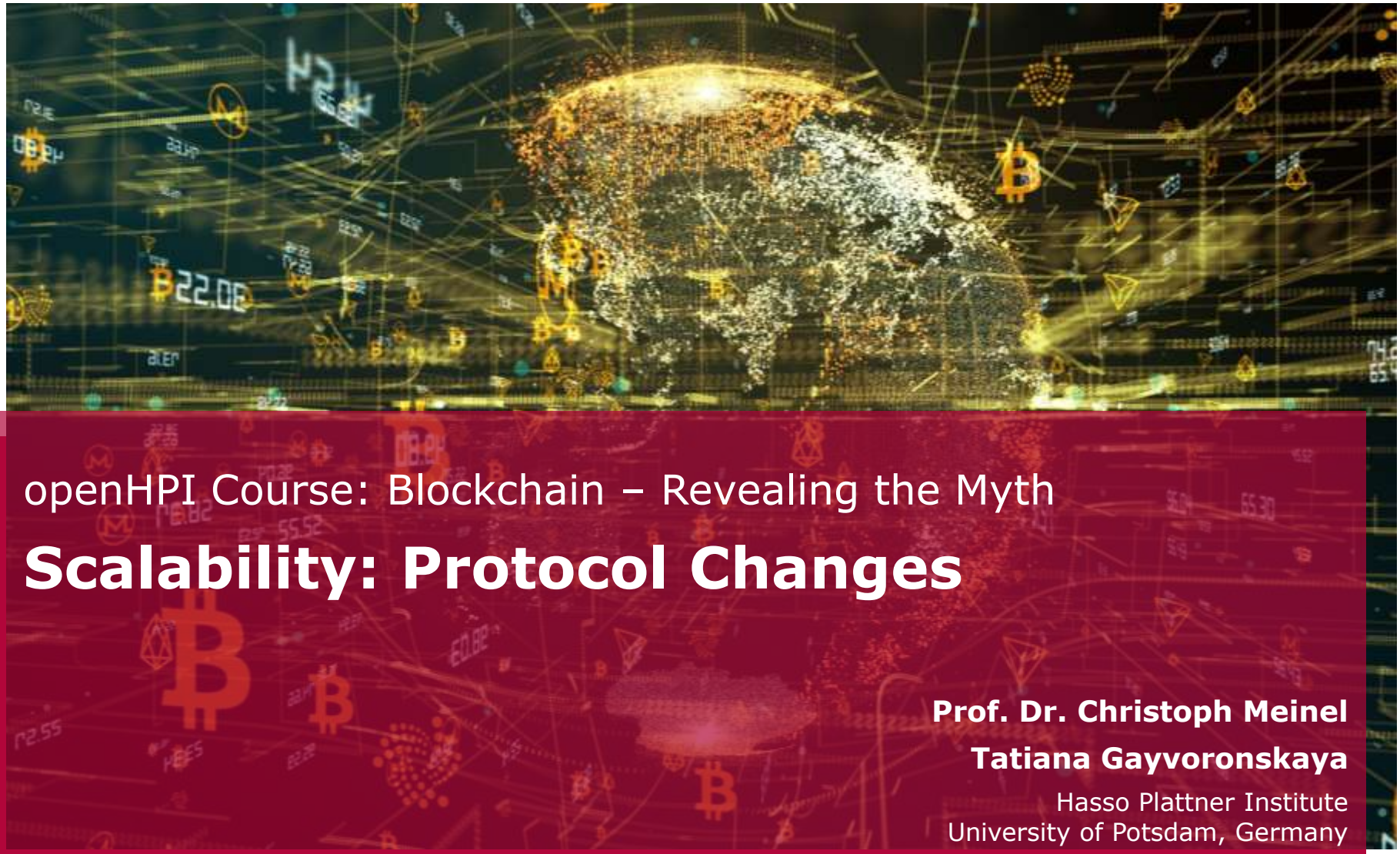


openHPI Course: Blockchain – Revealing the Myth

Scalability: Protocol Changes

Prof. Dr. Christoph Meinel
Tatiana Gayvoronskaya
Hasso Plattner Institute
University of Potsdam, Germany

Revealing the Myth

We have explored the **ideas and goals** of the first blockchain-based systems, such as Bitcoin and Ethereum, and the **technical solution behind** them

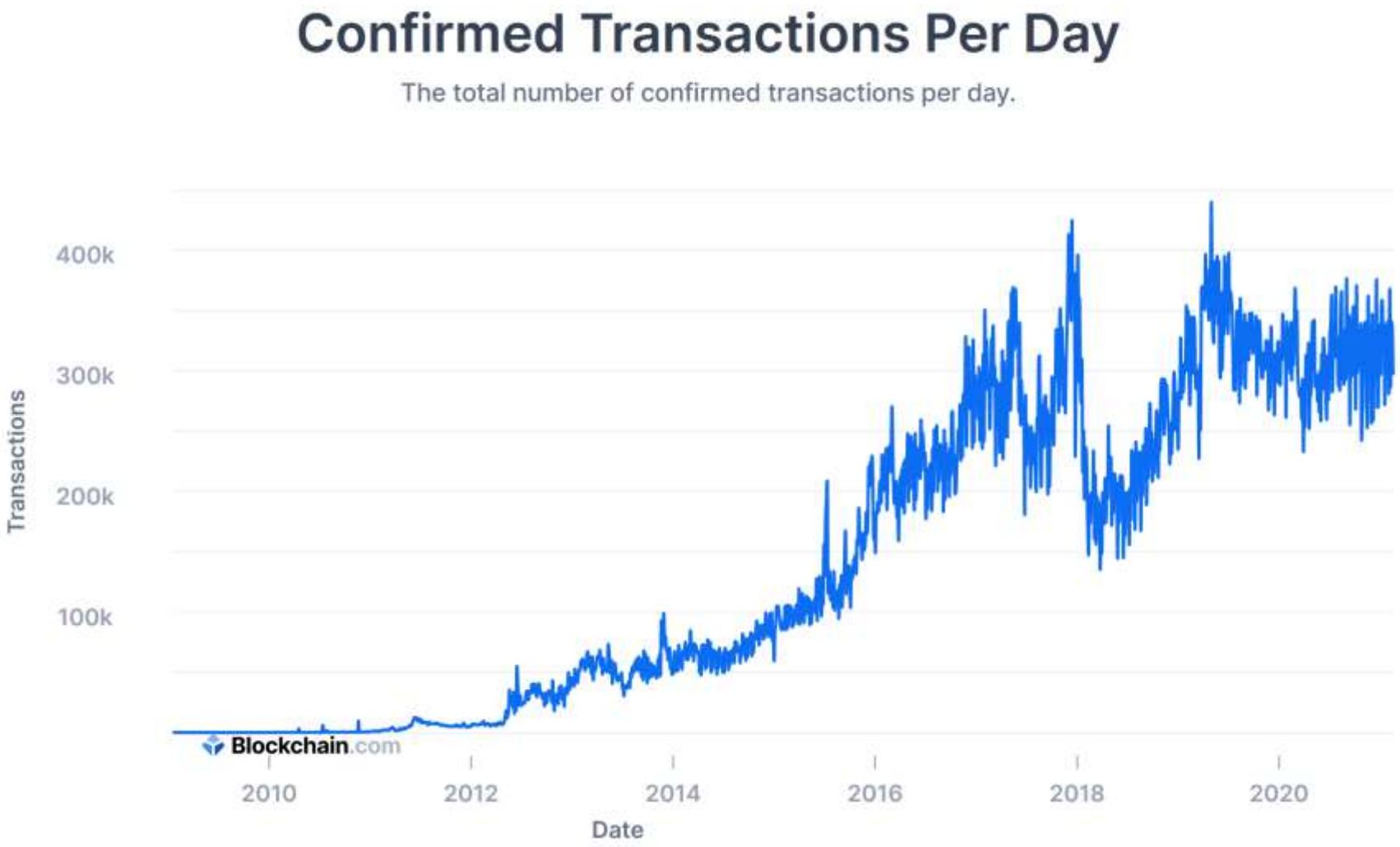
- We have **clearly defined** the blockchain technology
- We have seen **numerous attempts to adapt** the technology to **various needs**, e.g.,
  - to increase **efficiency of blockchain-based solutions**
- Here we look at the **real challenge** of blockchain-based systems which consists in their **scalability**

System Growth without Loss

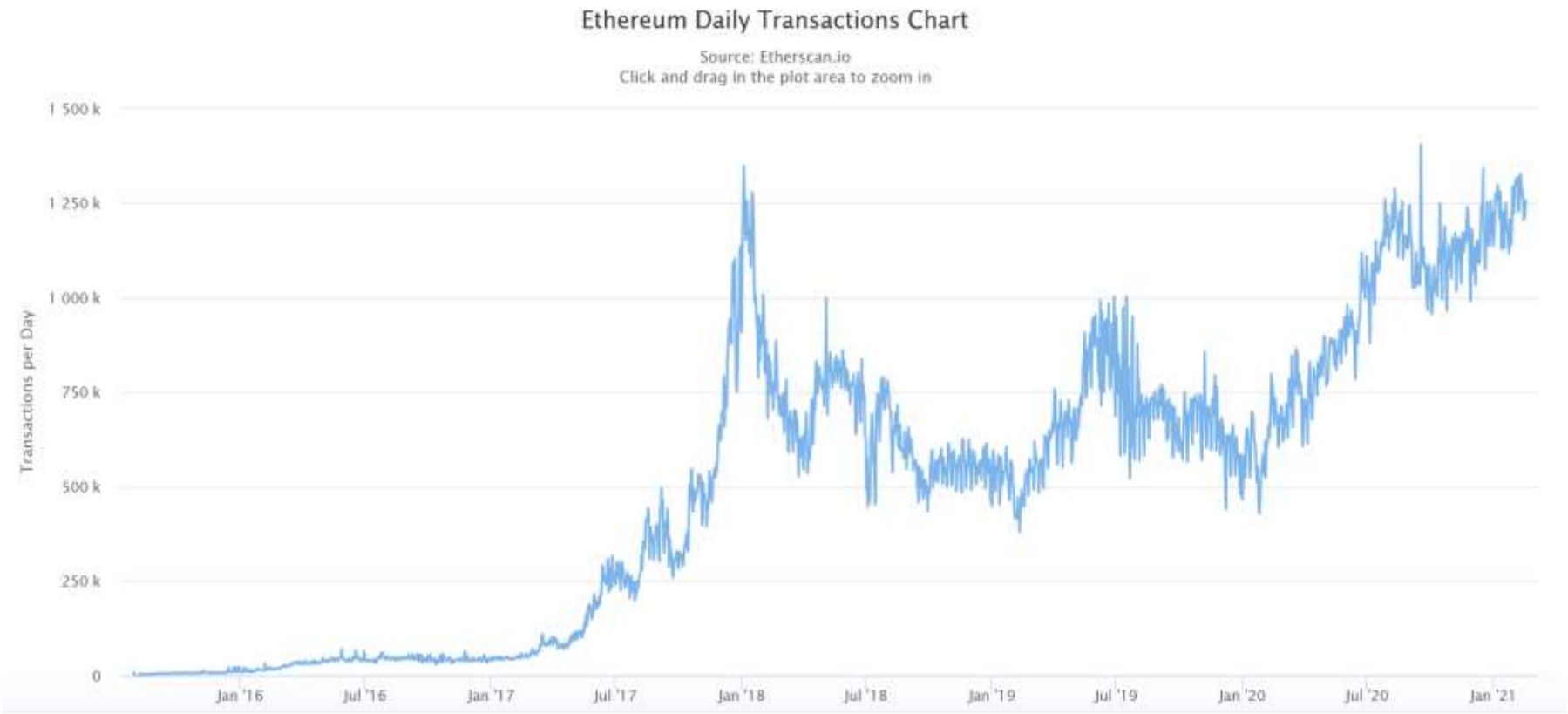
So, what is it about **efficiency** and so-called **scalability** in a blockchain-based system?

- With the increasing popularity of Bitcoin or Ethereum **more and more users are joining them**
- More users generate a **larger transaction volume**
  - **Bitcoin**
    - 2016 we saw around **230,000 confirmed transactions per day** added to the blockchain
    - 2021, alone in the first weeks, there are **300,000**
  - **Ethereum**
    - 2016 there were around **40,000 confirmed transactions per day** and
    - 2021, alone in the first weeks there are **1,200,000**

Bitcoin – Transactions Per Day



Ethereum – Transactions Per Day



What Makes the System Slow?

What is the **problem** with having **more interest**, **more users** and therefore **more transactions**?

Security measures that are **essential for** a **decentralized** and **permissionless** system

- **Limited block size** or **block time** – regular interval of time between new blocks being mined, fixed by difficulty target in PoW
- **Restrictions lead** to a certain **transaction throughput**, e.g.,
  - **Bitcoin** system can currently process up to **7 transactions per second** and
  - **Ethereum** up to **20**

Lowering the Block Time?

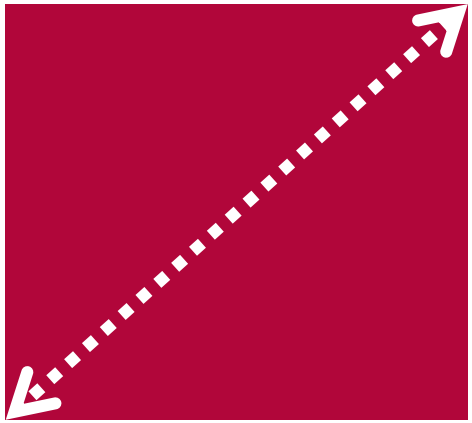
Block time is determined by the **difficulty of the target**. If this would be **lowered**, then …

- many miners would find a **solution** at the **same time** and **spread their blocks** in the system
- then **new blocks** would be generated and added to the chain much **faster** than the currently assigned 10 minutes in the Bitcoin system
- this inevitably leads to a **higher fork rate**
  - and a **higher** number of **confirmations** is required – originally a transaction is considered confirmed after 6 blocks
- and a higher fork rate also means that more **work is wasted** and it becomes more **difficult to reach a consensus** on the longest chain

Raising the Block Size?

To **raise** the **block size** would result in having **longer propagation** and **confirmation times**, which in turn would lead to an **increased fork rate**, too

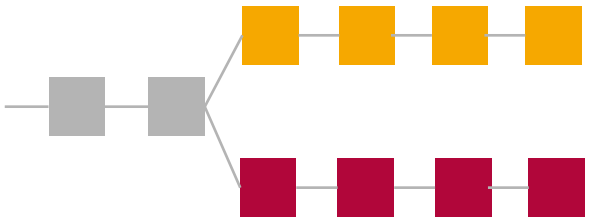
- Since the block time in **Ethereum** system is only **15 seconds**, the **block size** must be correspondingly **smaller** than in Bitcoin system **in order not to compromise the security of the system**
- Other measures in the Ethereum system are
  - the **inclusion of orphan blocks** in calculation of the "longest chain" and
  - the **rewarding of the miners** of these



Modification of Block Time or Block Size Leads to Splitting in the System

Fundamental changes in the protocol, like changing block size or block time require an **acceptance by all miners** and **all users**

- Those **who do not accept** these changes and **do not update** them are **"split off"** from the **system**
- **Neither** the Bitcoin **developers nor** the **miners** can **force users to accept** new changes that violate existing system rules
- This means that **developers can only hope** that the new changes will be **accepted by most** miners and users



Summary

We have familiarized ourselves with the **scalability challenge** of blockchain-based systems

- We looked at one of the most **common methods**, **adjusting system parameters** such as block size and block time, and how these affect the security of the system
- In the next video, let's look at other **scalability options** that go **beyond adjusting the parameters**