

Real-time Analytics for Internet of Sports

| *Marie Curie European Training Network*

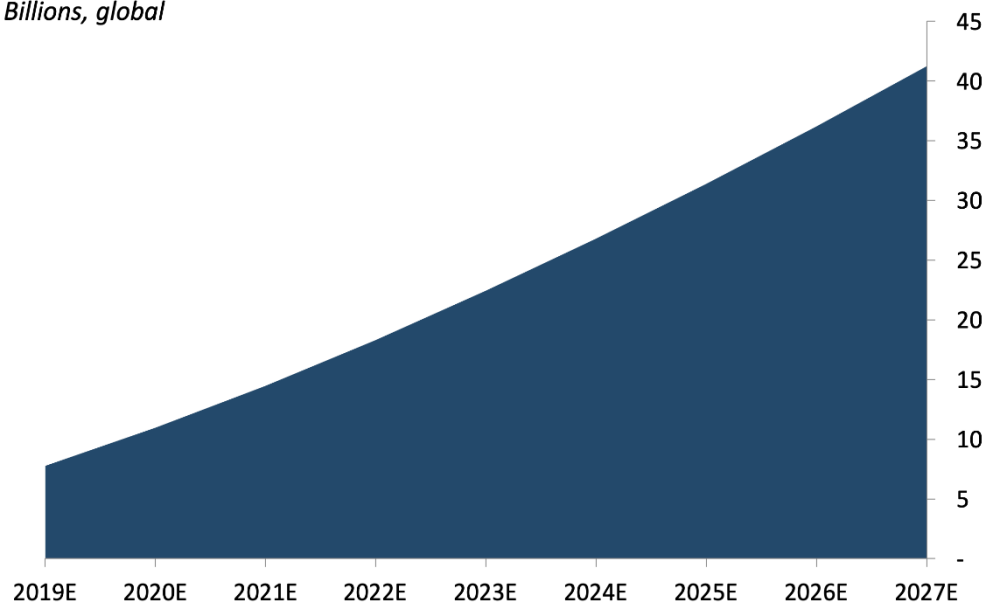
AN OVERVIEW ON BLOCKCHAIN-BASED DATA MARKETPLACES

Ioannis Savvidis, University of Cyprus (UCY)

Personal Data

- 41 Billion IoT Devices
- 2.4 trillion dollars annually by 2027

FORECAST: Total IoT Device Installation Base
Billions, global



Source: Business Insider Intelligence estimates, 2020

BUSINESS
INSIDER
INTELLIGENCE

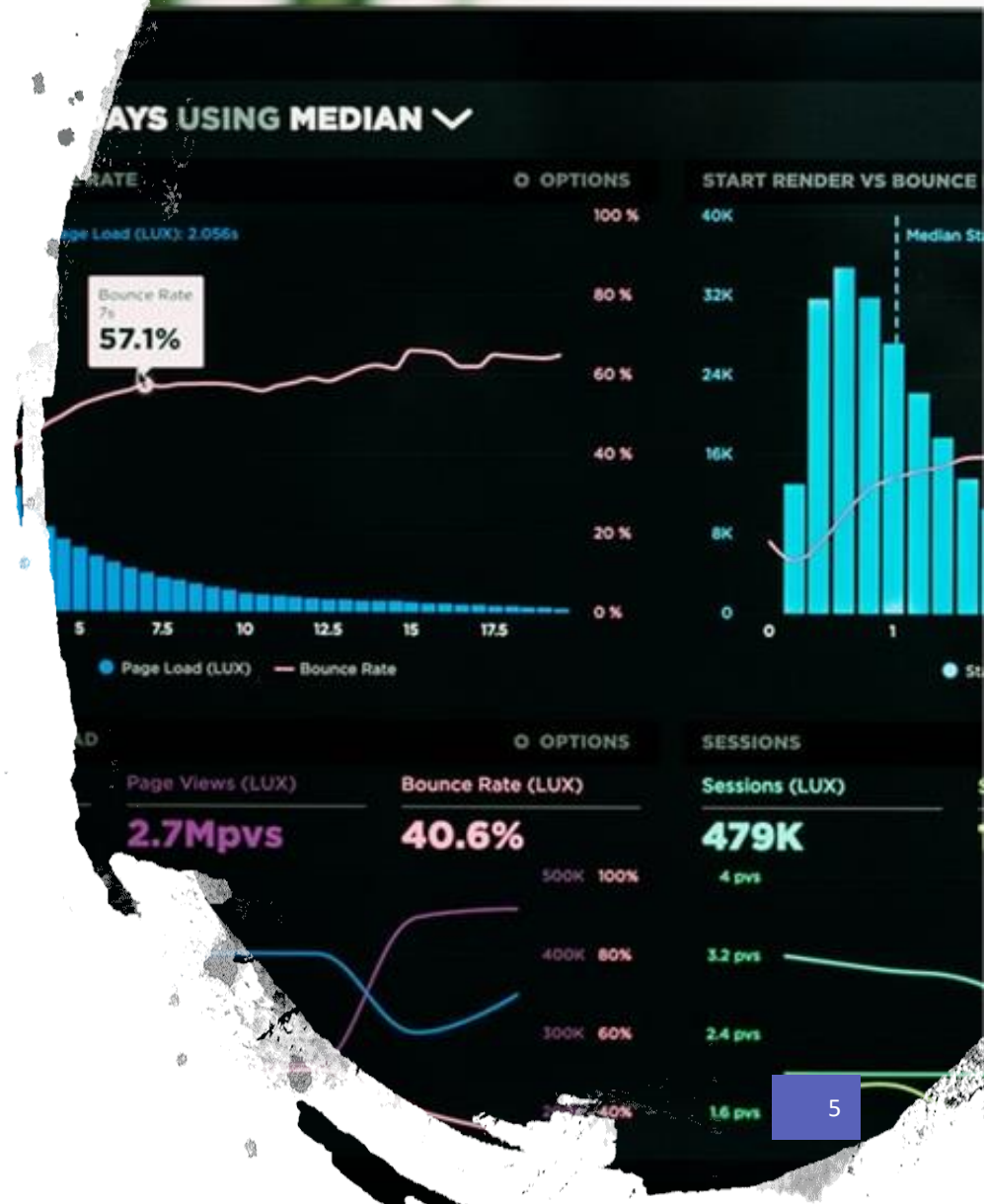
Personal data has value

- *“Data is the new oil.”*
- - Clive Humby

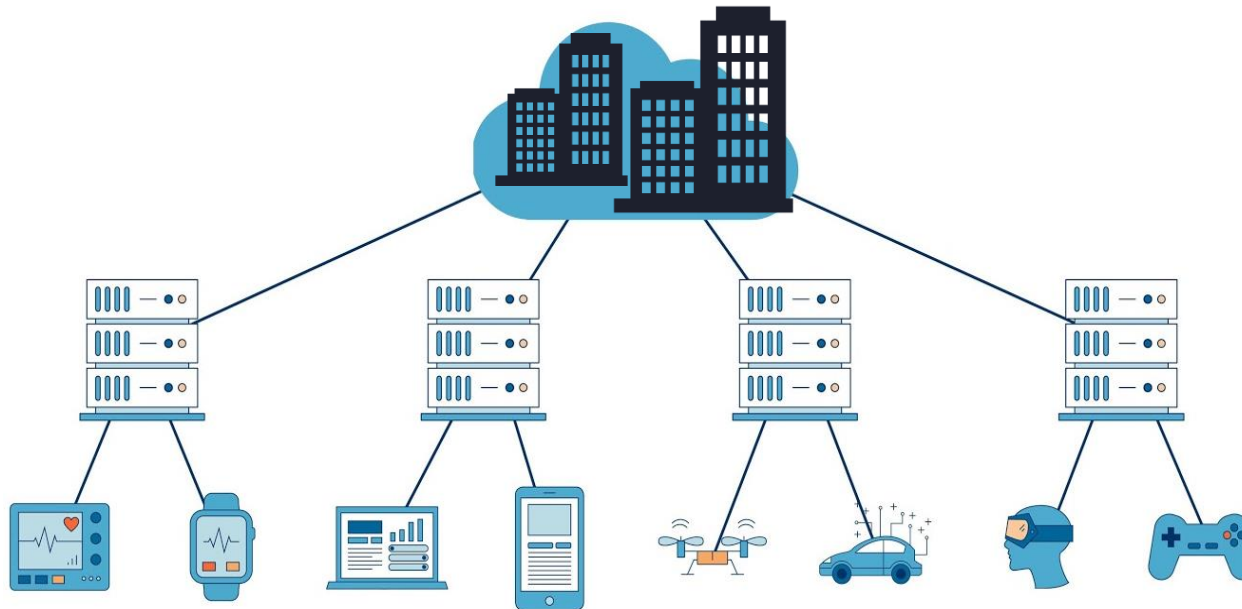


Why data has value?

- For Companies
- Tailored-made advertising
- Products and services based on consumer preferences
- Better understanding of their environment
- Competitive advantage



Traditional Model



Source: https://medium.com/@arus_ishkhyan/edge-computing-101-25ad3e14b849

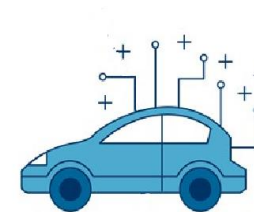
Personal Data



Browsing history



Smartphones



Smart city



Wearables



Healthcare

Source: https://medium.com/@arus_ishkhanyan/edge-computing-101-25ad3e14b849

Challenges

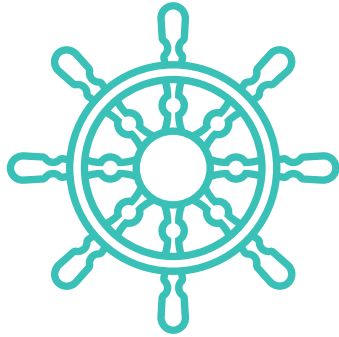
Data Brokers

Data is collected by data brokers who analyze it and sell the produced information to the interested companies





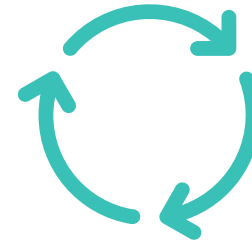
Security



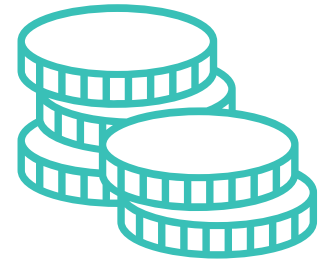
Control
and
Management



Privacy



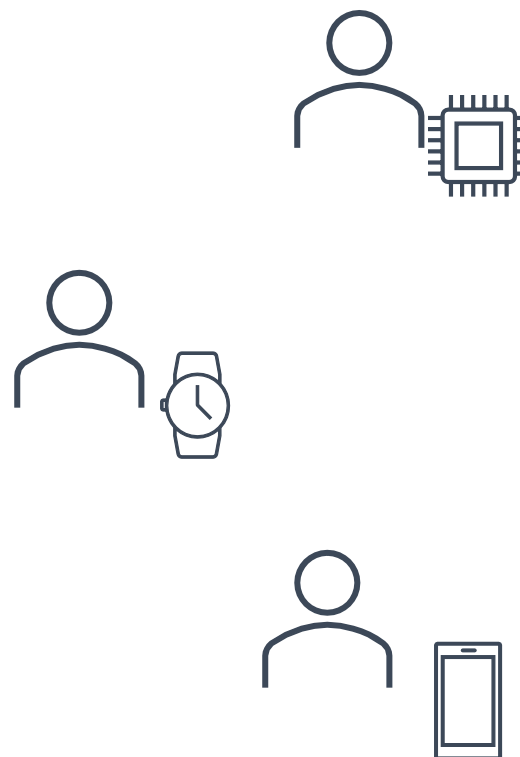
Availability



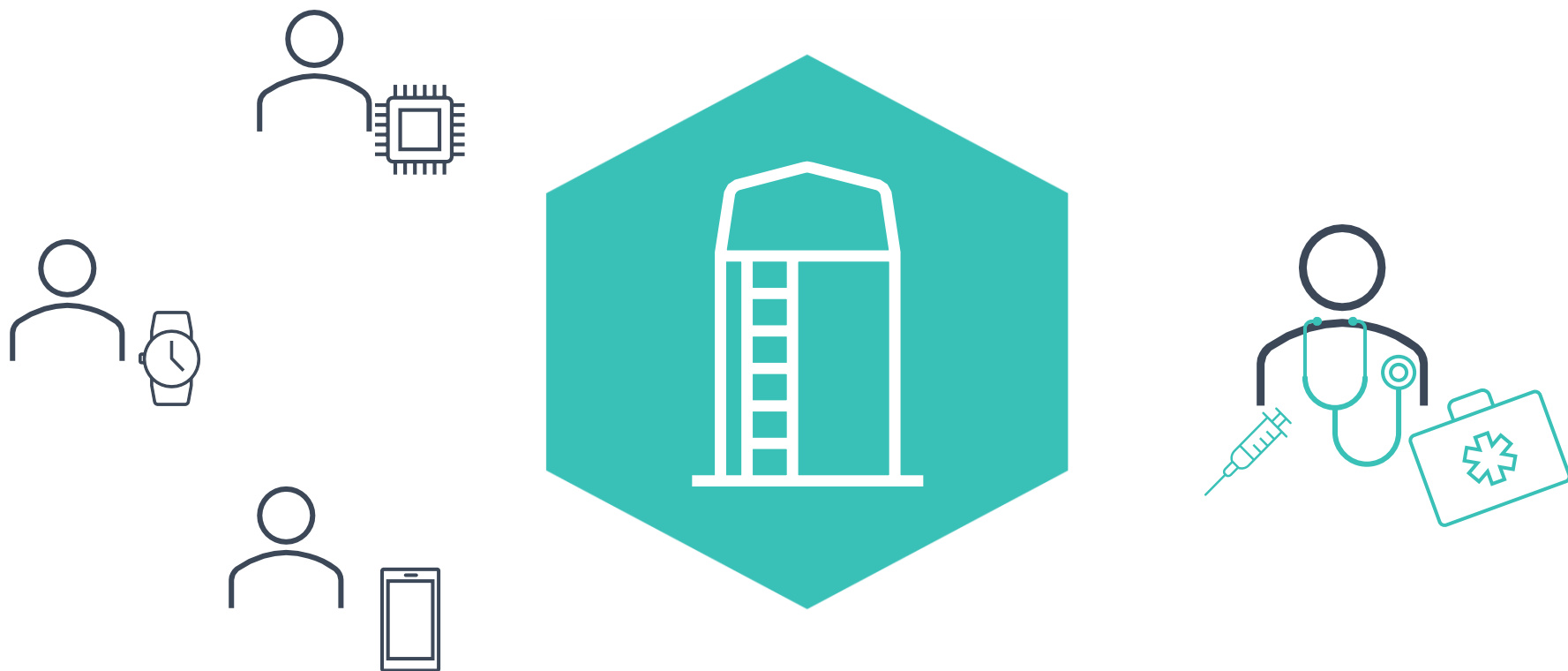
Reward

Challenges and Issues

Data Silos

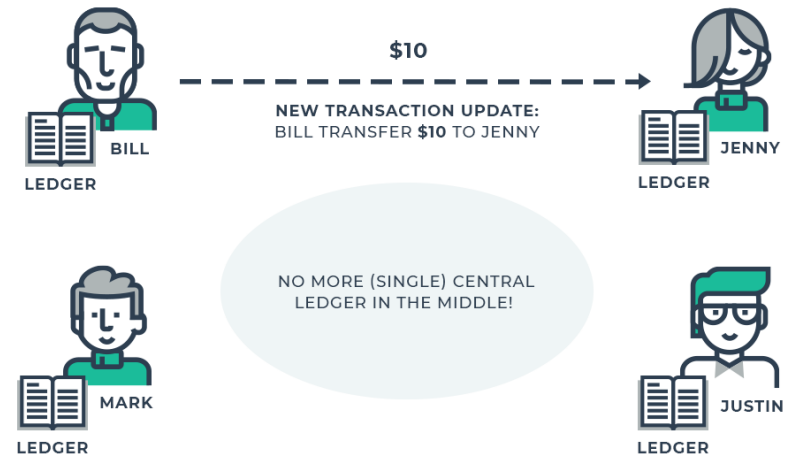
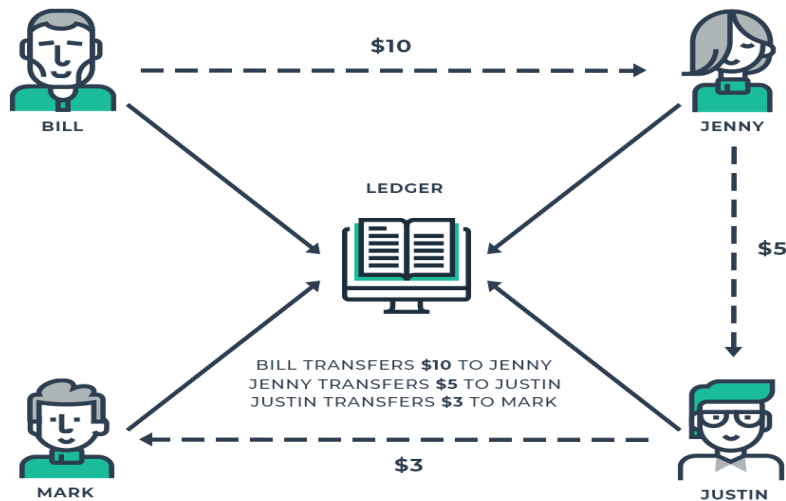


Data Silos



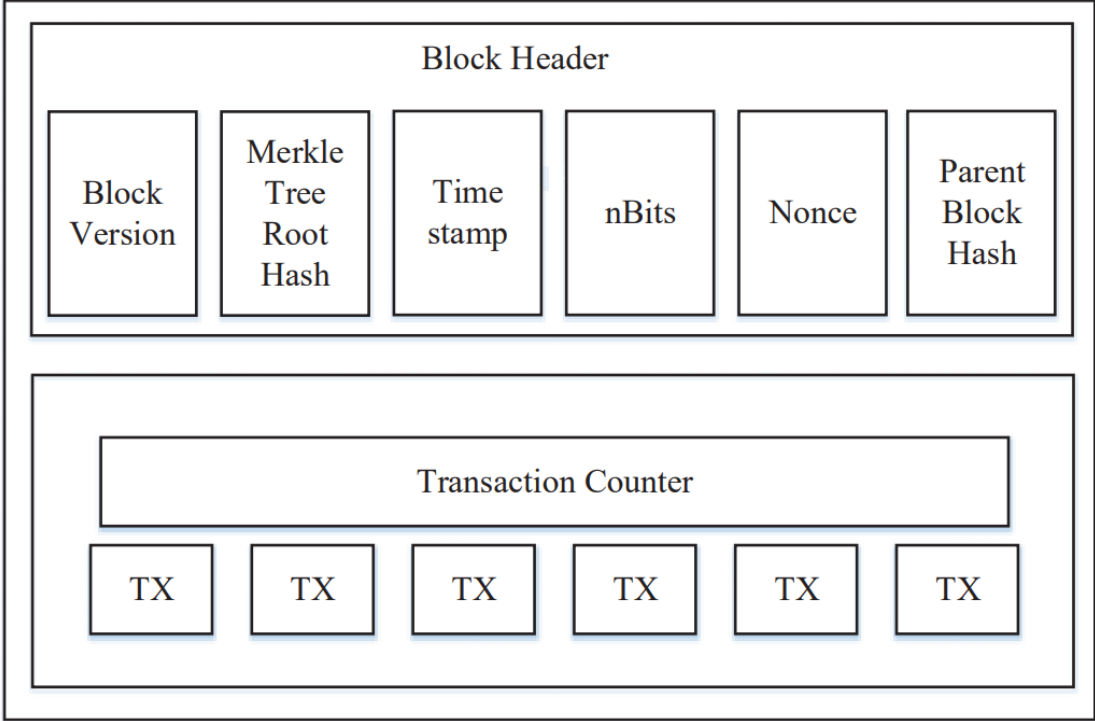
Blockchain

Decentralized Ledger

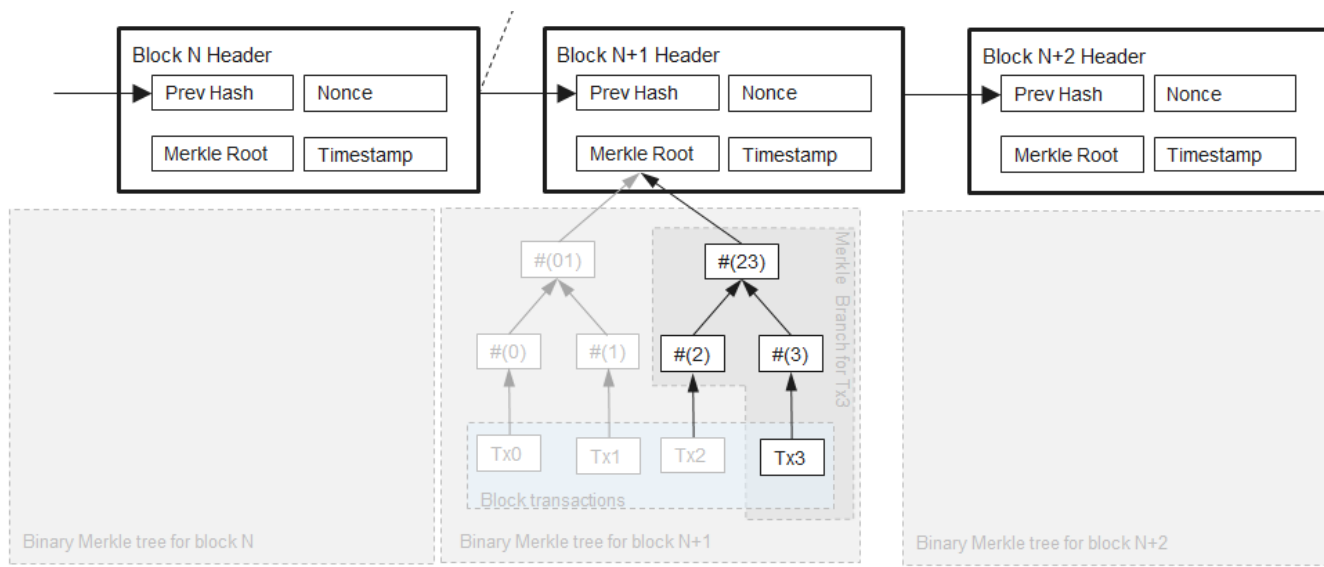


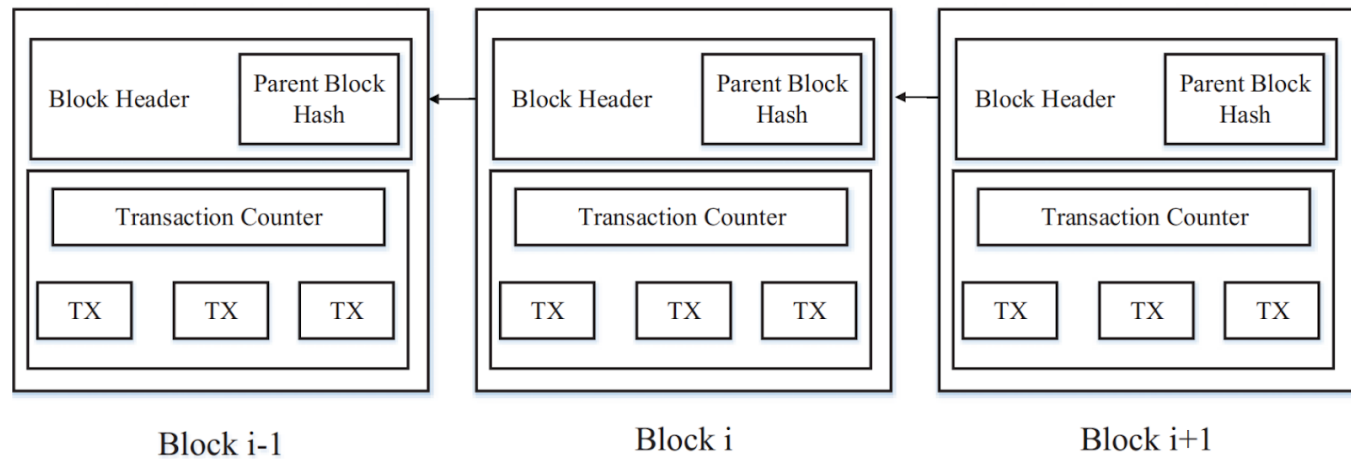
Source: <https://www.fintechamericas.co/news/blockchain-101/>

Block



Block





Blockchain

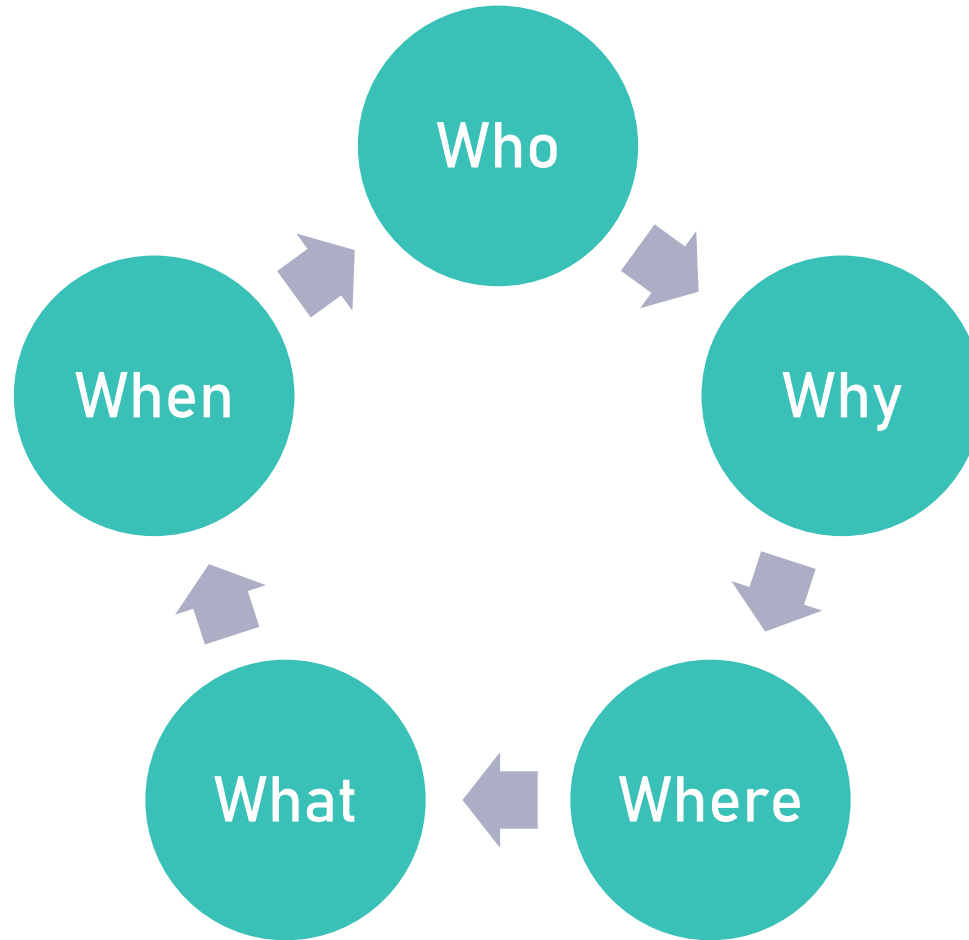
Smart Contracts

- Ethereum Virtual Machine (EVM)
 - Stack-based
- The code is written in a Turing-complete bytecode language (EVM bytecode).
 - Hexadecimal representation of contract.
- The smart contract code is public and is not updatable.
- Most common language is Solidity.
- Memory
 - Transient data
 - Not persisted across transactions
- Storage
 - Persistent associative map
- The execution of each line of code that affects the state, costs an amount of money (gas).



How can blockchain help?

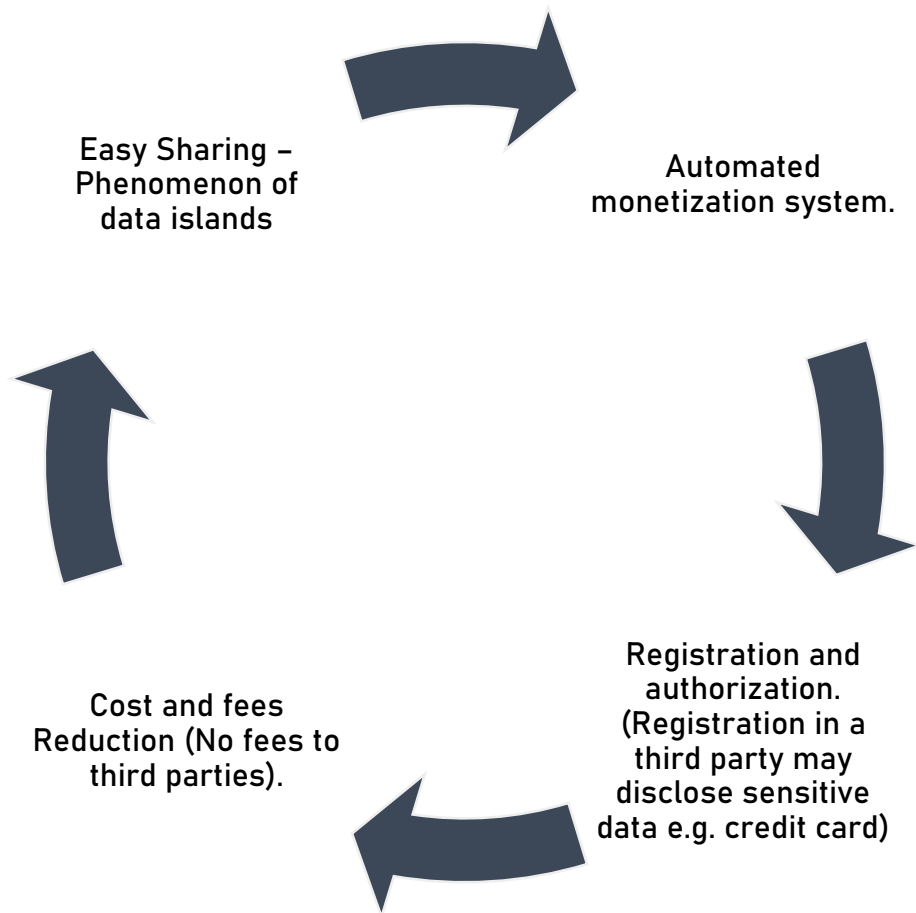
Smart Contract Enforce Policies



Why Blockchain?



Why Blockchain?



Data Marketplace

Data Marketplace

According to Schomm et al. (2013), data marketplace is “a platform on which anybody (or at least a great number of potentially registered clients) can upload and maintain data sets. Access to and use of the data is regulated through varying licensing models”.

Definition

Main Entities



Data Provider

$$DP_i = \{DP_1, \dots, DP_n\}$$



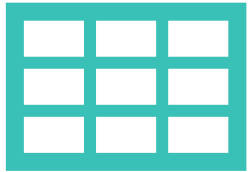
Data Consumer

$$DC_j = \{DC_1, \dots, DC_m\}$$



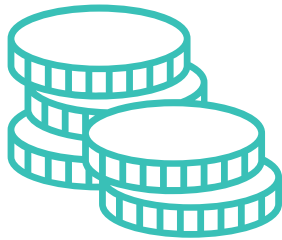
Governor

Other Primitives



Dataset

$$D_{il} = \{D_{i1}, \dots, D_{il}\}$$

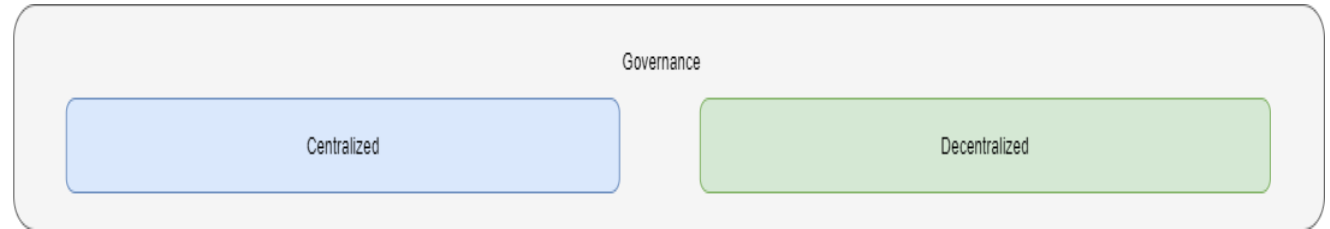


Data Cost

DK_{il} *For users' i Dataset l*

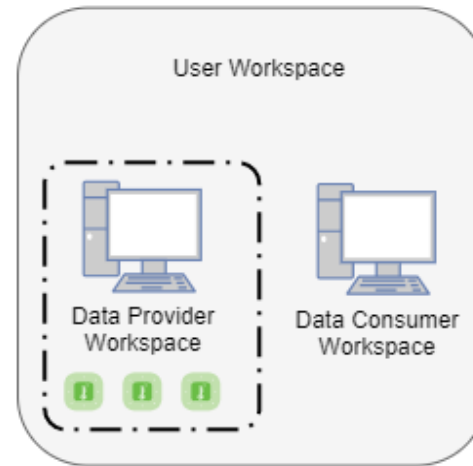


Agreement



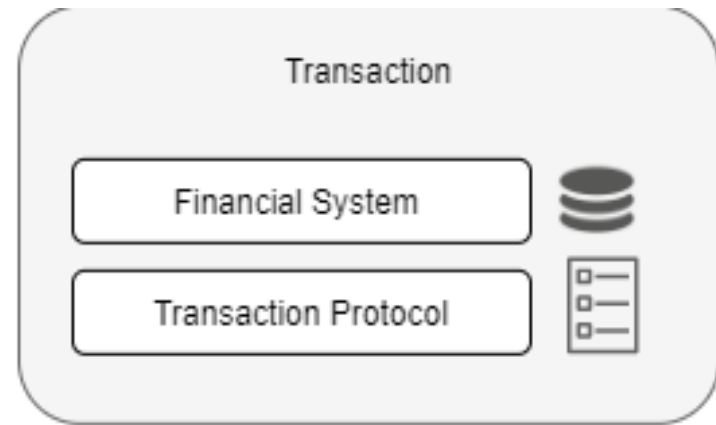
Governance

- Sets the rules
- Monitors the system
- Detecting malicious data providers and data consumers
- Detecting fraud transactions and enforcing penalties



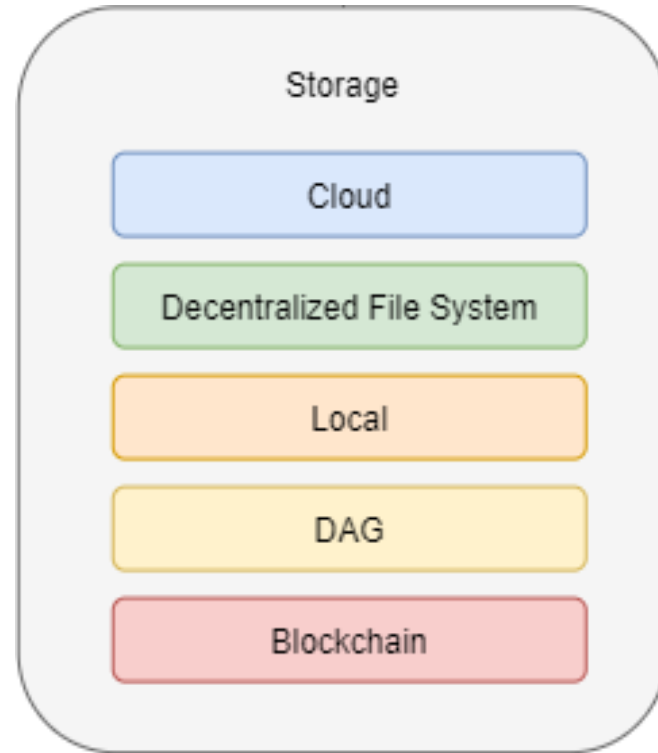
- Data Provider's Workspace
 - Registration environment for the user
 - Registration of the data
 - User determines his privacy preferences
 - User set transaction rules
 - SDK
- Data Consumer's Workspace
 - Possibilities related to the purchase of datasets

Transaction

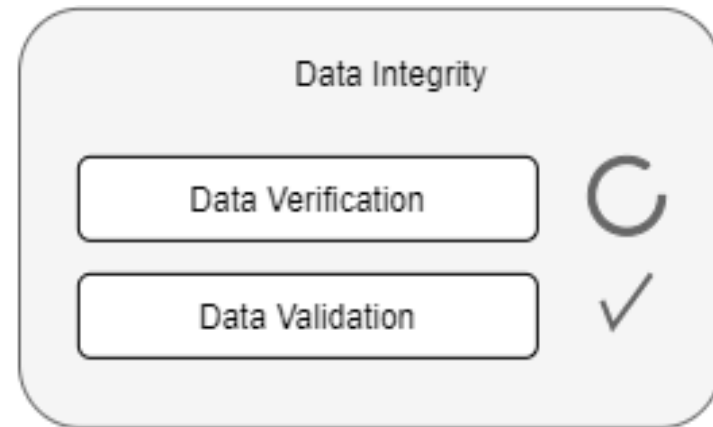


- Financial System
 - Pricing of the data
- Transaction Protocol
 - Procedure
 - Successful
 - Fair

Storage

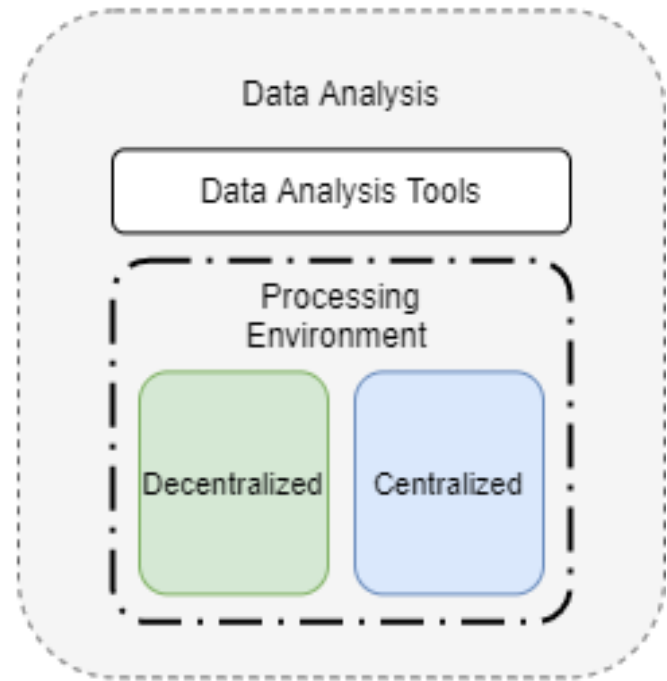


Data Integrity

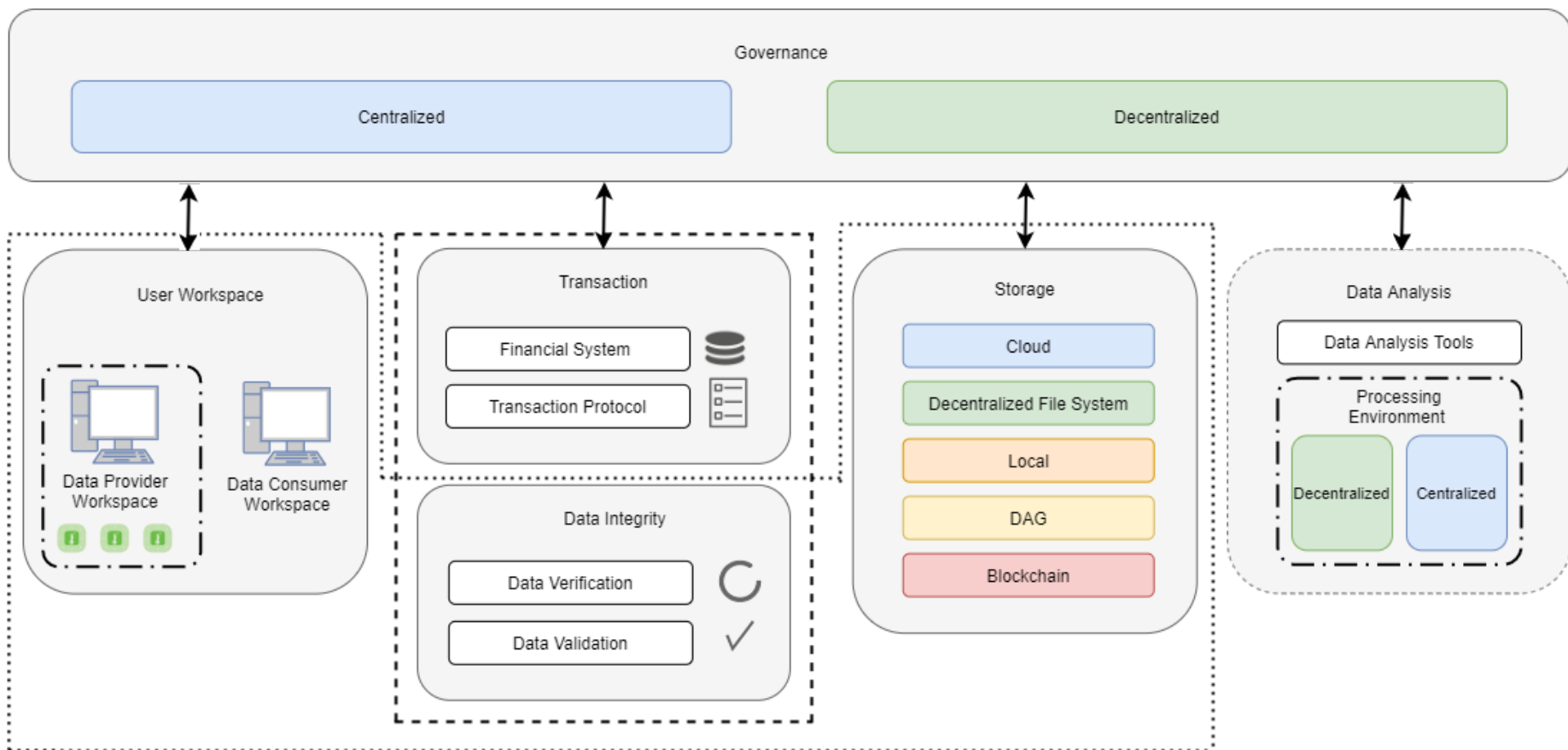


- Verification
 - Completeness
- Data validation
 - Quality
 - Usefulness
 - Replication

Data Analysis



Architectural Components



Solutions

Data Quality (Zheng et al, 2018)

Hardware

- Trusted Vendors
- Devices and Sensors transmit identification details

Software

- Machine learning techniques

Zheng, X., Mukkamala, R. R., Vatrappu, R. and Ordieres-Mere, J. (2018) 'Blockchain-based Personal Health Data Sharing System Using Cloud Storage.' *In 2018 IEEE 20th International Conference on e-Health Networking, Applications and Services (Healthcom)*, pp. 1-6.

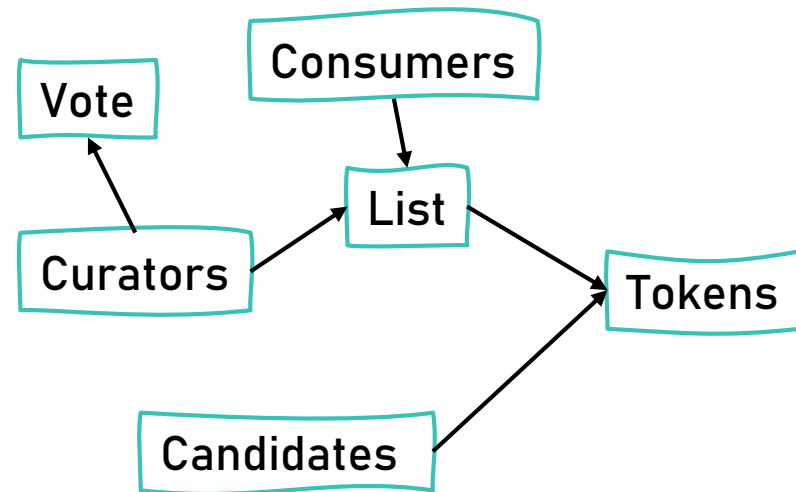
Data Quality (Ramachandran et al., 2018)

Dataset Rating

- Implementation using Smart Contracts
- Rating validity by checking Data provider – Data Consumer interaction

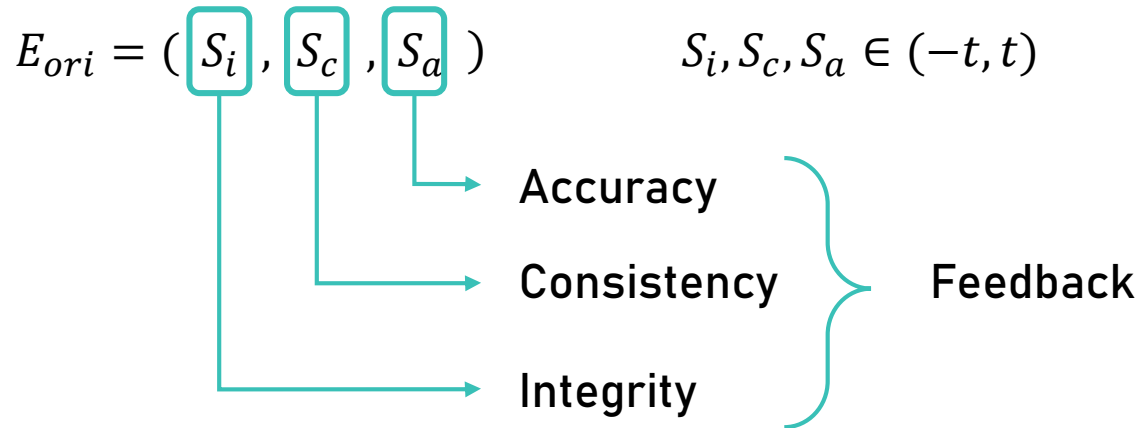
Token Curated Registries

- Decentralized lists
- Connected with Tokens
- Token value depend on list's quality



Ramachandran, G. S., Radhakrishnan, R. and Krishnamachari, B. (2018) 'Towards a Decentralized Data Marketplace for Smart Cities.' *In 2018 IEEE International Smart Cities Conference (ISC2)*, pp. 1-8.

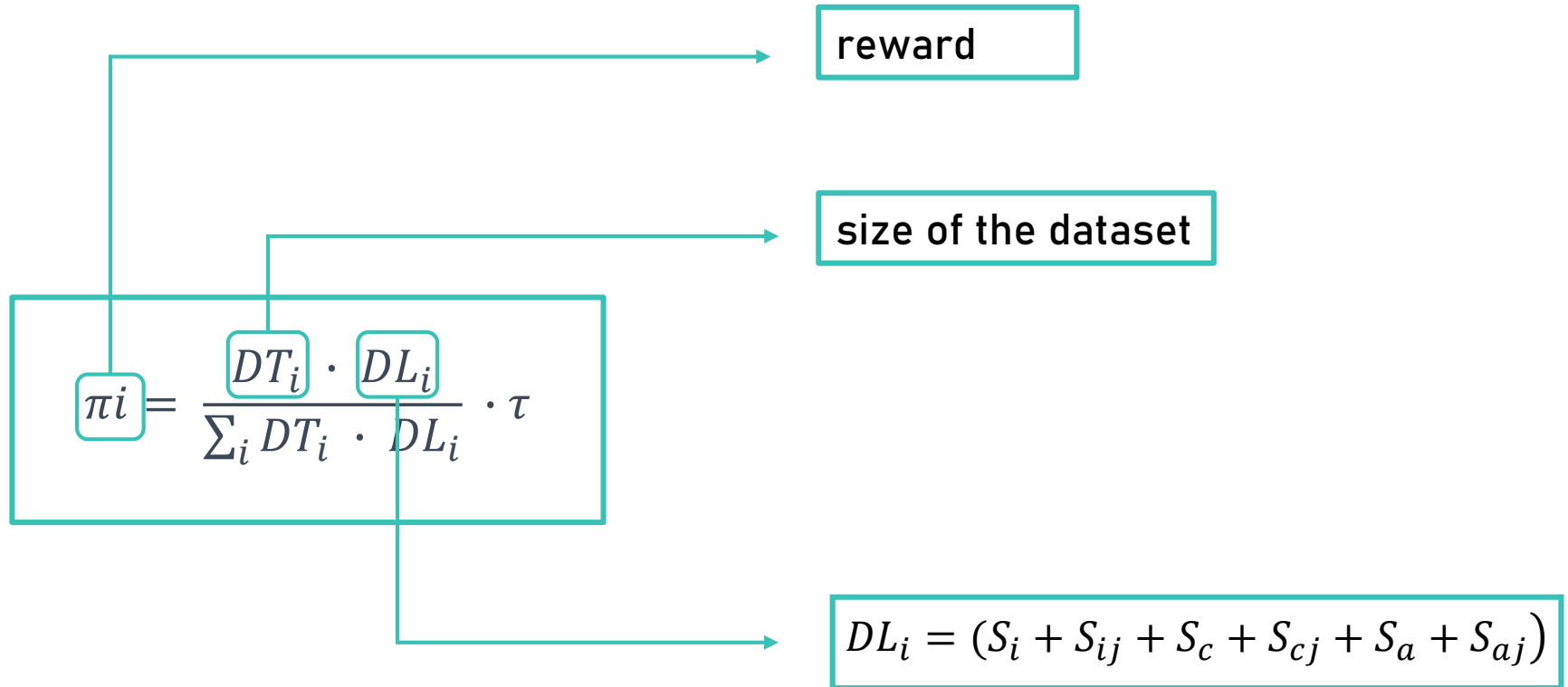
Data Quality (Zheng et al., 2020)



$$DL_i = (S_i + S_{ij} + S_c + S_{cj} + S_a + S_{aj})$$

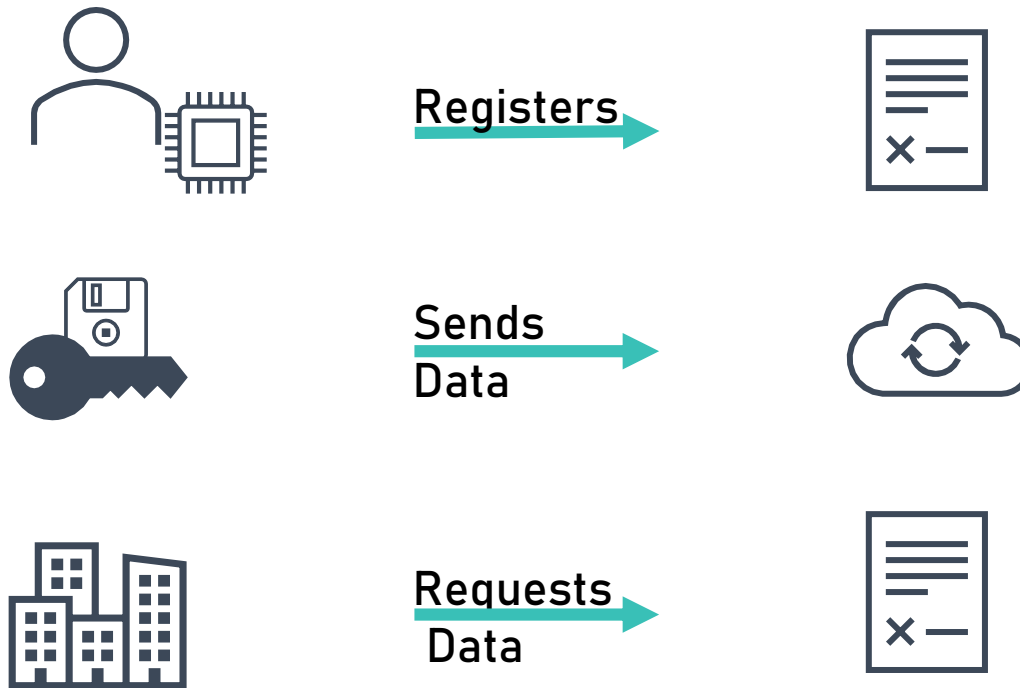
Zheng, S., Pan, L., Hu, D., Li, M. and Fan, Y. (2020) 'A Blockchain-Based Trading Platform for Big Data.' In *IEEE INFOCOM 2020 - IEEE Conference on Computer Communications Workshops (INFOCOM WKSHPS)*, pp. 991-996.

Rewarding System



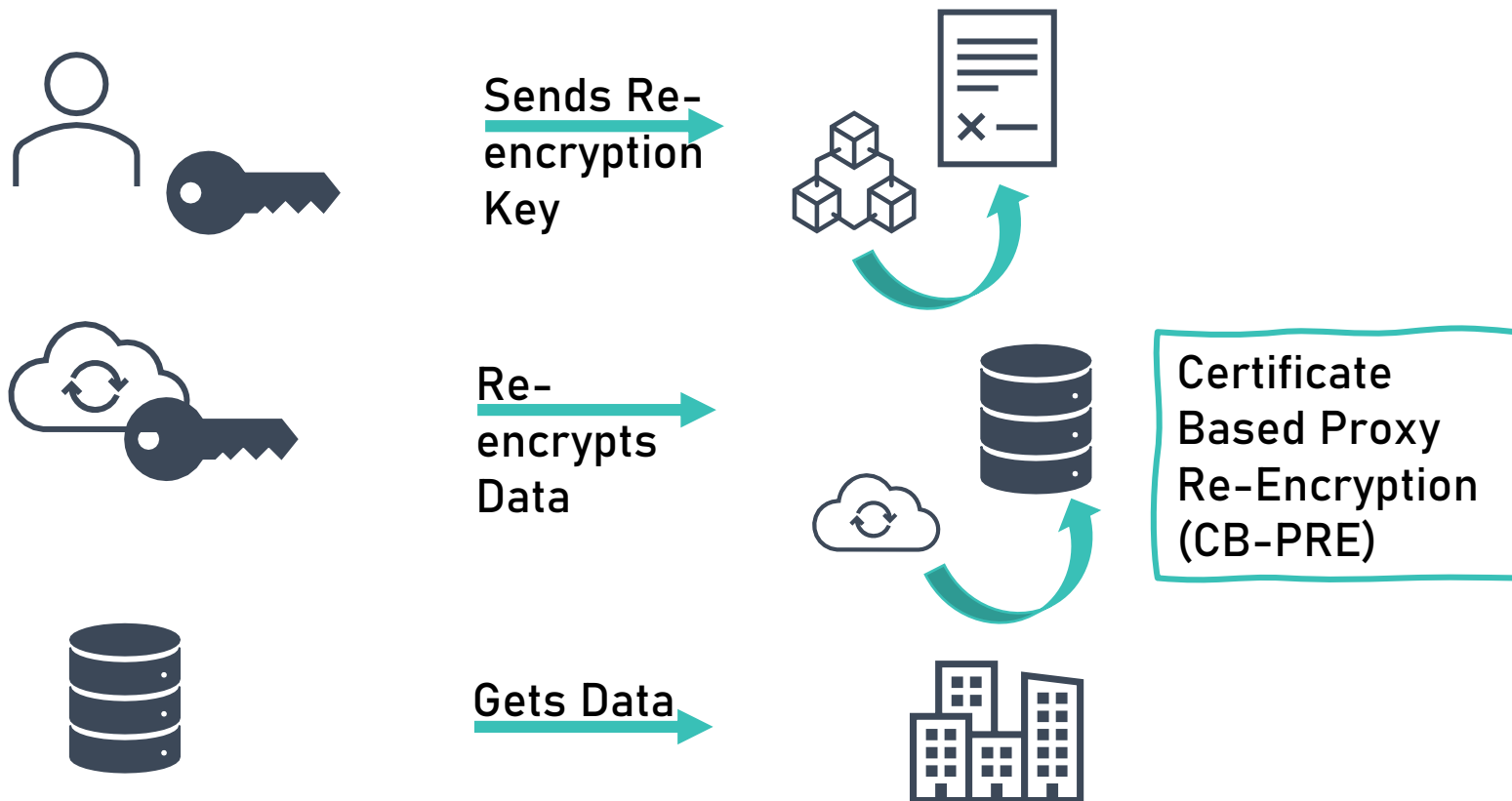
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Data Transfer (Manzoor et al., 2020)



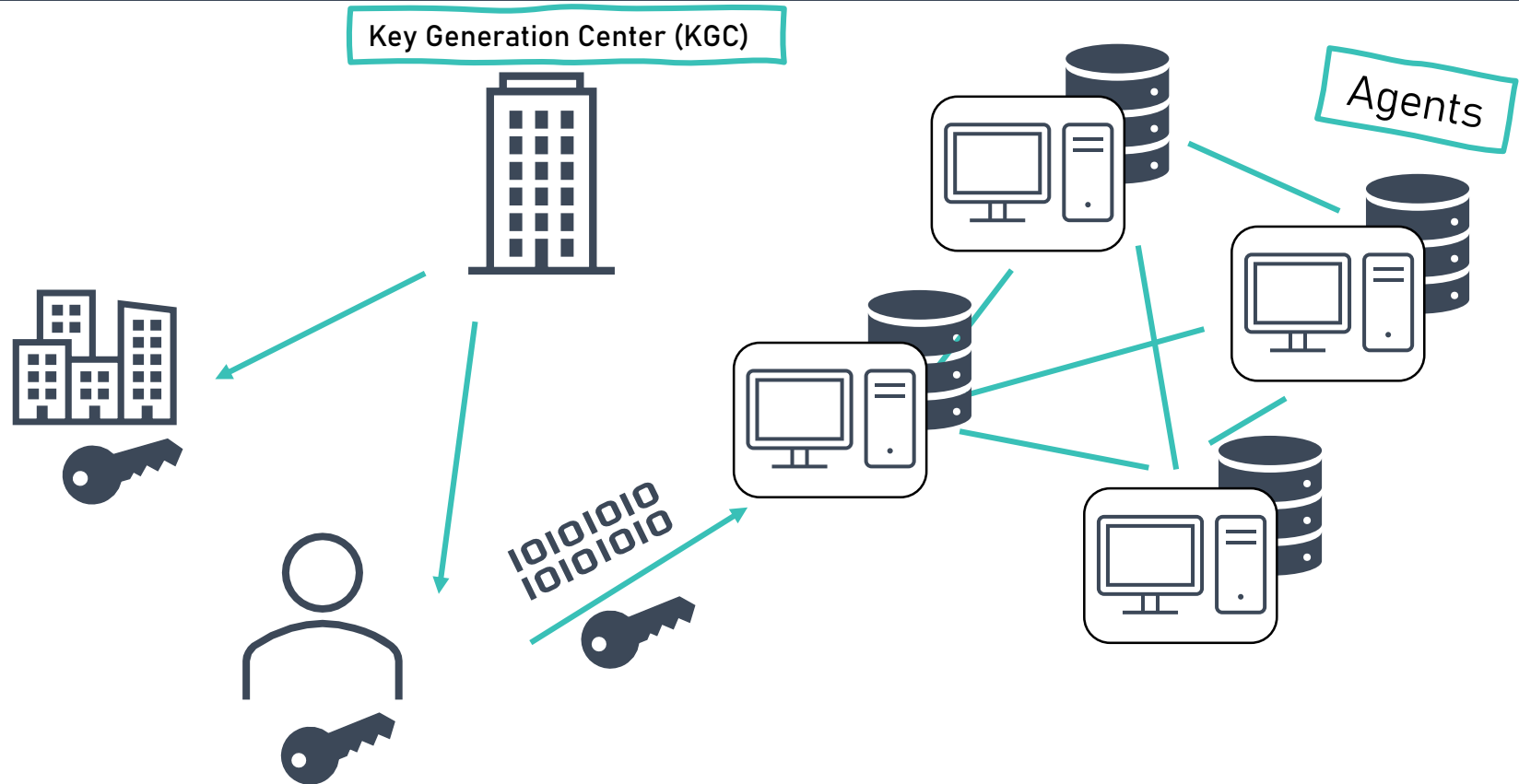
Manzoor, A., Liyanage, M., Braeke, A., Kanhere, S. S. and Ylianttila, M. (2019) 'Blockchain based Proxy Re-Encryption Scheme for Secure IoT Data Sharing.' *In 2019 IEEE International Conference on Blockchain and Cryptocurrency (ICBC)*, pp. 99-103.

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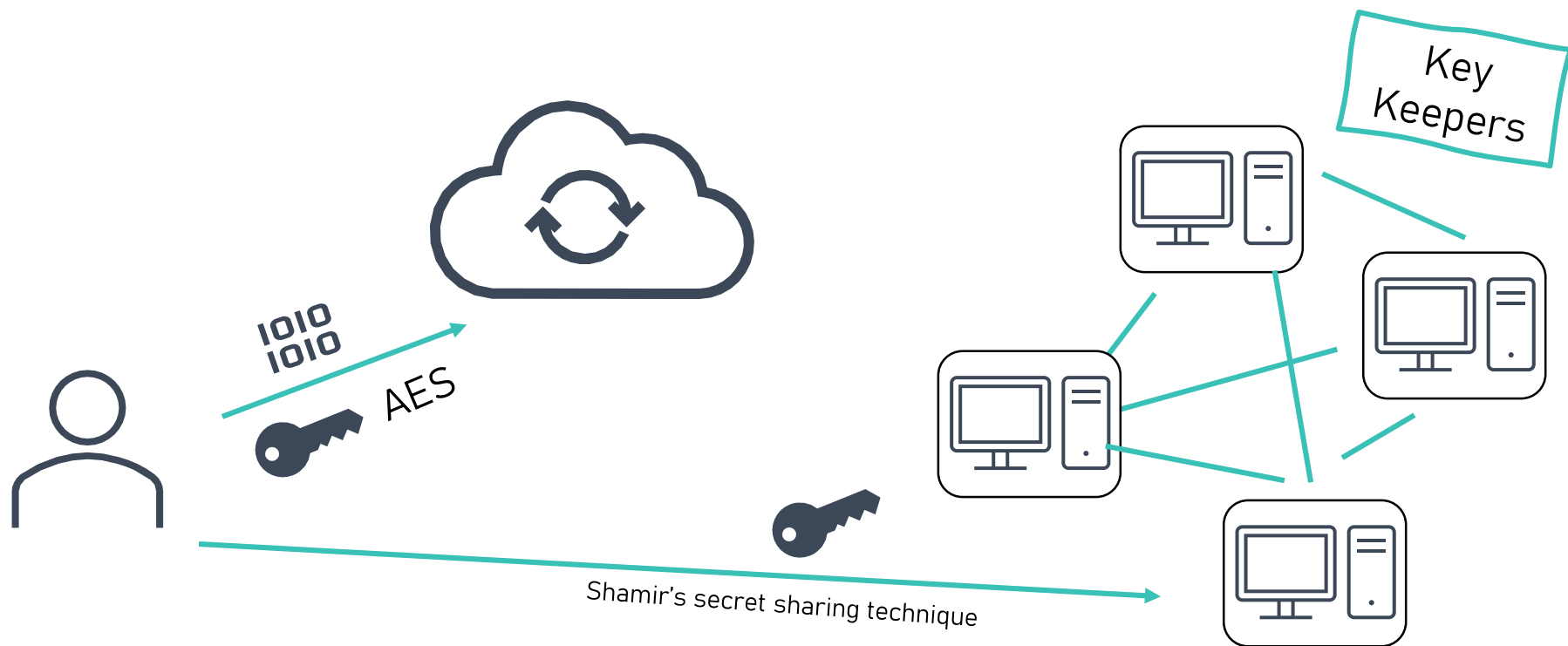
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Thank you!

Beneficiaries / Partners

BENEFICIARIES



WEMEMOVE



PARTNERS



Research Meeting, Thessaloniki Greece, 10th -11th December



Acknowledgement



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