

Blockchain Technologies

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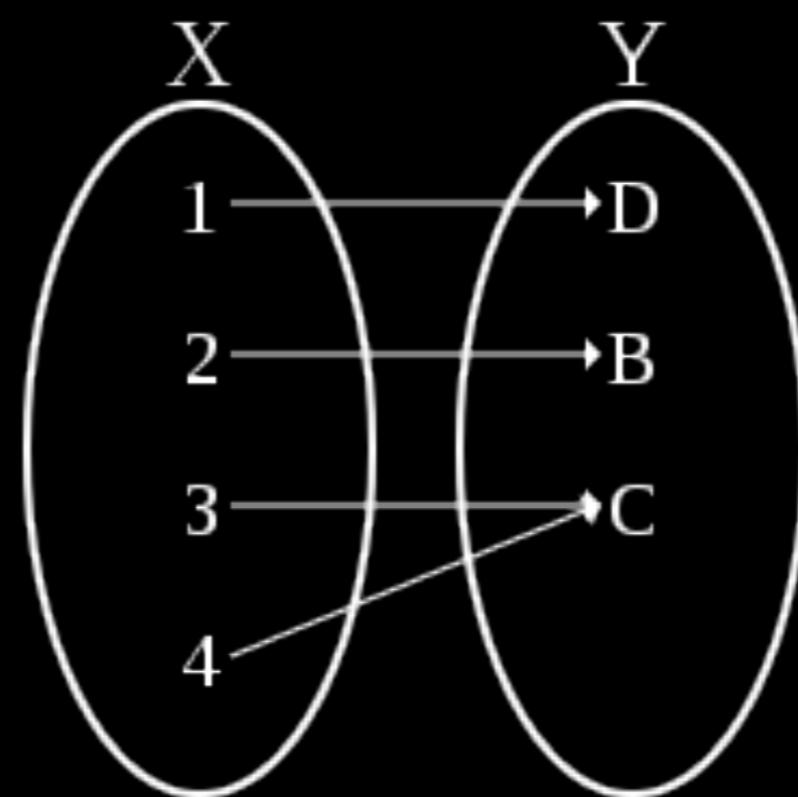
$$\text{hash}(x)=h$$

$\text{hash}(x)=h$
=> fast

$$\text{hash}^{-1}(h) = x$$

$$\text{hash}^{-1}(h)=x$$

=> slow / brute force / impossible



“RSA”

Asymmetric Cryptography

$p = 29, q = 31$

$$n = p * q = 29 * 31 = 899$$

$$t = (p - 1) * (q - 1) = (29 - 1) * (31 - 1) = 840$$

find e relatively prime to t

find e relatively prime to t
(t cannot be divisible by e)

find e relatively prime to t
(t cannot be divisible by e)
e.g. $e = 11$ ($t = 840$)

find d such that $(d * 11) / t$ give us a remainder of one
 $d * e \equiv 1 \pmod{t}$

p - 29

q - 31

n - 899

t - 840

e - 11

d - 611

public key n & e
private key n & d

$$C = M^e \bmod n$$

$$C = M^e \bmod n$$
$$M = 'w'$$

119

$$C = M^e \bmod n$$

'w' => ascii value is 119

$$C = 119^{11} \bmod 899 = 595$$

595

$$M = C^d \bmod n$$

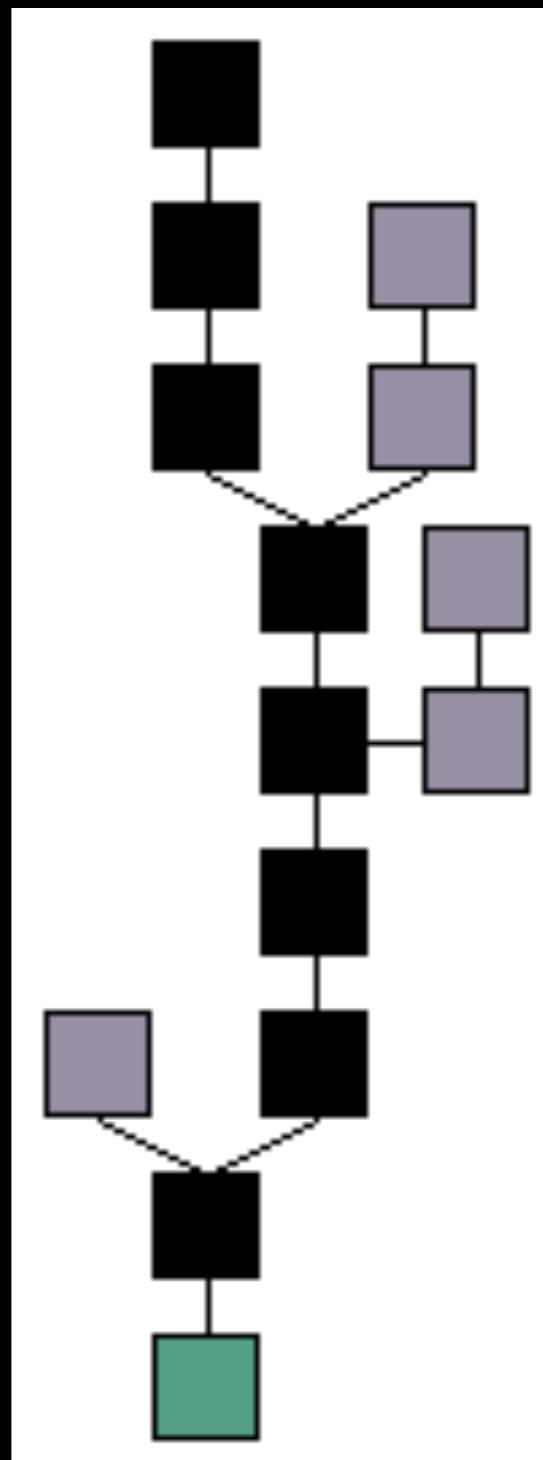
$$M = 595^{611} \bmod 899 = 119$$

119

What was Bitcoin?

- **oldest cryptocurrency**
- **initiated anonymously (paper + source code)**
- **creates a distributed ledger (blockchain)
secured by proof of work**
- **proof of work SHA-256 based**
 - **This is a problem! (see later)**

Bitcoin (Blockchain)



Bitcoin (Block)

Field	Description	Size
Magic no	value always 0xD9B4BEF9	4 bytes
Blocksize	number of bytes following up to end of block	4 bytes
Blockheader	consists of 6 items	80 bytes
Transaction counter	positive integer VI = VarInt	1 - 9 bytes
transactions	the (non empty) list of transactions	<Transaction counter>-many transactions

Bitcoin (Transaction)

Field	Description	Size
Version no	currently 1	4 bytes
In-counter	positive integer VI = VarInt	1 - 9 bytes
list of inputs	the first input of the first transaction is also called "coinbase" (its content was ignored in earlier versions)	<in-counter>-many inputs
Out-counter	positive integer VI = VarInt	1 - 9 bytes
list of outputs	the outputs of the first transaction spend the mined bitcoins for the block	<out-counter>-many outputs
lock_time	if non-zero and sequence numbers are < 0xFFFFFFFF: block height or timestamp when transaction is final	4 bytes

Proof of Work

- $\text{sha256}(\text{sha256}(\text{Block} + \text{Nonce})) = \text{Hash}$
- choose Nonce so that Hash starts with d leading zeros
- d depends on “difficulty”
 - continuously updated by the bitcoin network
- Finding correct Nonce is "proof of work"
 - rewarded with bitcoins (bitcoin mining)

Proof of Work

```
Hello, world#0 => fa2881e9b47b8e1535df08f1d6d47b71854aa0706c959a2726fc964fc90ff15
Hello, world#1 => 795544e740045733b4713381f8e3e47bfff379e059aca1971b711b0ab8b54fb4
Hello, world#2 => d4d47d6600c4b5f6e2aa6936925741758714a5f8dd8d69eda0ccf3a0287a2c0e
Hello, world#3 => 32192c79cd80b64e57808745bbbaafc4aebab6bec25f5df5435a439323930833
...
...
...
Hello, world#69159 => 46201a335a85608d349fec758409160b40c612fdb51a6c91e65d3b4fddb2f06a
Hello, world#69160 => fecc199b038da2d577745fb05ea85227eb823b2489bb8070e2f42f38d60155f3
Hello, world#69161 => 35ff61c959bec6a6c66ff2cc602a84d02823c46e9ca2e70f03f6ea9c9212842b
Hello, world#69162 => 0000c5a9a24161e58868c858fc2700eeabf21a86862cbfa3bbd18a4d63e5b010
```

The Problem with SHA256

- Easy to speed up using
 - GPU
 - FPGA
 - ASIC
- Currently without the latest ASIC you spend more on energy than earning bitcoins

```
for (i=0,j=0; i < 16; ++i, j += 4)
    m[i] = (data[j] << 24) | (data[j+1] << 16) | (data[j+2] << 8) | (data[j+3]);
```

What is an ASIC?

*Very low cost ultra high performance chip
specialised on only one task*



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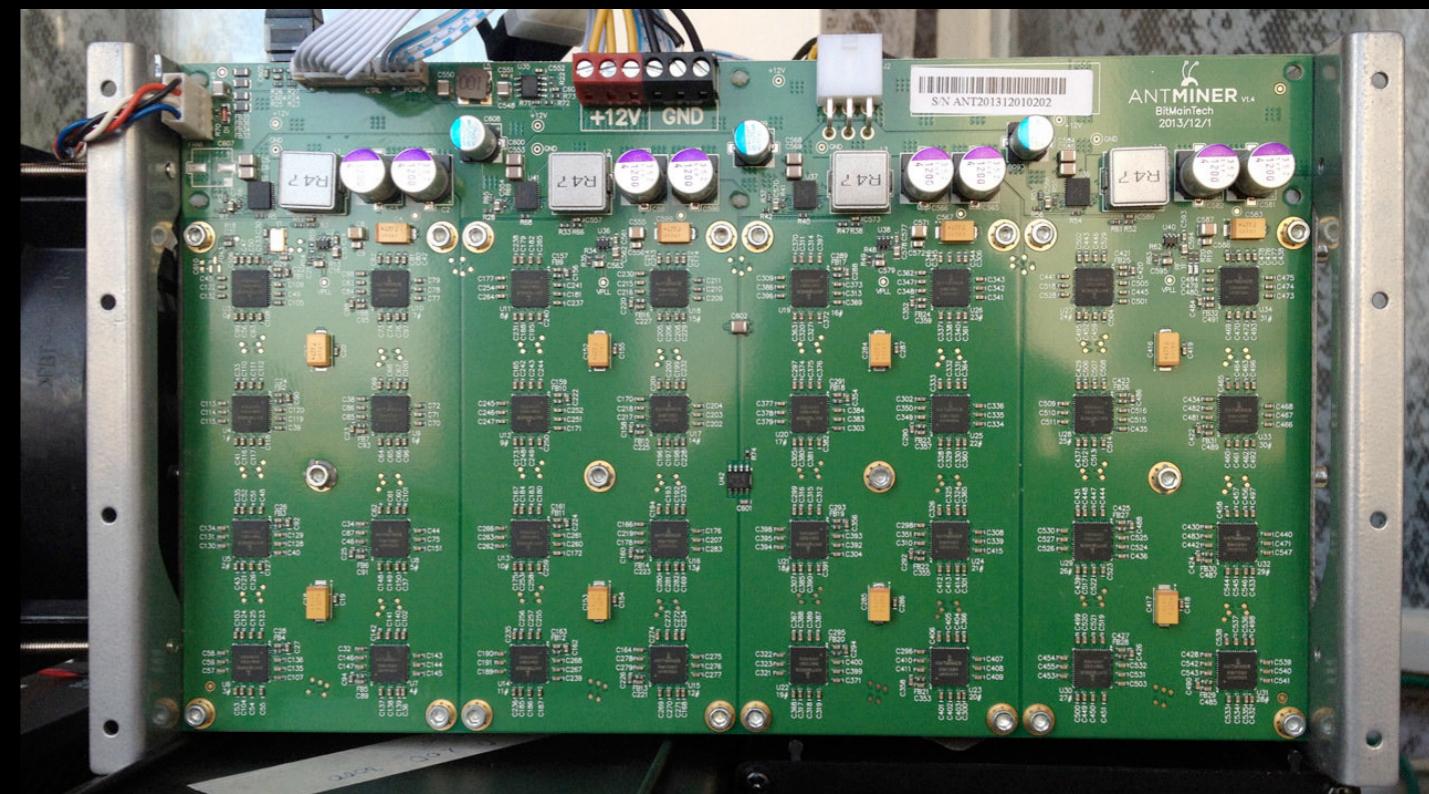
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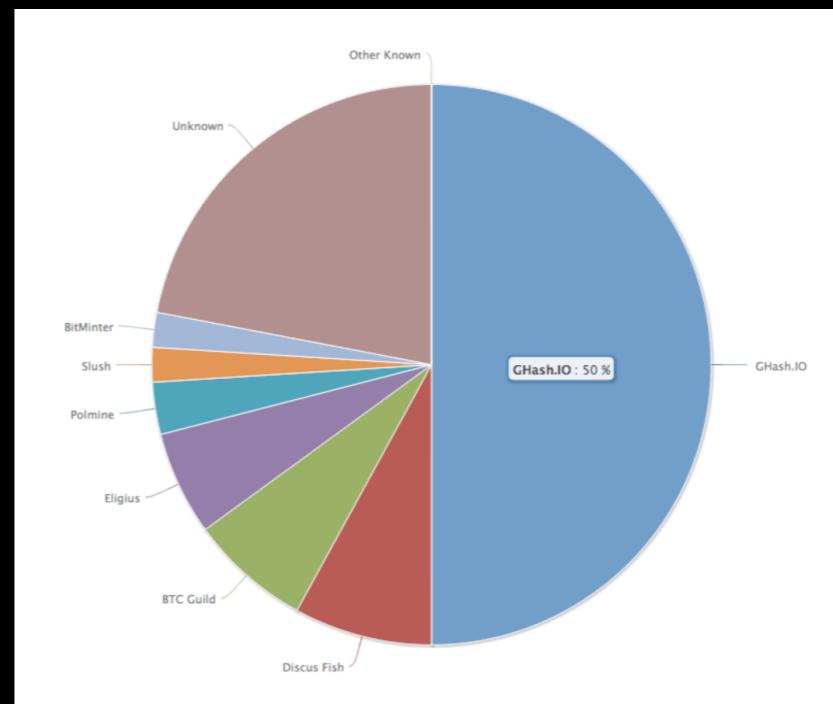
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The Problem with SHA256

- *Original Idea is gone (everybody can mine bitcoins using his spare compute resources at home)*
- *system vulnerable to 51% attack*
- *recently 50% of mining power achieved by a single pool*



Alternative CryptoCurrencies

- *There are many alternatives*

- *Auroracoin, BlackCoin, Dash, Dogecoin, DigitalNote, Ethereum, Litecoin, Mastercoin, MazaCoin, Monero, Namecoin, Nxt, Peercoin, Emercoin, PotCoin, Primecoin, Ripple, ShadowCash, Titcoin*

- *Alternative hash algorithms*

- *scrypt, X11, cryptonight, hashimoto*

- *Alternative consensus methods*

- *proof of work, proof of stake, proof of elapsed time*



beyond payments

- *Idea: BlockChain as distributed ledger to ensure non-centralized authority on validation of any type of transaction and business logic*
- *two promising candidates*
 - *Ethereum (Swiss Non-Profit Organization)*
 - *Hyperledger Project (The Linux Foundation, members: IBM, Deutsche Börse Group, Intel, JP Morgan, Cisco, RedHat, ...)*

What is a Blockchain?

*A distributed, peer-to-peer
replicated, integrity protected
linked-list of data blocks*

Hyperledger

- IBM Research prototype “OpenBlockchain”
- OpenSourced by IBM and donated to the Linux Foundation
- Any member can contribute and steer development
- 1st production ready release "Hyerledger Fabric V1.0" was announced at IBM Interconnect 2017

What is a Hyperledger Fabric?

*"Hyperledger Fabric is a enterprise grade, distributed based on blockchain technology that use smart contracts that enforce trust between entities" @gatakka
Ivan Vankov*

Misconceptions

- Hyperledger is a Blockchain
- Hyperledger is not a Cryptocurrency
- Hyperledger is not using Mining/PoW(Proof of Work)
- But preserves important properties of a crypto blockchain

Main benefit

- throughput of the system
- Ethereum 1000 transactions per minute
- Hyperledger 500 000 transactions per minute
- No loss of money through mining (electricity)

Architecture Intro

- distributed by design
- no single point of failure

Fabric-CA

- User management through X.509 certificates
- Attributes inside certificates are used to define roles and rights
- Can be attached to LDAP / Active Directory
- "only" a tool, can also use standalone OpenSSL

Peer

- place where ledger is stored

Orderer

- coordinator for transactions

Membership Service Provider

- Certificate Management for Hyperledger Fabric Components

Channel

- **data isolation / multi-tenancy**
- **every party must accept an additional party to join**
- **peers take part in channel**
- **add / remove possible during runtime**

Chaincode

- Smart-contract / Business-logic over data in the ledger
- Only way to interact with the ledger
- NodeJS, GoLang, Java
- no limit of what you can use, external libraries, external network calls
- Chaincode runs inside channel

Chaincode

- Needs to be installed and instantiated on every peer (can be automated)

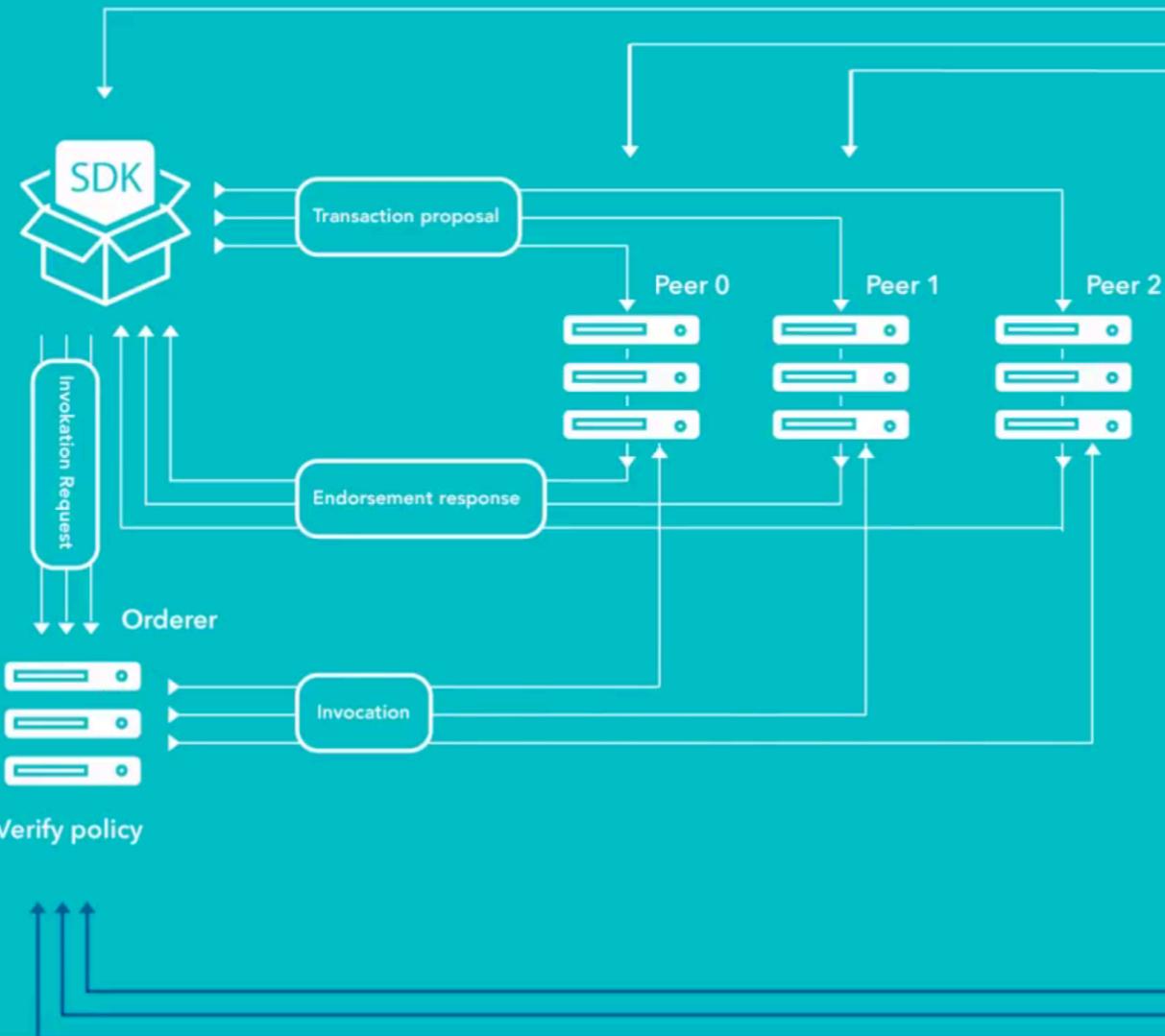
Policies

- Define level of security
- No chaincode without policy file

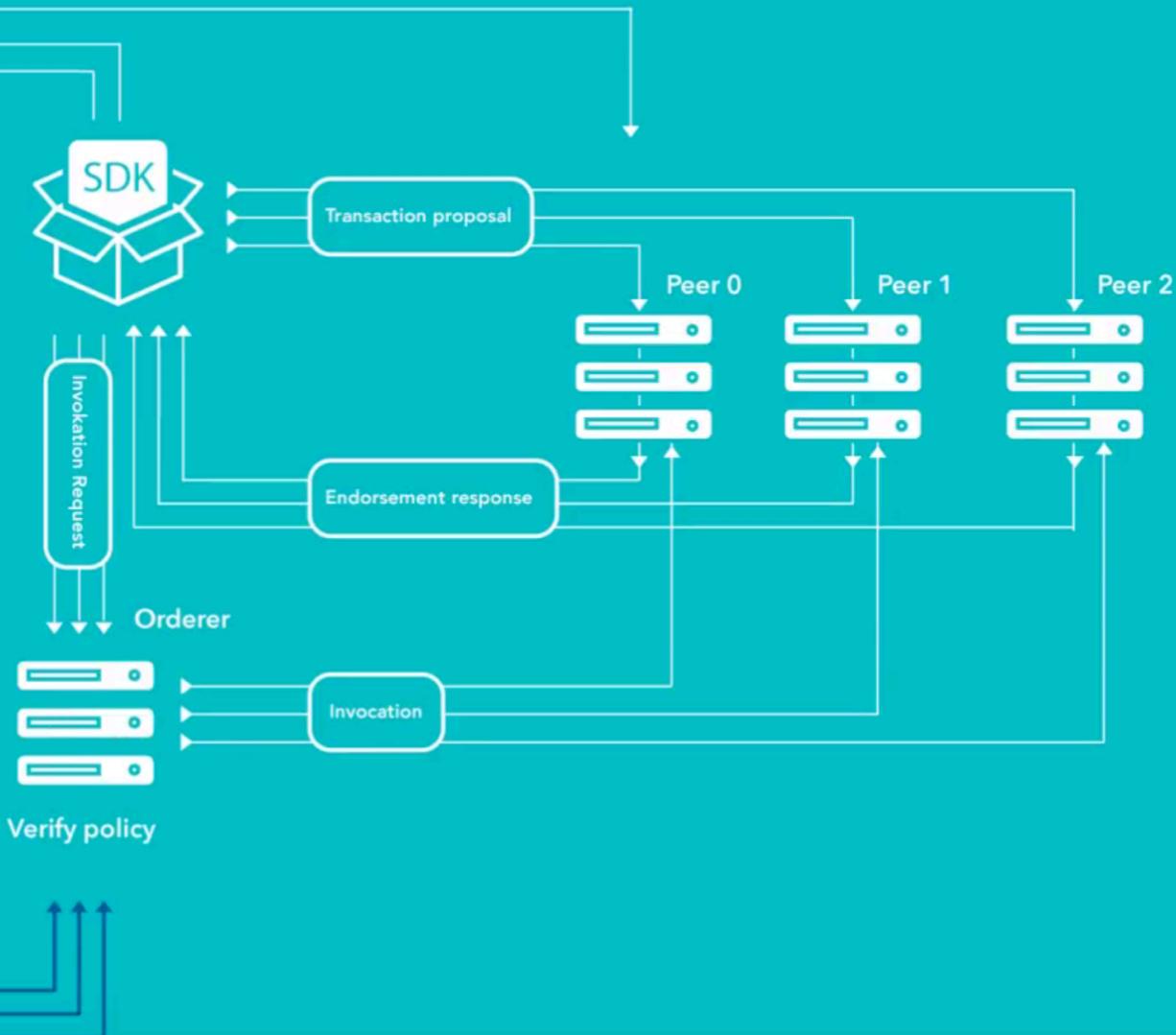
RECAP

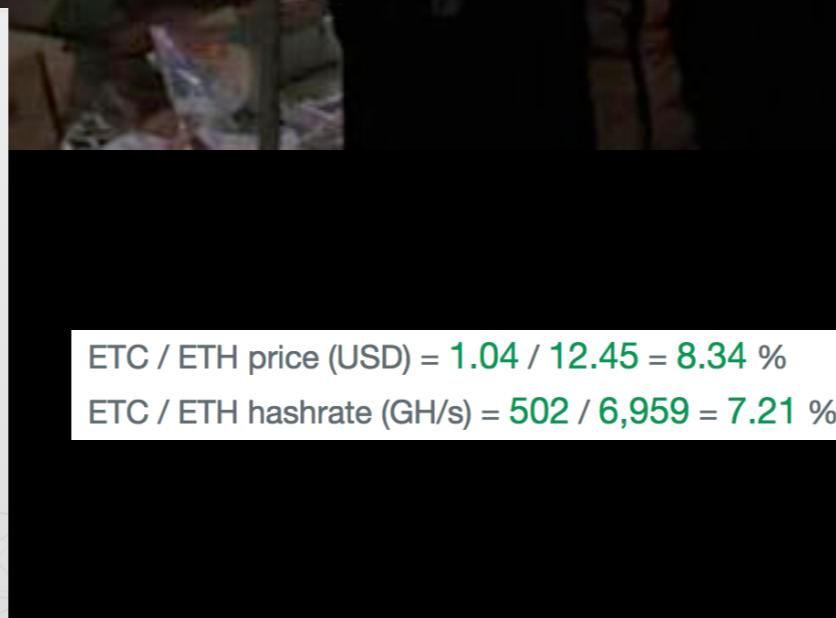
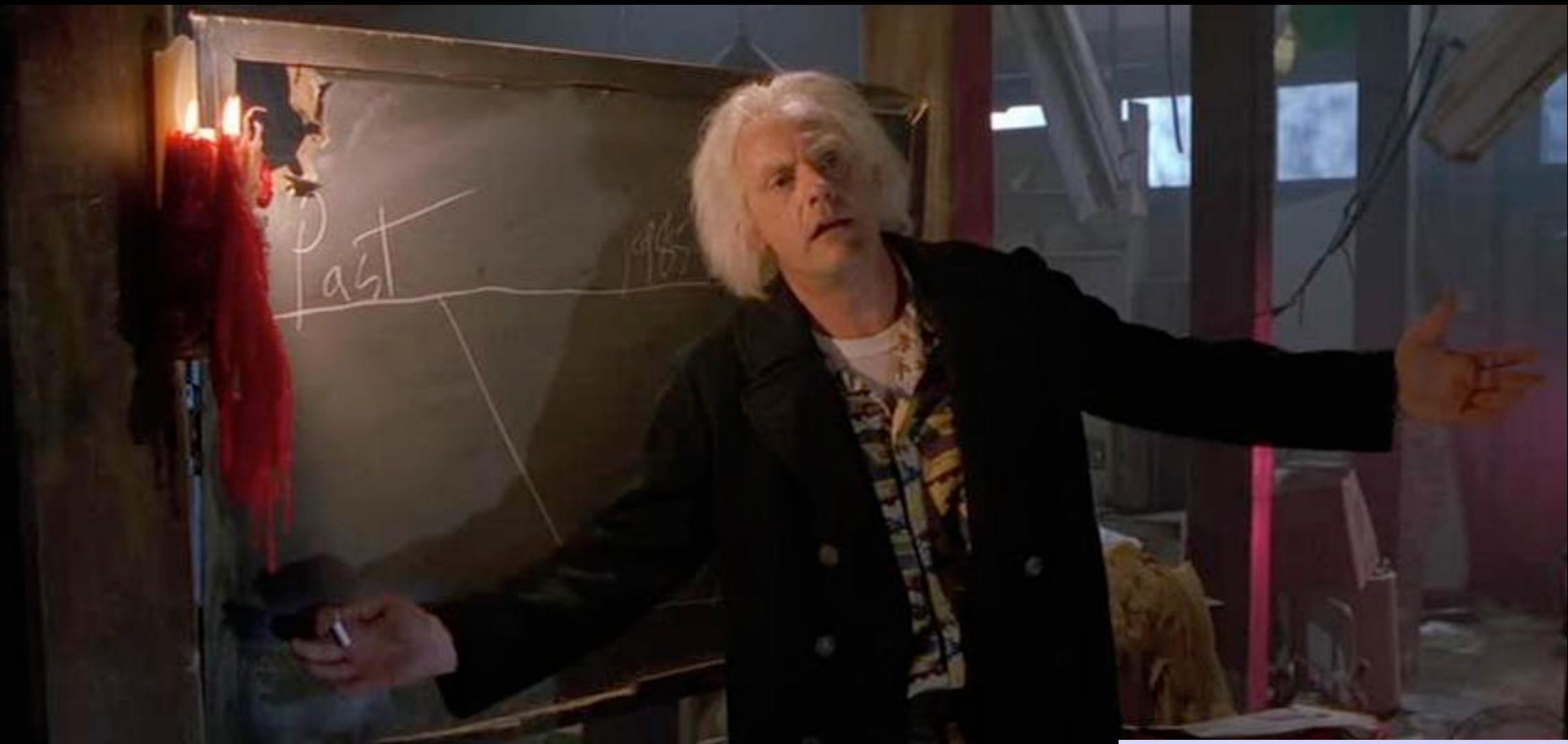
- Peer - may be part of one or many channels
- Every single channel has a separate ledger
- Every channel has one or many chaincodes
- Every chain code has a different policy

1 ORGANISATION

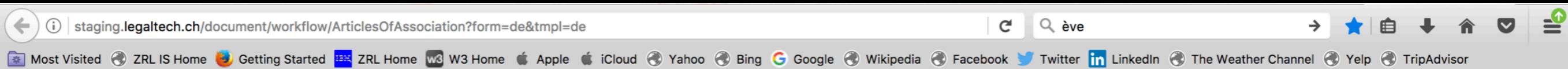


2 ORGANISATION





digital switzerland challenge



Gesellschaftsrecht-Statuten (Aktiengesellschaft)

Sign in Sign up

- Angaben zur Aktiengesellschaft
- Aktien und Aktienkapital
- Generalversammlung
- Datum und Unterschrift
- Beglaubigung

Aktien und Aktienkapital

Bitte geben Sie das Aktienkapital (CHF) der Gesellschaft ein.

*
50000

In welche Anzahl Namenaktien ist das Aktienkapital der Gesellschaft eingeteilt?

*
5000

Bitte geben Sie den Nominalwert (CHF) pro Namenaktie ein.

*
10

Back

Next

Statuten
der
Gesellschaft
(the „Company“)

Art. 1 Firma, Sitz, Dauer und Zweck
Name, Domicile, Duration and Purpose
Art. 1 Firma, Sitz, Dauer
Under the name of
bestellt eine Aktiengesellschaft, welche den Vorschriften des 26. Titels des Zivilgesetzbuchs (ZGB) unterliegt.
Der Sitz der Gesellschaft ist in...
Die Gesellschaft besteht auf...
Art. 2 Zweck
Die Gesellschaft kann im In- und Ausland Zweigniederlassungen einrichten, sich an anderen Unternehmen beteiligen, gemeinsame Übernahmen sowie Verträge abschließen, um die Geschäftstätigkeit der Gesellschaft zu fördern; ob direkt oder indirekt damit im Zusammenhang stehen, dass die Gesellschaft für eigene oder fremde Rechnung Geschäfte abschließt, gegen Abgabe von Garantien und Leistungen für verbindliche Handelsgeschäfte für verbundene Unternehmen und Dritte eingehen.

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Legal Entity Establishment 4w - 6w => 48h

<https://ibm-blockchain.github.io/>