Let's Talk about Blockchain
... und was sie für die Hotellerie leisten kann

HSMAday, September 2023

Prof. Dr. Ingo Weber

ingo.weber@tum.de

http://imweber.de/

Full professor at TUM and
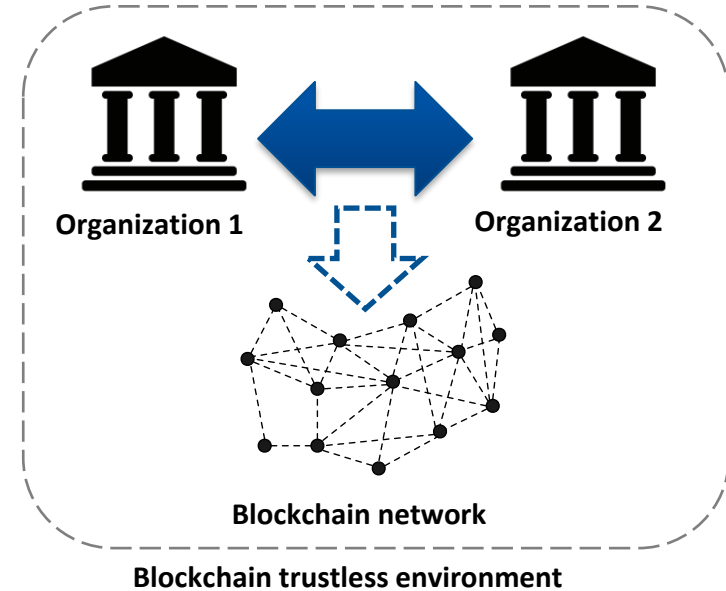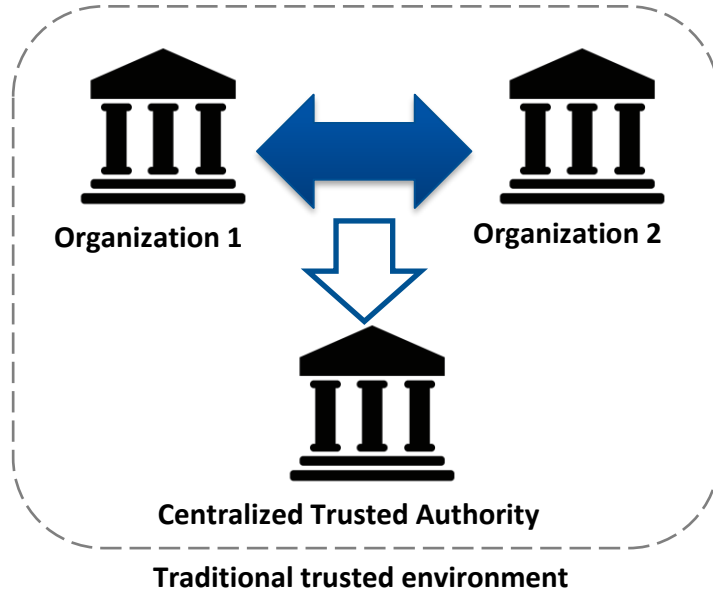Director IT infrastructure & digital transformation
at Fraunhofer

TUM

Fraunhofer

Let's Talk about Blockchain
## ... und was sie für die Hotellerie leisten kann

Blockchain – replacing centralized trusted authority

Organization 1   **Organization 2**

Centralized Trusted Authority

Traditional trusted environment

Organization 1   **Organization 2**

Blockchain network

Blockchain trustless environment

How?

- **Immutable data base**
  - Public ledger
- **Every node hosts a replica**
  - Distributed consensus
    - *No central owner of consensus*
- **Transaction is verified by every node**

- **Combination of knowledge from Distributed Systems, Peer-to-Peer, Cryptography, Incentive Systems and Game Theory**
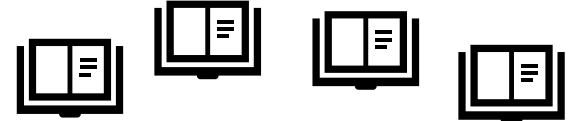
Blockchain network
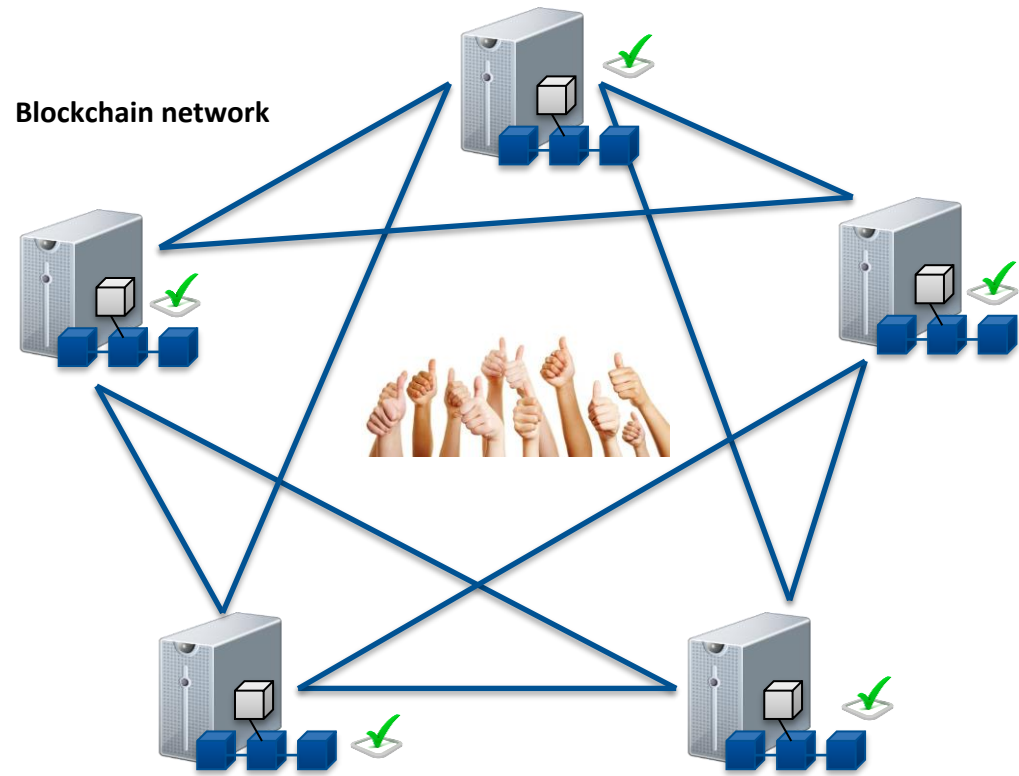
Intuition: physical ledger copies (1/2)

Imagine an empty ledger book

On the first page, we write the current account balances

- Say, 100 SE-Ed-$ per attendee:
  - Grace: $ 100
  - Rod: $ 100
  - Len: $ 100
  - Ingo: $ 100
  - …

Now imagine we make a lot of copies of the ledger; one per attendee

Len wants to buy a copy of my blockchain book, so he transfers $ 40 to me

- We all need to update our ledger copies, so Len writes and signs a note (like a cheque) about the transaction, and sends a copy of that to each of us
- We all check that (i) he has the money, and (ii) the signature is his
- Then we add this transaction to page 2 of the ledger

Intuition: physical ledger copies (2/2)

Now I want to buy a copy of Len's new book, so I transfers $ 60 to him

- I write and sign a note about the transaction, and
  send a copy of that to each of you
- You all perform your checks as before, then add my transaction to page 3 of the ledger

The current account balances are:

- Grace: $ 100
- Len: $ 120
- Ingo: $ 80 …

Analogy:

- Ledger is the data structure, pages are blocks
- Transactions are transactions, but signatures are digital
- From the sender account, anyone can check the validity of the signature
- We need to ensure everyone has the same version of ledger (consensus),
  no pages can be removed, etc.

Blockchain 1ˢᵗ gen — Cryptocurrency

Send 2 BTC from my account to Bob.
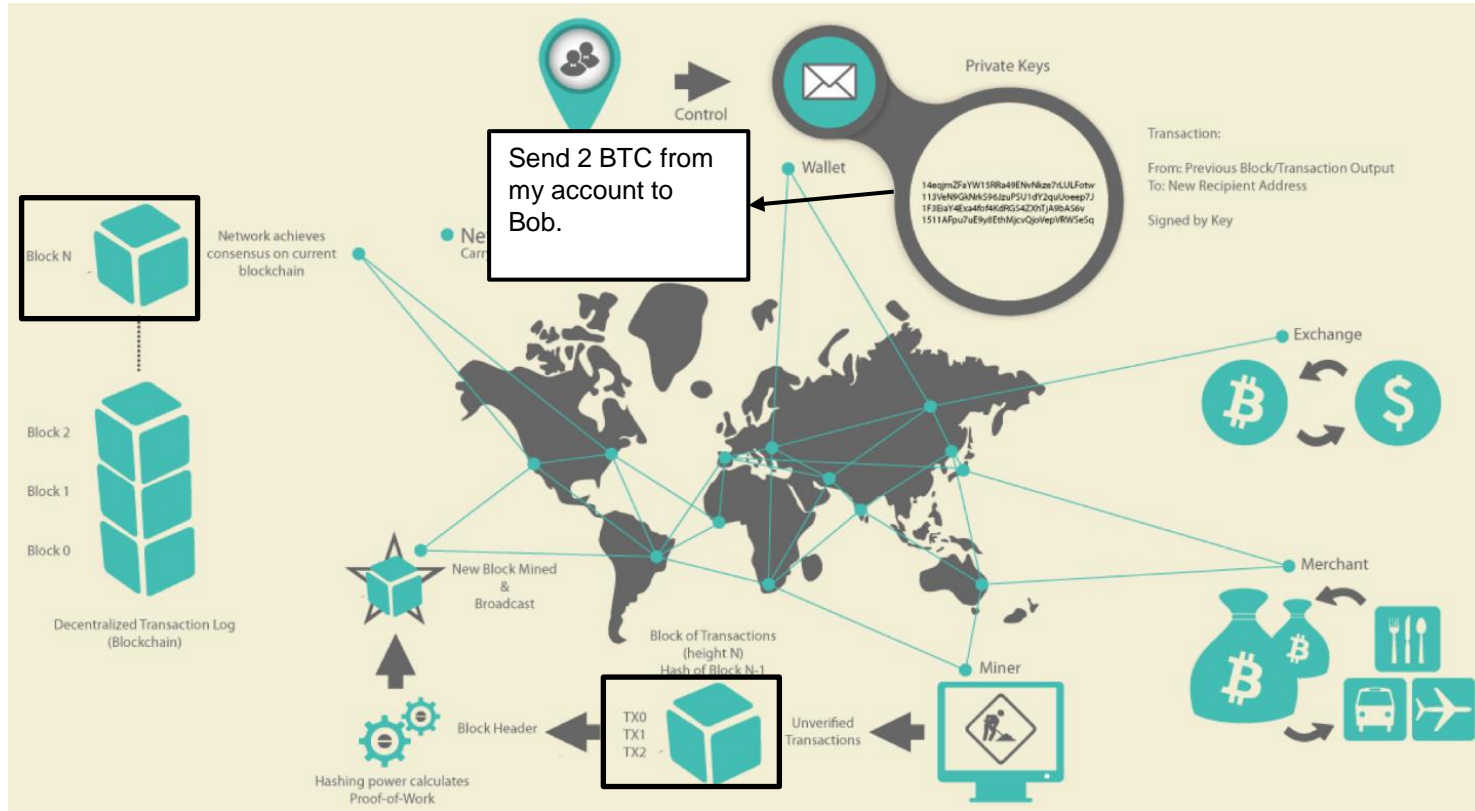
Users:
- create transactions,
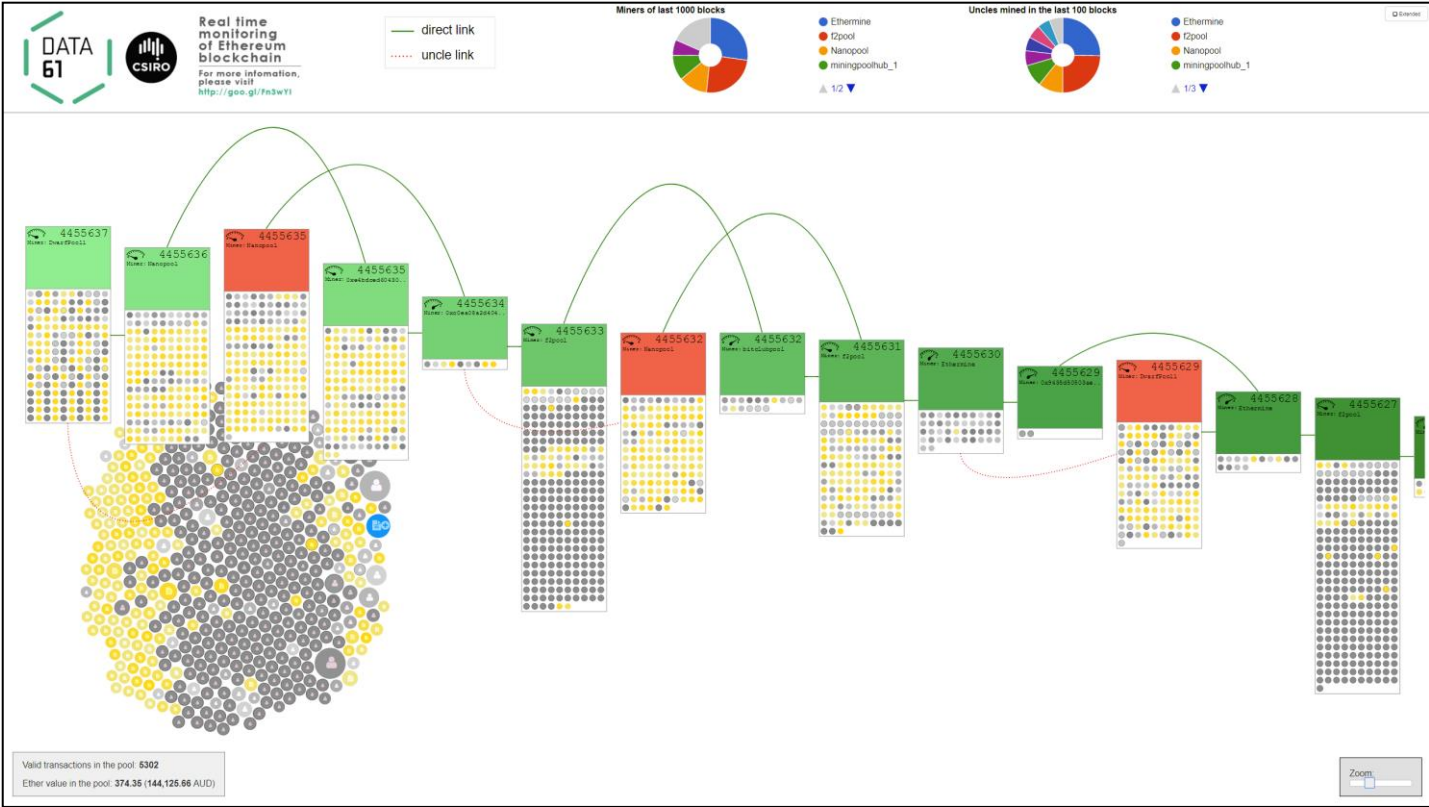- sign them, and
- announce them to network

Miners:
- receive transactions
- include them in a new block,
- (try to) append the new block to the data structure

When a transaction is part of the data structure, it has taken place (though it's a bit more complicated – more later).

What is a Blockchain?

Visualization of a Blockchain: http://ethviewer.live

Blockchain 2nd gen – Smart Contracts

- 1st gen blockchains: transactions are financial transfers
- Now Blockchain ledger can do that, and store/transact any kind of data
- Blockchain can deploy and execute programs: Smart Contracts
  - User-defined code, deployed on and executed by whole network
  - Can enact decisions on complex business conditions
  - Can hold and transfer assets, managed by the contract itself
 - Ethereum: pay per assembler-level instruction

So what?

Well, blockchains are exciting because they can be used as a new foundation for re-imagining systems:

- Neutral infrastructure for processing transactions and executing programs
- Potentially interesting for innovation at **all touch-points** between organizations or individuals
- ➤ **Blockchain applications have the potential to disrupt the fabric of society, industry, and government**

Blockchains can also be used as a technology platform to handle hard issues of data replication and system state synchronization with high integrity.
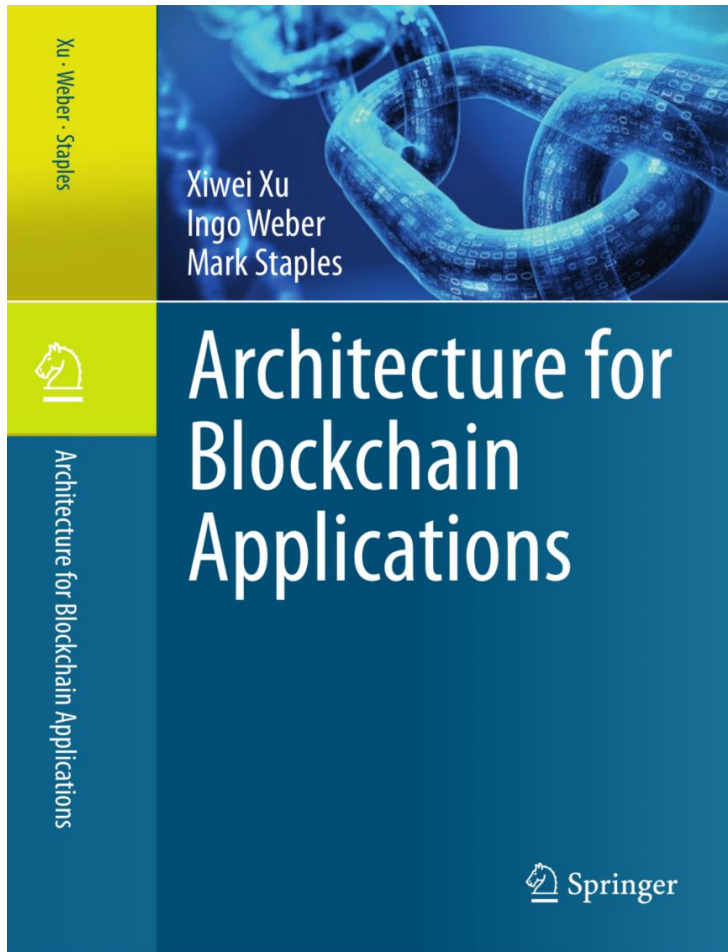
Blockchain book

Xiwei Xu, Ingo Weber, Mark Staples.
Architecture for Blockchain Applications.
Springer, 2019.

http://dx.doi.org/10.1007/978-3-030-03035-3
→ accessible from the TUM network

Cryptocurrencies and Tokens

Cryptocurrencies

- 'Baked in' to the core platform of public blockchains
  - base currency of blockchains
- Symbiotic relationship
  - Blockchain keeps track of the ownership of portions of that currency, e.g. Alice owned 2 Ether, transferred 1 Ether to Bob, offered 0.01 Ether to miner
  - Cryptocurrency enables the incentive mechanism for blockchain operations

Digital tokens

- Created and exchanged using smart contracts
- Represent assets
  - Fungible asset: individual units are interchangeable, e.g. company share, gold
  - Non-fungible asset: represents a unique asset, e.g. cryptokitties, car title

Not all applications are the same:

- Transferring coins / tokens vs. tracking movement of physical goods
- Core difference: where is the default version of the truth, on or off-chain?

Let's Talk about Blockchain
... und was sie für die Hotellerie leisten kann

#1 Use Case for the Hotel Industry: Loyalty Programs

Core idea:

- Loyalty points earned and owed can be tokens
  - Tokens are digital assets / liabilities
- Tokens can be traded, exchanged, settled, etc
  - Customer to customer, business to business
  - Redeeming for services
  - Trading for other digital assets, e.g.:
    - Vouchers
    - Other loyalty tokens

- Why? What are the advantages?
  - Currently highly fragmented loyalty programs, membership in ~30 programs is the average in the US
  - Liabilities stay in the books for lengthy periods → trading liabilities becomes possible / easier
  - Flexible coalitions are easy to set up
  - High integrity → high customer trust
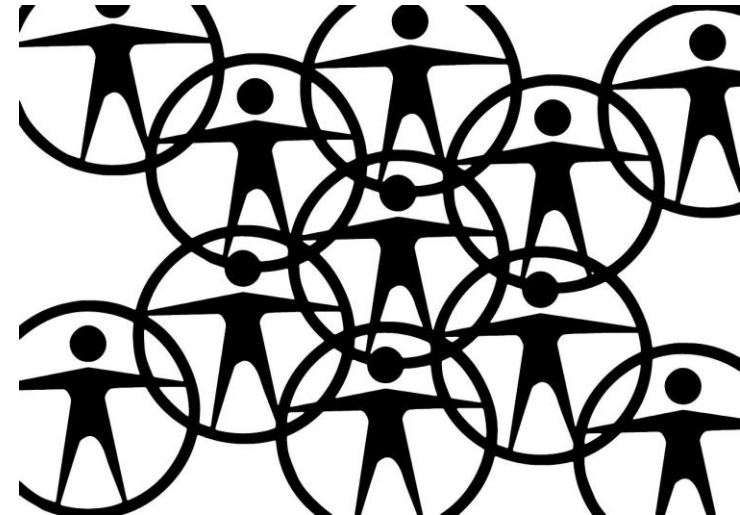 - Independent auditability → compliance

Other Possible Use Cases in the Hotel Industry

Identity management:
- Fast, automated check-in (even for first time customers)
- Selective sharing for customer data might be easier
- Data (like address, phone number, …) is more likely to be current if stored in one place

Generally: blockchain is useful for coopetition
- Hotels in a city could jointly bid for large contingents, even if otherwise in competition
- Joint use of some facilities, e.g. breakfast, gym, pool
- Handling of overbooking / problems where rooms are unusable (e.g. due to a burst water pipe or storm damage)
- Reaction to natural disasters or unexpected demand (e.g. UK ATC outage with hundreds of cancelled flights)

Let's Talk about Blockchain
... und was sie für die Hotellerie leisten kann

HSMAday, September 2023

Prof. Dr. Ingo Weber

ingo.weber@tum.de

http://imweber.de/

Full professor at TUM and
Director IT infrastructure & digital transformation
at Fraunhofer