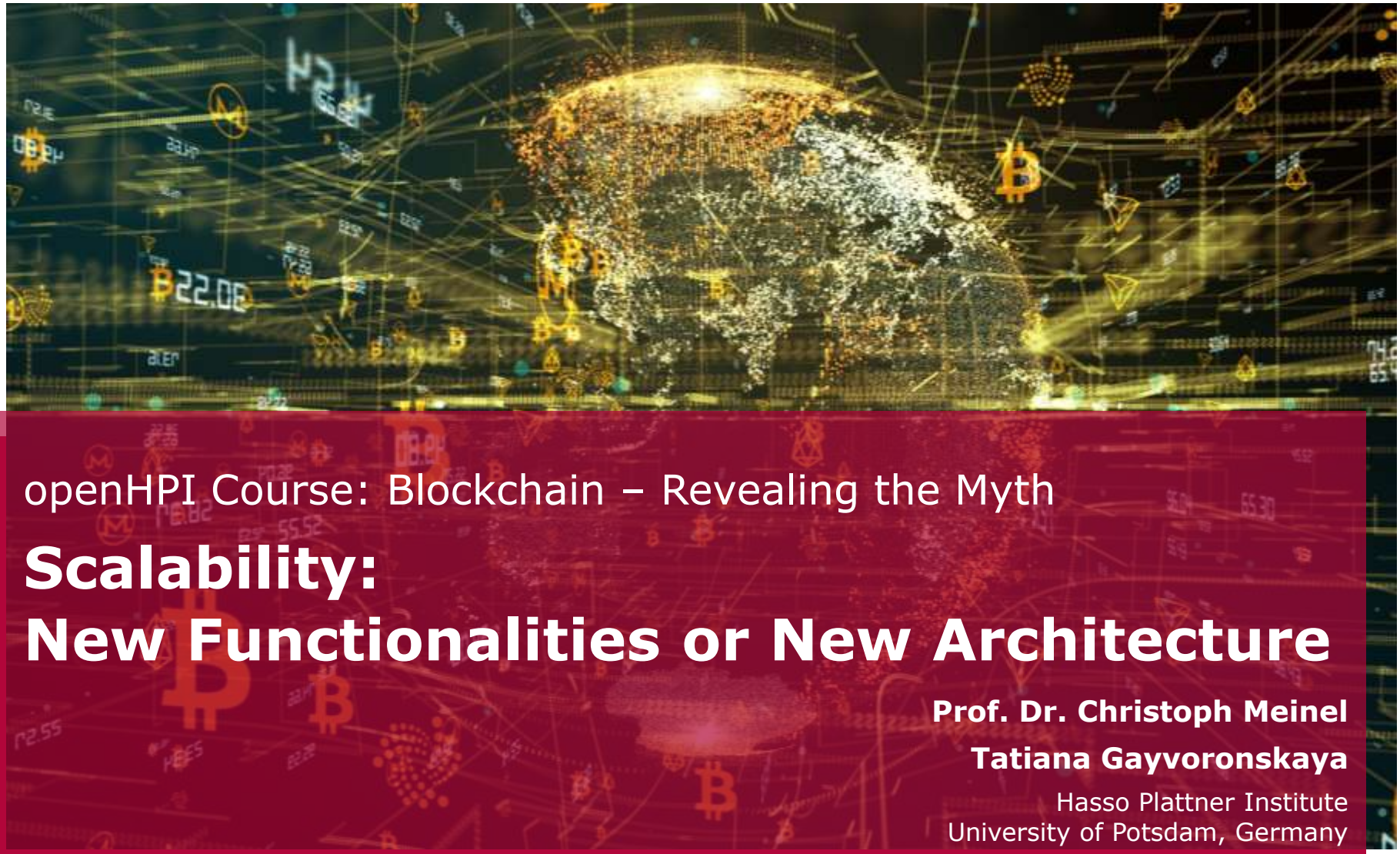

openHPI Course: Blockchain – Revealing the Myth

Scalability: New Functionalities or New Architecture

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New Functionality for Better Scalability of the Bitcoin System

In the last clip we mentioned that **fundamental changes in the blockchain protocol** like modification of block size or block time would …

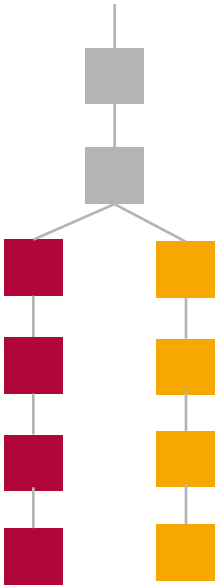
- require the **acceptance by all miners** and **all users**
- and those **who don't accept** the changes are **"split off"** from the **system**

Indeed, a new cryptocurrency called **Bitcoin Cash (BCH)** was created **through such a split** on August 1, 2017

- It introduced **8 MB blocks** instead of the existing **1 MB**

Another group in the **Bitcoin community** chose to take a **different path** in solving the block size problem

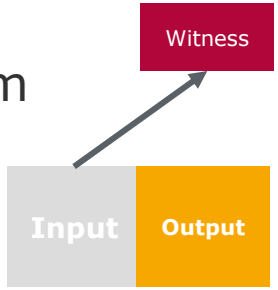
- Instead of changing the protocol, they introduced a **new functionality** called "**Segregated Witness**" or shortly **SegWit**



New Functionality for the Bitcoin System Segregated Witness

The **advantage** here is that **users can be updated at any time**, after the **miners** have **accepted** the changes

- Miners and users, **who have not yet updated** the new functionalities, **continue to belong to the same** system as the updated users
  - they only see an **"extra text"** that they **do not understand**
- However, this does not pose a problem as **it does not mean any changes** to the fundamental rules
- The **focus** of the new functionality is a **new data structure called Witness**
- A part of the transaction is "**moved**" **therein**, namely the **signature**, which otherwise makes up to **70 percent** of a transaction



New Functionality for the Bitcoin System Witness

"**Witness**" still remains **part of the transaction**, but is **not hashed** in the **transaction ID**

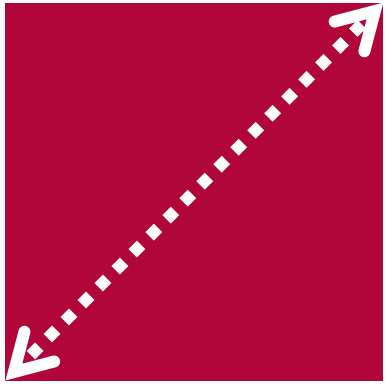
- **Users** who have **not yet implemented SegWit** think that SegWit transactions **do not have a signature** (in the ScriptSig) and **do not require one** (in the ScriptPubKey)
- **Updated users understand the instructions** in the ScriptPubKey and **know** that the **necessary signature** is in the "**Witness area**"

Not updated user **Updated user**

New Functionality for the Bitcoin System Increasing Block Size

But how the **size of the transaction** is **decreased** if **Witness** still **remains part of the transaction**?

- **Block size limit** in the Bitcoin system **remains unchanged** at 1 MB after the SegWit update
- **Block size** is replaced by "**block weight**," and the block can have a "weight" of between 2 and 4 MB



Limits to What the Bitcoin System Can Currently Handle

This means, the current full nodes **need more time than before to verify a block**

- This correspondingly **increases** the **block's spread time** in the system
- SegWit supporters consider, that the **additional verification time** and the **associated longer propagation time** for a block **lie within the limits of what the network can currently handle**

Ethereum Has Also to Struggle With a Larger Amount of Data

What about the Ethereum system, which has to struggle with a **larger amount of data** than the Bitcoin system?

- In this sense, the **account-based** Ethereum system has a considerable **advantage over** the **UTXO-based** Bitcoin system
- When **verifying a transaction**, the **entire blockchain** is **no longer searched** for an output, which is referenced in the current input
- Instead, the **current state** of the **respective account** (account state) is checked as to whether it has a sufficient balance

Ethereum System
Long-Term Scalability Improvement

For a **long-term improvement** in **scalability** of the Ethereum system developers plan to create and introduce an **Ethereum 2.0** within the next years

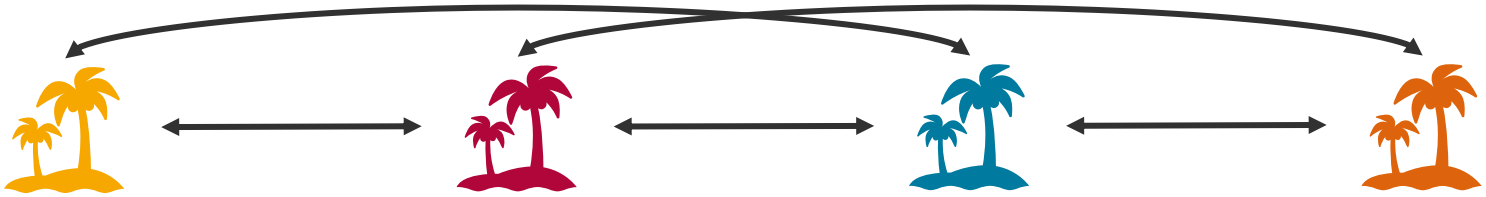
- Focus is on
  - **splitting** the entire system **into numerous groups** and thus
  - **dividing** the **transaction load** and
  - allowing **parallel calculations**
- **Entire architecture** of the Ethereum system is thereby "**rebuilt**" and can be displayed in **several layers**

Ethereum 2.0 Architecture
Sharding

Let us take an **example** from Vitalik Buterin on this topic and imagine that the **Ethereum system** is **divided into thousands of islands**

- **Each island** has its **own functionalities** and **inhabitants** (user and smart contract accounts)
- **Inhabitants** of an island **communicate** with each other, **organize** themselves and have their **own transaction history**
- **Islands** can **interact** with each other

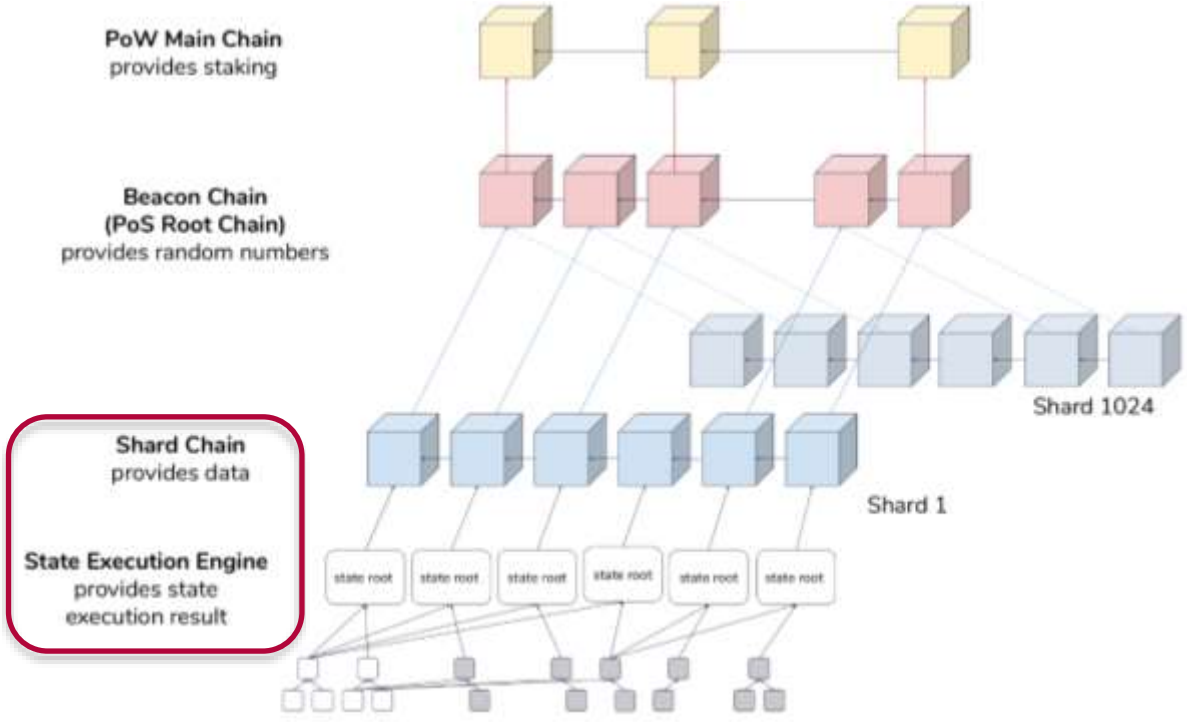
This procedure is called **sharding** and the "islands" are correspondingly called "**shards**"



Ethereum 2.0 Architecture
Data and Execution Layers

Shards represent **the two lowest layers** of this new architecture: the **data** and **execution layers**

- The **transactions** and **smart contracts** are executed and saved **for each shard**

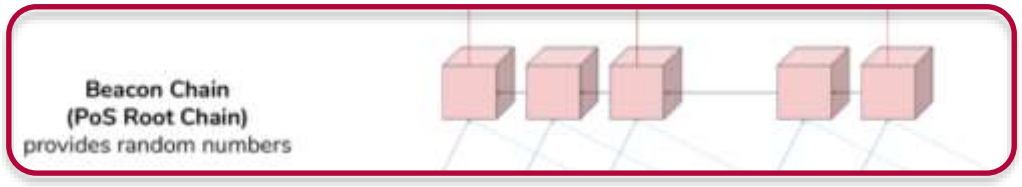


Source: Hsiao-Wei Wang – Presentation "Ethereum, Serenity"

Ethereum 2.0 Architecture
Coordination and Validation Layer

Next layer is used to **coordinate** and **validate** the **data produced in the shards**

- It consists of a **new blockchain** – a so-called **beacon chain**, which uses a **PoS algorithm**
- Miners are replaced by validators, which have the **possibility to create a block in a shard** that has been randomly assigned to them
- For each shard, a **group** made up of **100** randomly selected **validators**, authenticate the new block by signing
- **Block header** is included in the **beacon chain block** with at least 67 signatures as **references to the shard block**

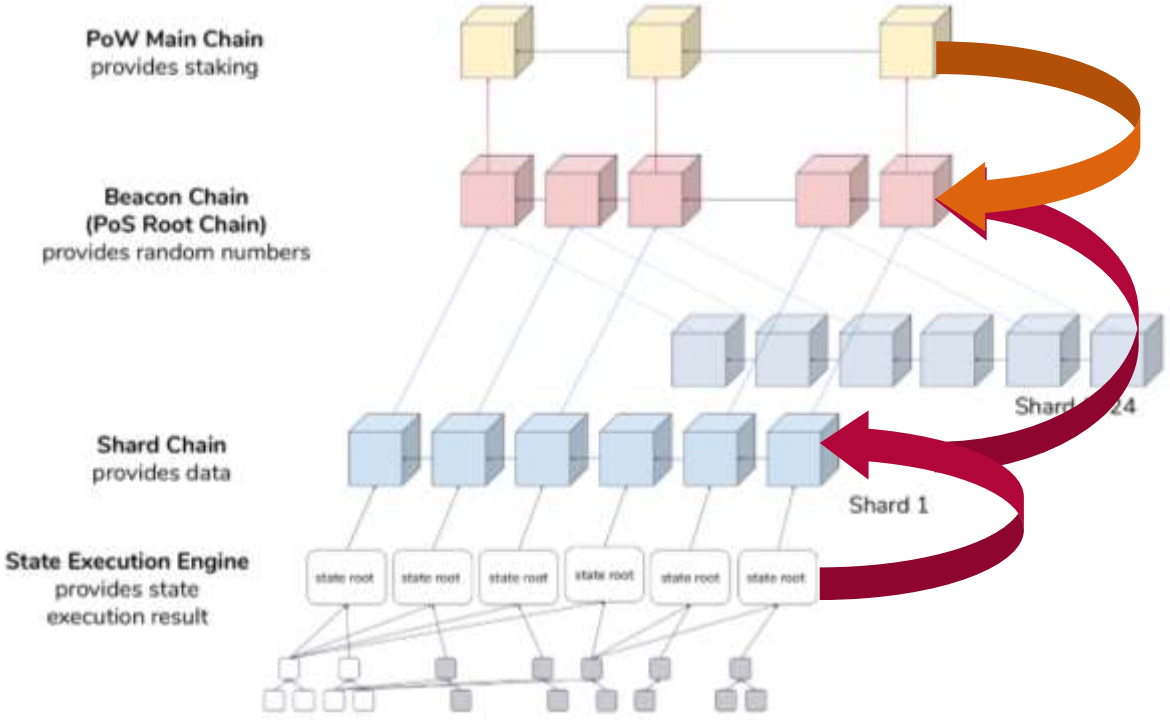


Source: Hsiao-Wei Wang

Ethereum 2.0 Architecture
Top Layer

The **current Ethereum blockchain** remains available, uses **PoW** and represents a **top layer**

- **Any Ethereum user** who stores 32 Ether in form of a smart contract in the Ethereum top layer **can be a validator**



Source: Hsiao-Wei Wang – Presentation "Ethereum, Serenity"

Summary

We have considered **various ways** to make a **blockchain-based system a bit more "efficient"**

- **Adjusting parameters** such as block time and block size
- **Introducing additional functionalities** that avoid changing the set parameters or
- **Completely new architecture** that still has a PoW blockchain as its basis

In the next clip we look at a **last scaling option**, that intends to relieve the system, so-called **off-chain approach**