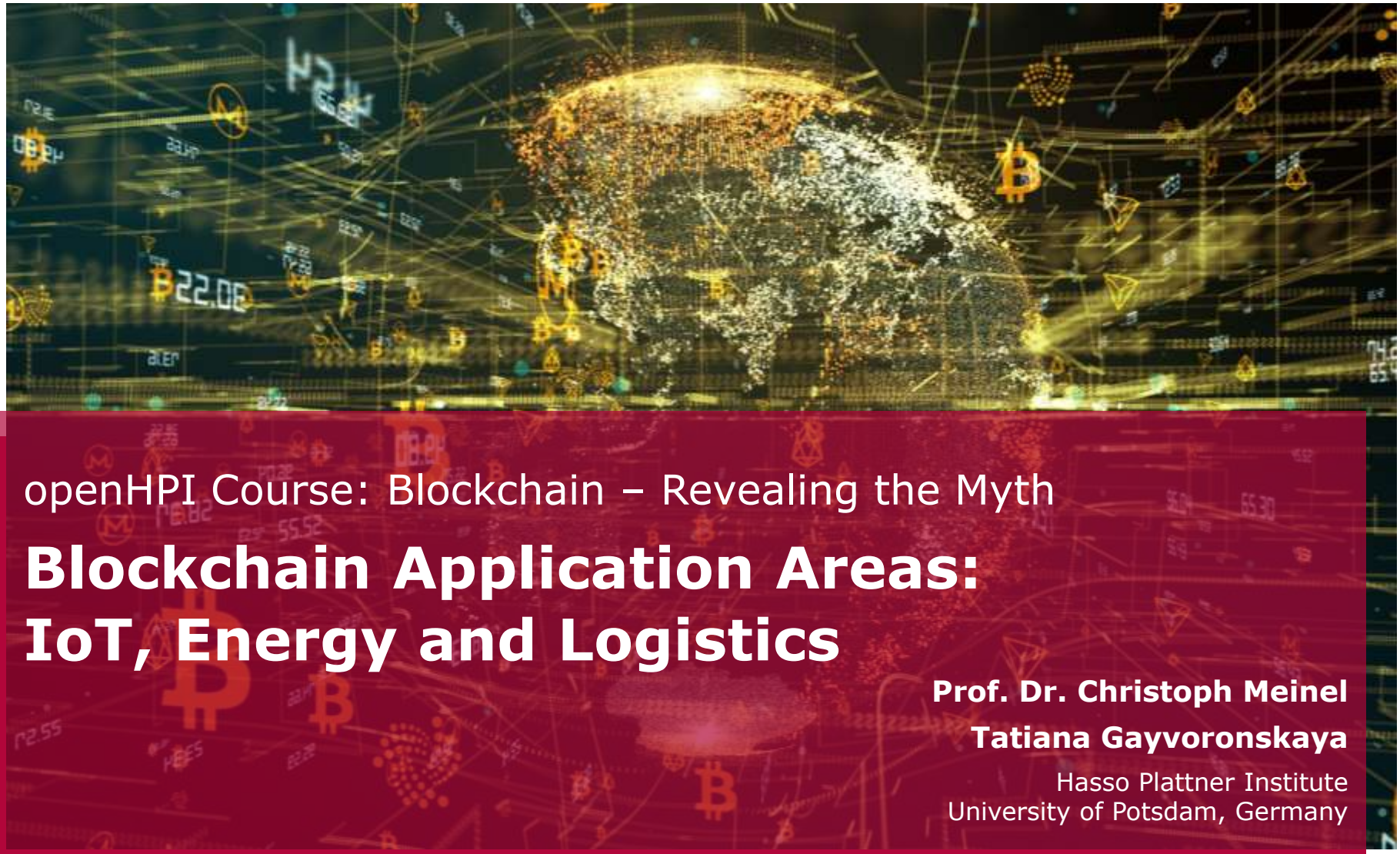


openHPI Course: Blockchain – Revealing the Myth

Blockchain Application Areas: IoT, Energy and Logistics

Prof. Dr. Christoph Meinel

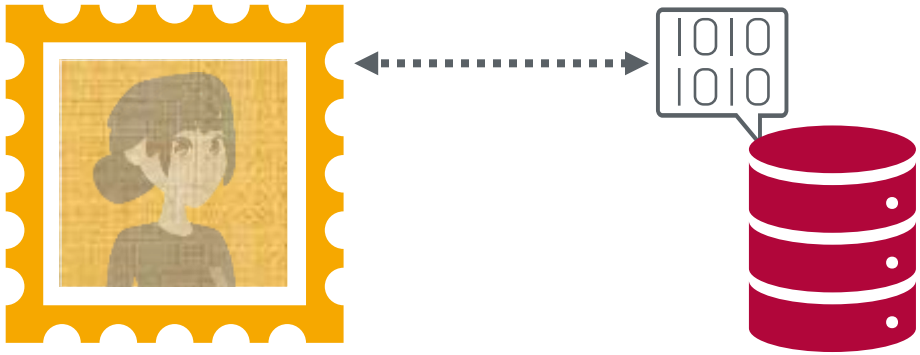
Tatiana Gayvoronskaya

Hasso Plattner Institute
University of Potsdam, Germany

Tracking Possession of Value

As we have mentioned before, **tracking possession of value** is **one of the most widespread** use cases of blockchain technology …

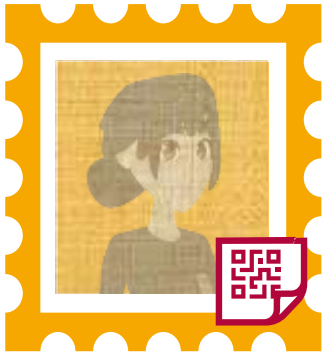
- … together with **automated contracts** and **identity systems**
- Let us consider an **example of tracking ownership history** of **paintings at auctions**
- The question arises, **how is the connection** made between the **physical art object** and **its digital identity**?



Various Possibilities for such Connection

Indeed, making **such connection tamper-proof** is a big issue

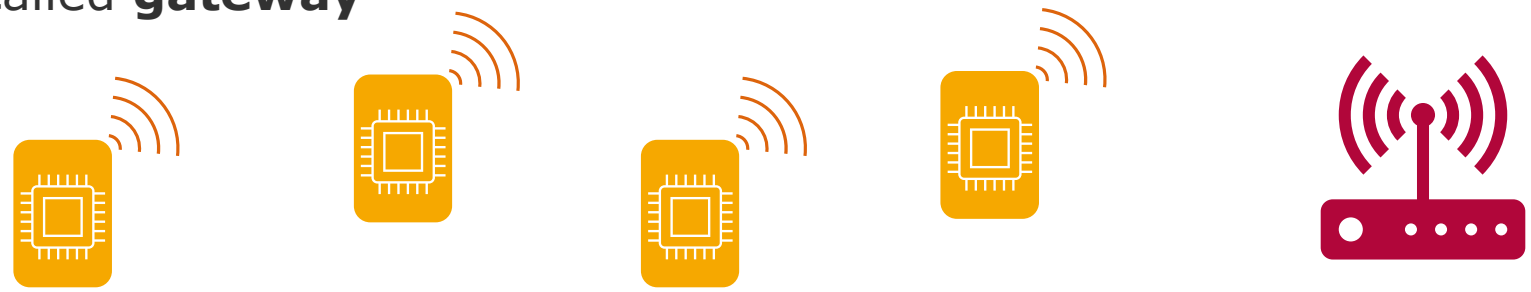
- There are **various possibilities** for this, such as **QR codes**, **RFID chips** or miniaturised computers, more precisely **IoT devices**
- All this still **does not meet the demands** for the **high level of security**, especially for such objects as art
- In this course we **will not pursue this further**
- We will **focus on the solution** often used in the **digital tracking of physical objects** …
- … by means of the **IoT technology** which is able to **provides more data** about the object than just an identification number or code



Internet of Things

In the **Internet of Things** – **IoT** – **every smart device** has/needs its **own digital identity** …

- … to uniquely **identify** it **in the network** and **enable interaction** with **other IoT devices** and **people**
- **IoT devices** are **miniaturized computers** that have
  - diverse **sensors**
  - **low storage** and **computing resources** as well as
  - **limited energy supply**
- Usually they are **connected** to a **powerful IoT hub**, called **gateway**



IoT Devices

Via the **gateway** **IoT devices** are **connected** to a **cloud** from which they are controlled

- Use of **blockchain technology** provides:
  - **autonomy** and **interoperability** for P2P communication
  - **without intermediaries** and a **central authority**
- **IoT devices** can, e.g.,
  - have their **own Ethereum accounts** controlled by **smart contracts** or
  - they can **generate smart contracts** themselves

Implementation Challenges

A **challenge** is created by the **limited resources** of IoT devices since it is already **problematic** for most devices to run an application for **lightweight users** …

German company **Slock.it** offers a solution for this situation

- In summer 2019 Slock.it was **acquired** by the company **Blockchains**, which is owned by the crypto millionaire Jeffrey Berns
- Berns plans to build a **smart city** in the Nevada desert
- The city is to include, among other things, a **highly secure high-tech park**
  - that combines **blockchain technology** with **artificial intelligence**, **3D printing** and **nanotechnology**

Solution for Connection of Low Performance IoT Devices to a Blockchain

This **solution enables**

- The **connection of low performance IoT devices** to a **blockchain**
- Without the **necessity** of **extra hardware** or **significant Internet bandwidth**
- This consists of **In-cubed clients** (**IN3** client – Incentivized Node Network)

Solution is **chain-agnostic** – a single IN3 client can connect to **multiple blockchains** at the **same time**

- Not only **private providers** who have discovered the topic and its potential for themselves
- **Various consortia** have emerged to support the **collaborative development of open-source standards** for **blockchain technology** in diverse areas, including IoT

IoT in Conjunction with Blockchain for Energy and Logistics Sectors

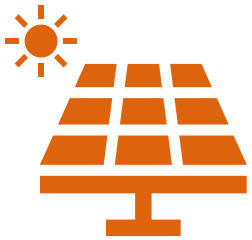
Combination of **IoT** and **blockchain technologies** offers **a lot of new opportunities**, e.g., for the **energy** and **logistics sectors**

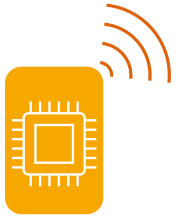
- **Numerous projects** have already emerged that make use of these advantages
- The **information from IoT** devices is **transferred** to a **blockchain network** and often **controlled by smart contracts**
- We demonstrate the underlying idea by the **following examples** from each of this two areas of application

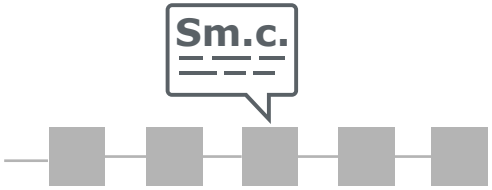
IoT in Conjunction with Blockchain for Energy Sector (1/2)

A **microgrid** in conjunction with **blockchain** and **IoT** makes it possible to **trade locally produced renewable energy** in a **local marketplace**

- **Microgrid** is an **energy network** that **unites** energy **producers** and **consumers**, e.g.,
- **Surplus energy** generated by **roof solar panels** can be sold to a neighbor **without** having to rely on a **middleman**
  - **data** collected by the sensors **of the IoT** device on surplus energy becomes a **blockchain token** which can be controlled by a **smart contract**







IoT in Conjunction with Blockchain for Energy Sector (2/2)

Via an **app**, participants …

- … have **access** to their own **electricity consumption** and **production data** and
- can **specify their price expectations** for locally generated energy

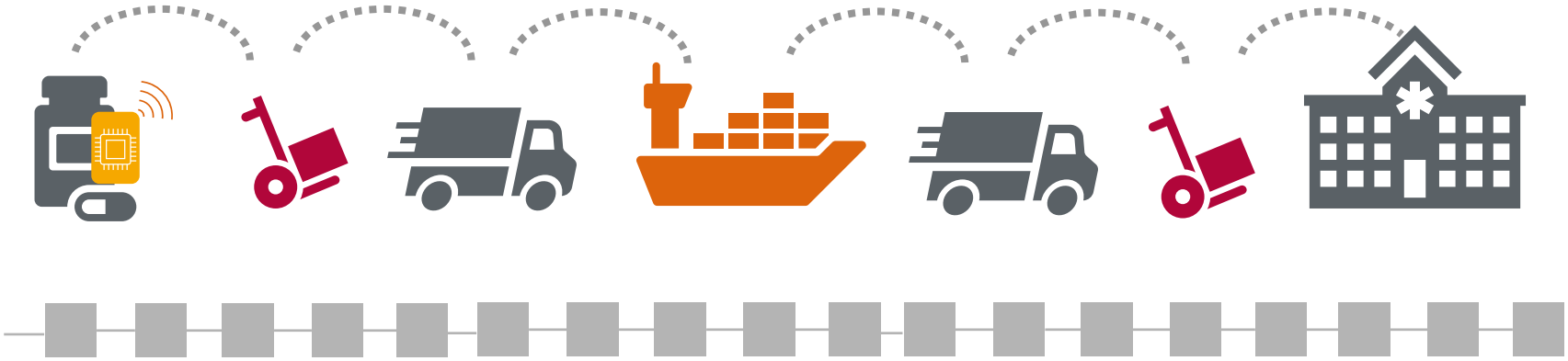
The **first project** to make this idea a reality was **Brooklyn Microgrid (BMG)**, developed and implemented by the company LO3 Energy

- System **connects households** in the New York district of **Brooklyn** that own solar energy systems with households that want to buy local solar energy

IoT in Conjunction with Blockchain for Logistics Sector (1/2)

There are **several possible use cases** in **logistics**

- **Highly sensitive goods** like medical drugs can **be equipped** with **IoT** devices which **send collected information** (temperature, humidity, ..) to the **blockchain**
- **Information** can be **secured** in a **decentralized manner** and **controlled along the supply chain** by **smart contracts**



IoT in Conjunction with Blockchain for Logistics Sector (2/2)

- Today, **supply chains** are **very complex** and include **numerous participants** from all over the world
- Thus, a **blockchain-based supply chain management** can
  - **automate** and
  - **optimize** the **supply chain processes**
  - **without any intermediaries**
- Modum.io is one company that offers such a solution

Summary

- **Tracking possession** is **one of the most widespread** use cases of blockchain technology
- However, **connecting** the **physical object** to **its digital identity tamper-proof** is a big issue. There are **various possibilities** to do this:
  - **focused on IoT-solutions**
- **Combination** of **IoT and blockchain technologies** offers **a lot of new opportunities** for the **energy** and **logistics sectors**
  - it **optimizes** and **automates processes** between the individual objects and users **without relying on intermediaries**