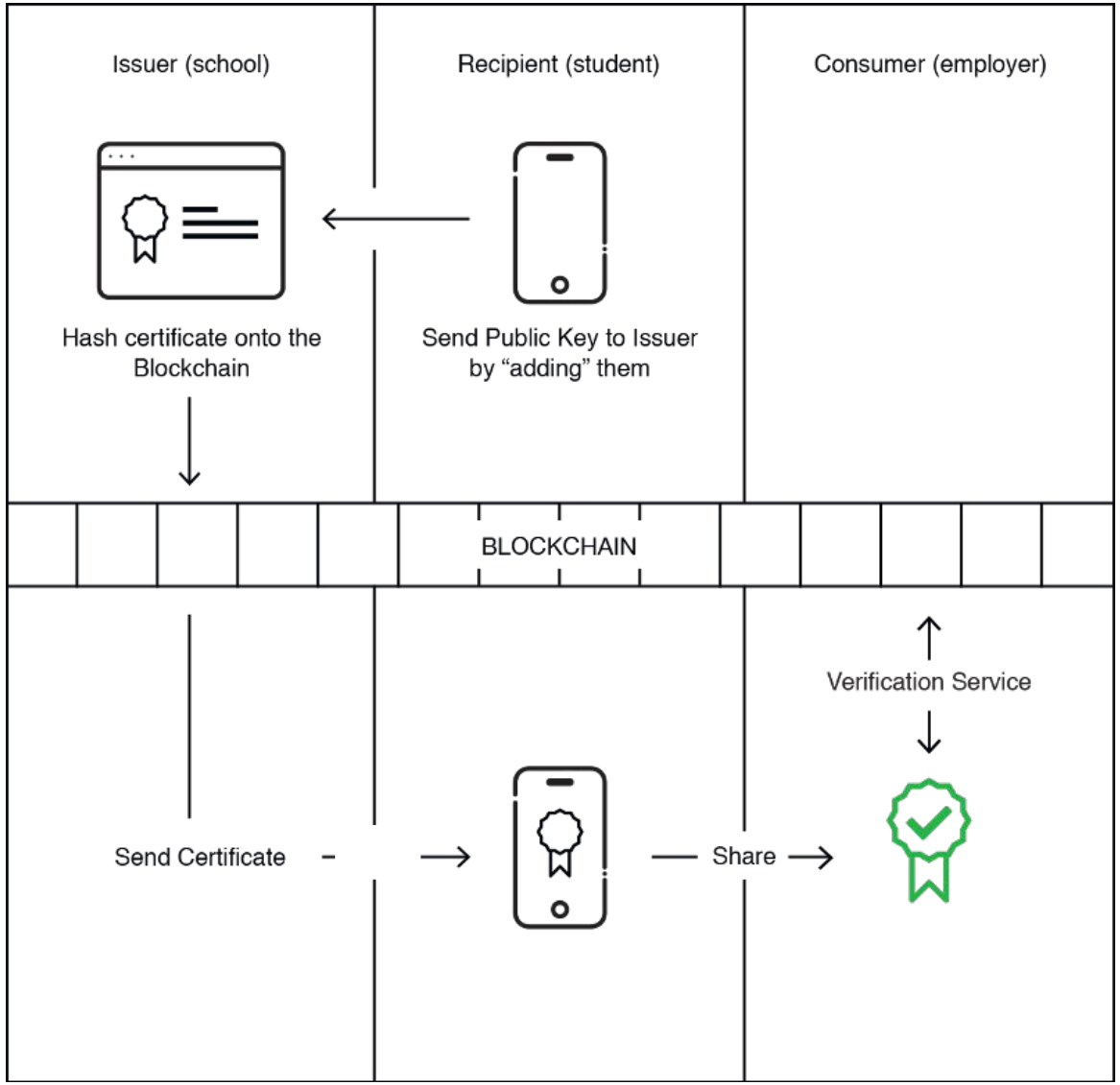
2. School issues a certificate and puts its hash on the Blockchain

Education: Blockchain-based academic certificates



3. The student gets also the certificate (already on Blockchain)

Education: Blockchain-based academic certificates



4. When student applies for a job and send a link to certificate to his employer, HR system uses independent Blockchain verification service to verify the certificate

Education: Blockchain-based academic certificates

Assisting & engaging citizens

US Citizenship and Immigration Services:

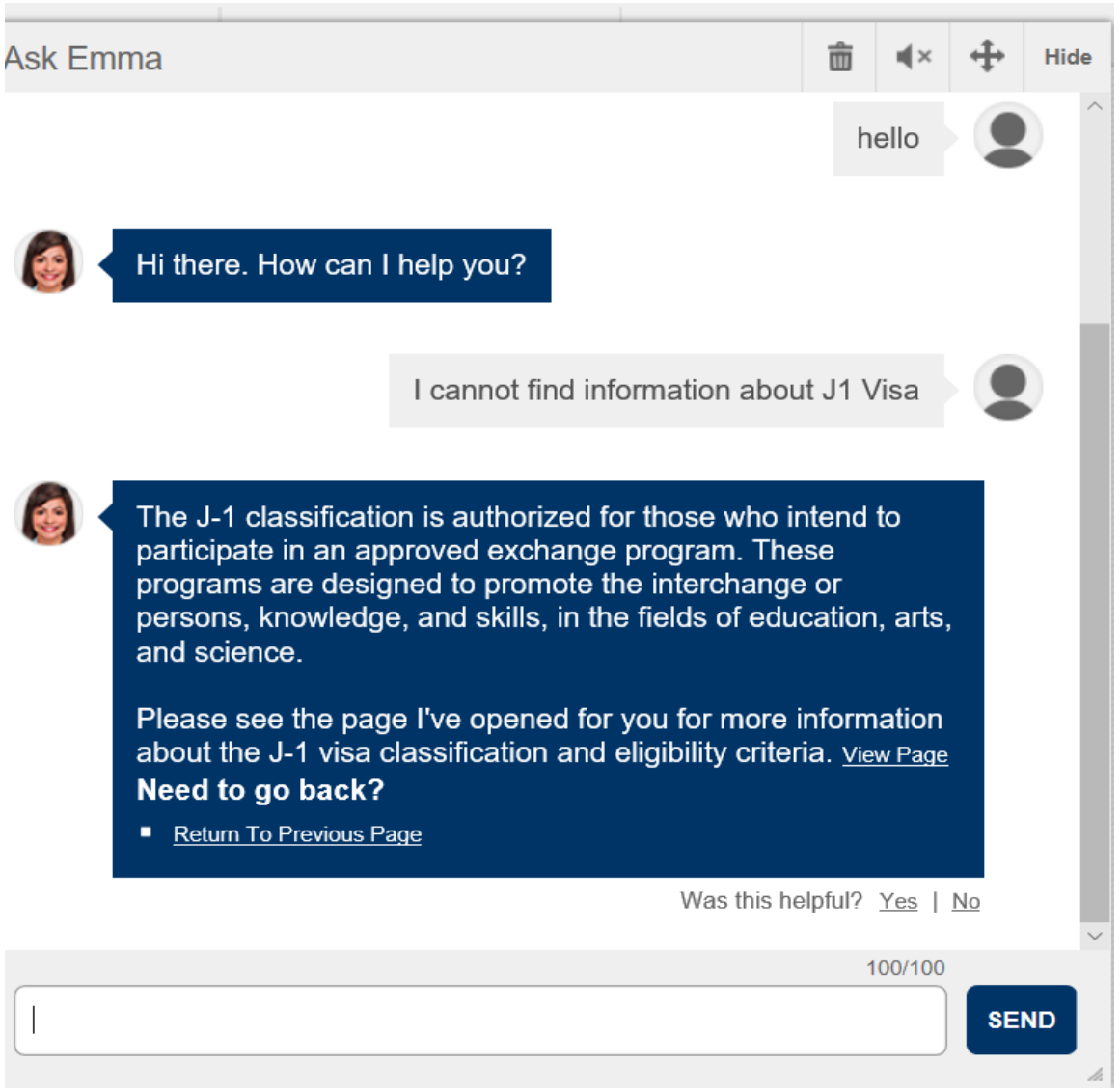
- Virtual assistant Emma

Australian tax office:

- Virtual assistant Alex

Atlanta metro:

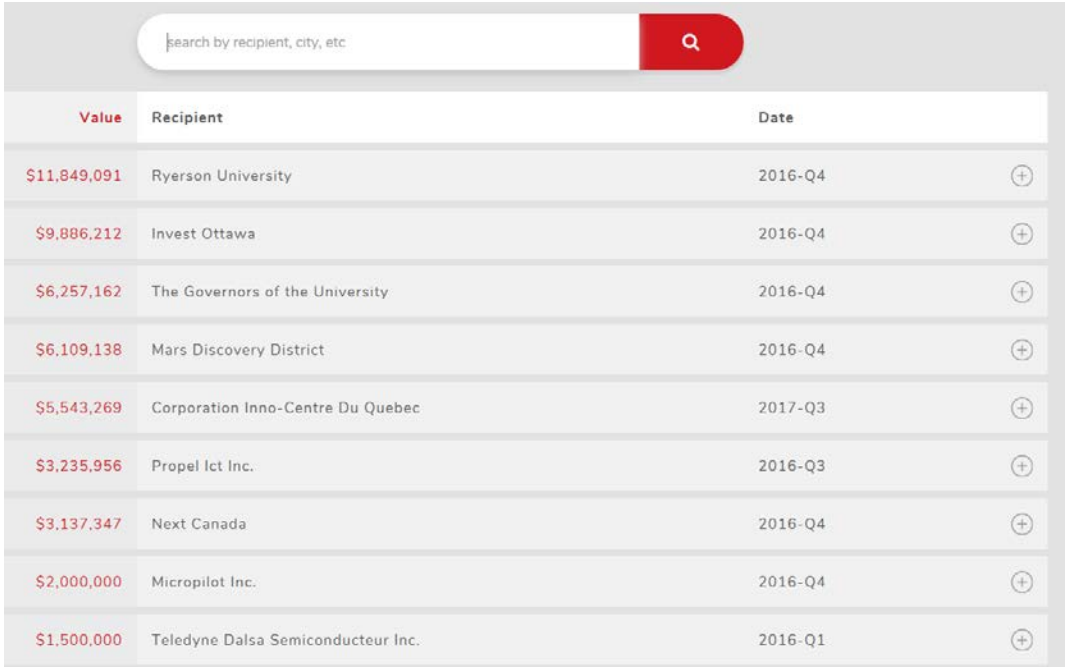
- Textizen (interactive text messaging platform) to engage residents about the future of local transportation



Public transparency

National Research Council of Canada:

- Sharing information about funding and research grants related to Industrial Research Assistant Programme in real time
- Underlying platform: Ethereum-based Catena Blockchain Suite



Disclosure Details

ORGANIZATION
National Research Council Canada

RECEIPENT NAME
Mars Discovery District

VALUE
$6,109,138

TYPE
Contribution

DATE
2016-Q4

REGION
Toronto, Ontario

COUNTRY
Canada

PURPOSE
To support a firm in the "Lessors of non-residential buildings (except mini-warehouses)" industry (NAICS: 531120) with a research and development project.

Blockchain info

TRANSACTION ID
0x3643a884ef1d3a204943bde3e8cc072b8c99a27898de4fe15c6eae28d72056c7

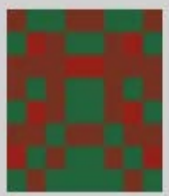
PUBLISHED
21-Nov-2017

BLOCK NUMBER
4592238

CONTRACT INDEX
2332

SIGNED CONTRACT
0xff77e51f2c6473f72392865e0a0000de19af774a

IDENTIFYING ICON



Closing Remarks

- Myriad of applications – however, mostly, at the level of POCs
- Growing convergence of technologies (analogous with computer, telephone, television)
- Still a lot of challenges on technology side
- Other hurdles to adoption
- When implementing, better a market-pull approach
- Marketing vs. meaningful use case
- Interdisciplinarity is essential

Please feel free to reach out

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