An Introduction to Blockchain

my two bits
arun sharma

How did it come about

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The realization

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- An open, distributed database
- Disintermediation - P2P
- Consensus based, hack proof
- Trustless transfer of value - transactions
- Definitive representation of value
- Insert only, permanent

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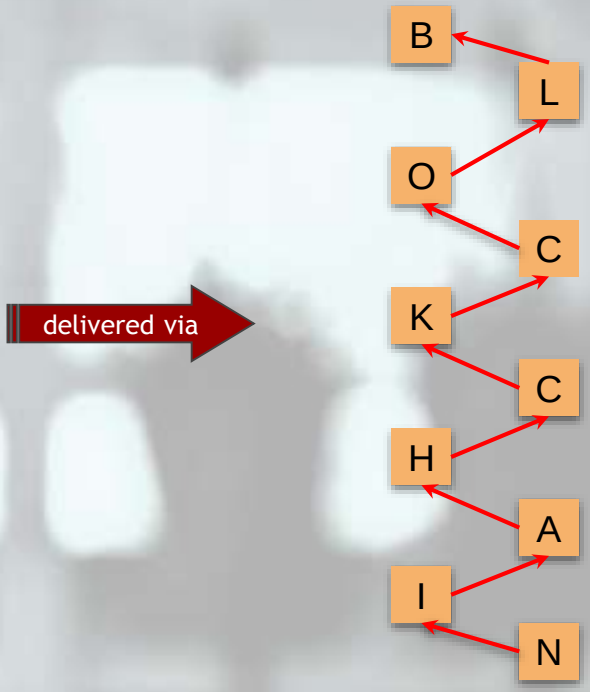

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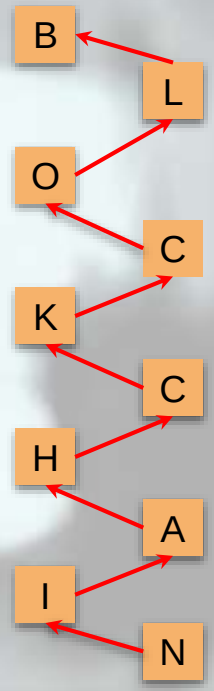

The Internet of Value

The technology promise

The technology promise

Distributed

Failure resistant
Shared Infrastructure

Decentralized

Censorship resistant
No middlemen
True P2P

Trust(less)

Encrypted
Cryptography based
Cheat proof

Open Source

Hack resistant
Clear rules

Immutable

Auditable
Open ledger
Traceability

Programmable

Platform creation
Business apps
Governance

Accessibility

Permissionless
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Pseudonymity
Anonymity

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Incentivized
Game Theory based

The technology promise

Disruptive ?
Transformative ?
Revolutionary ?
Sharing economy 2.0 ?
Internet 3.0 ?

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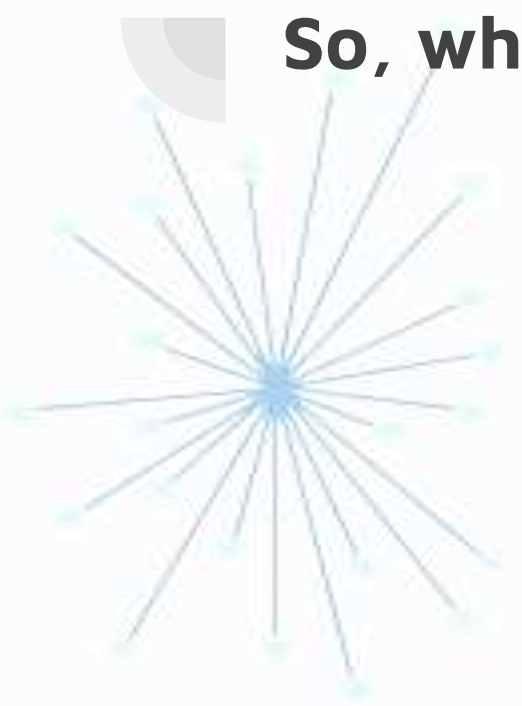
The Internet of Participation

So, what exactly is it?



Centralized

Decentralized

Distributed

So, what exactly is it?

A **Distributed Ledger of Transactions**, stored as **Immutable Blocks** that are connected to one another thereby forming a **Chain**, the validity of which has been **Agreed Upon** by **Peers** on a **Decentralised Network**, and secured by **Cryptography**.

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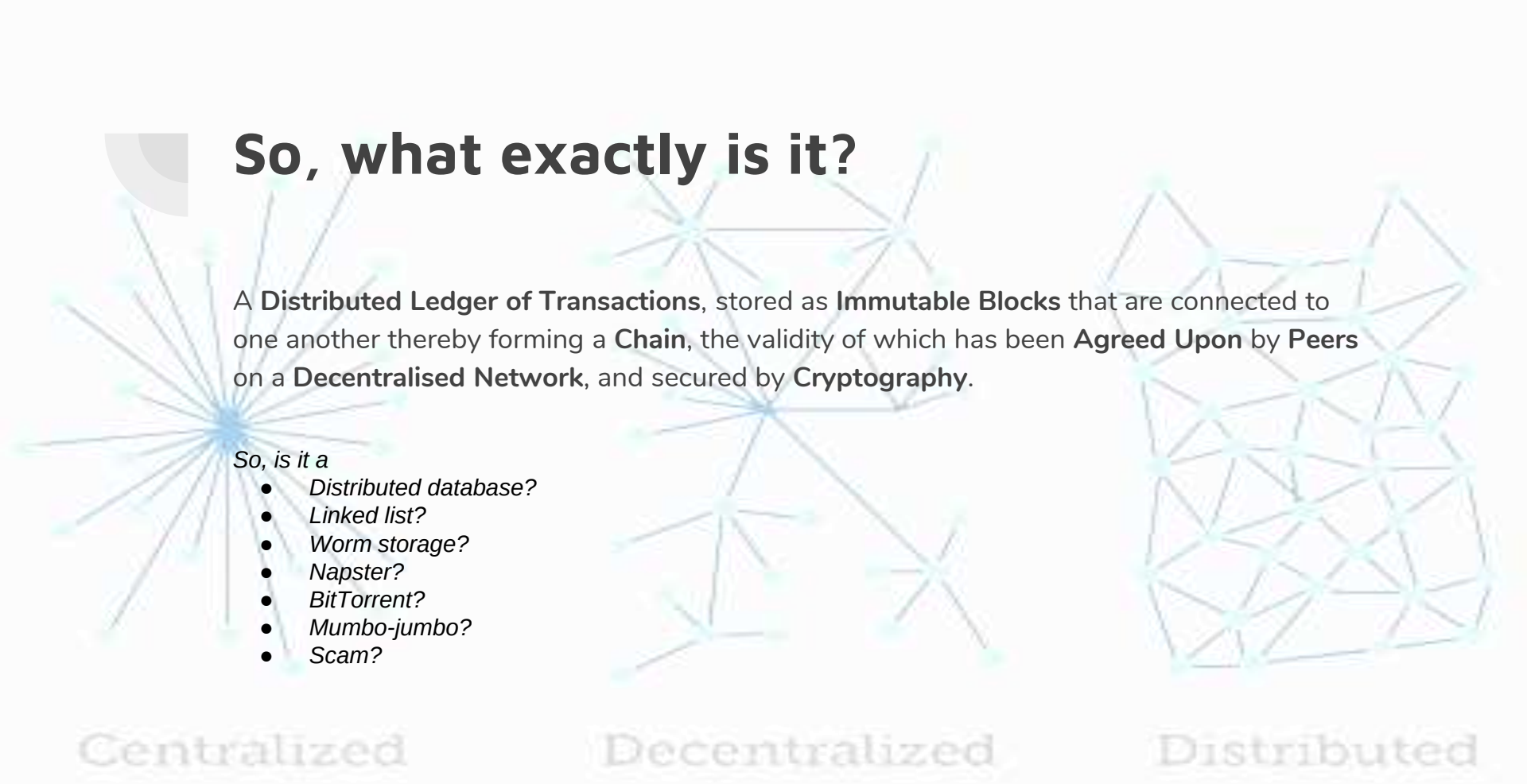
- *Linked list?*
- *Worm storage?*
- *Napster?*
- *BitTorrent?*
- *Mumbo-jumbo?*
- *Scam?*



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Combines concepts of

- ➔ Distributed Computing +
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- ➔ Application Code +
- ➔ Network +
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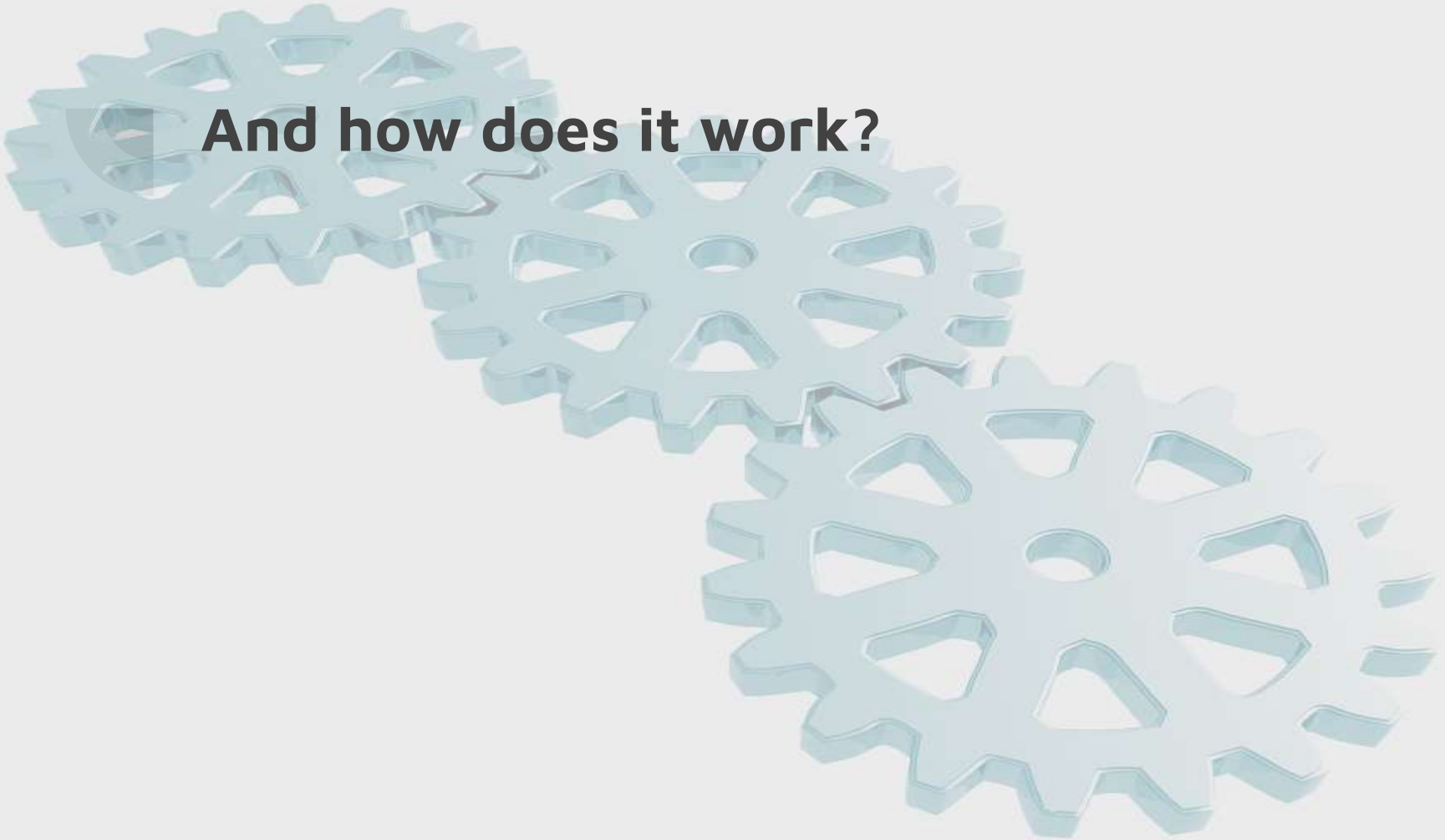
Centralized Decentralized Distributed

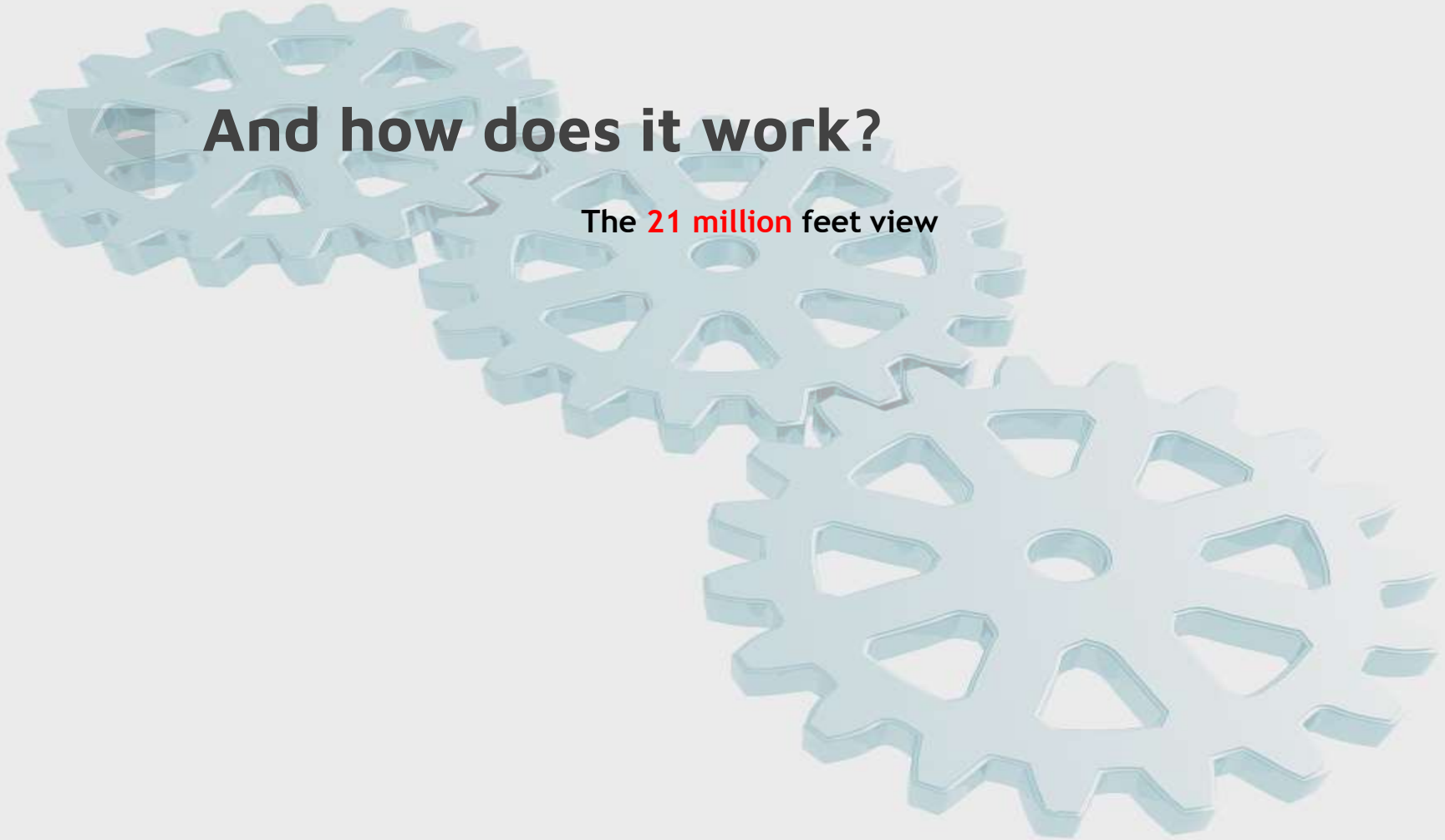
Based on sound principles

And how does it work?



And how does it work?

The 21 million feet view



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Create the
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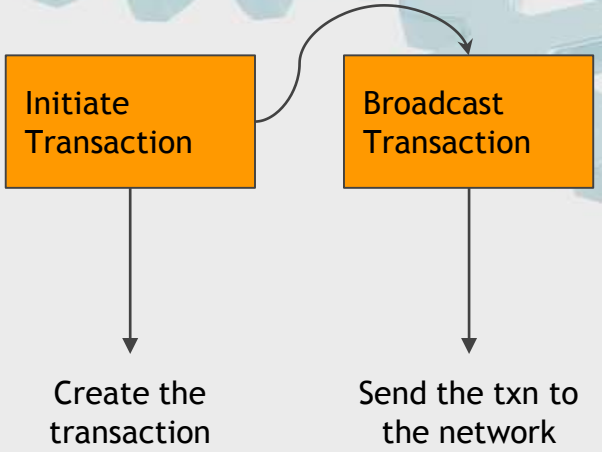

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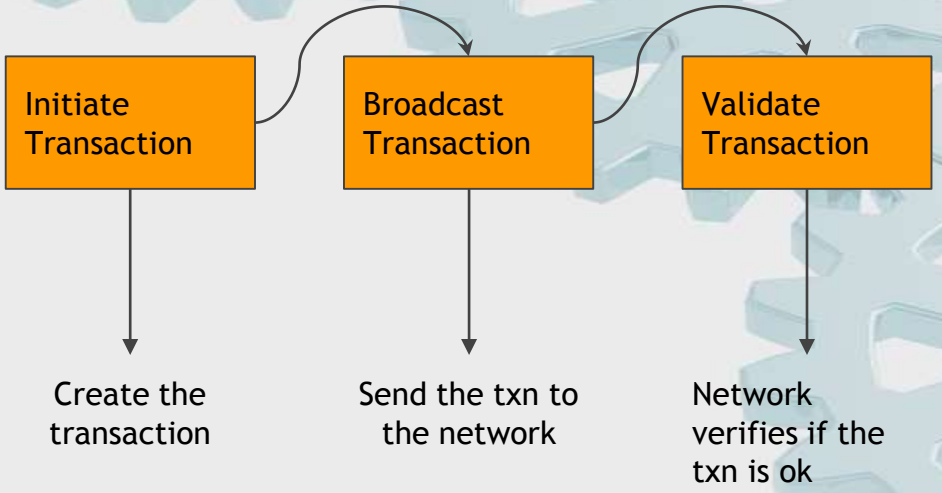

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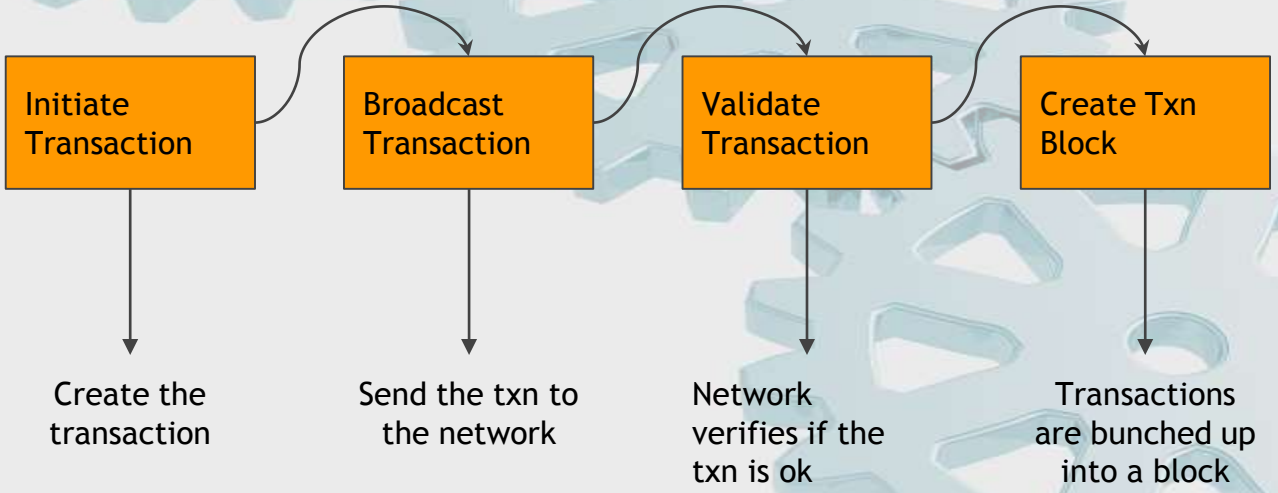

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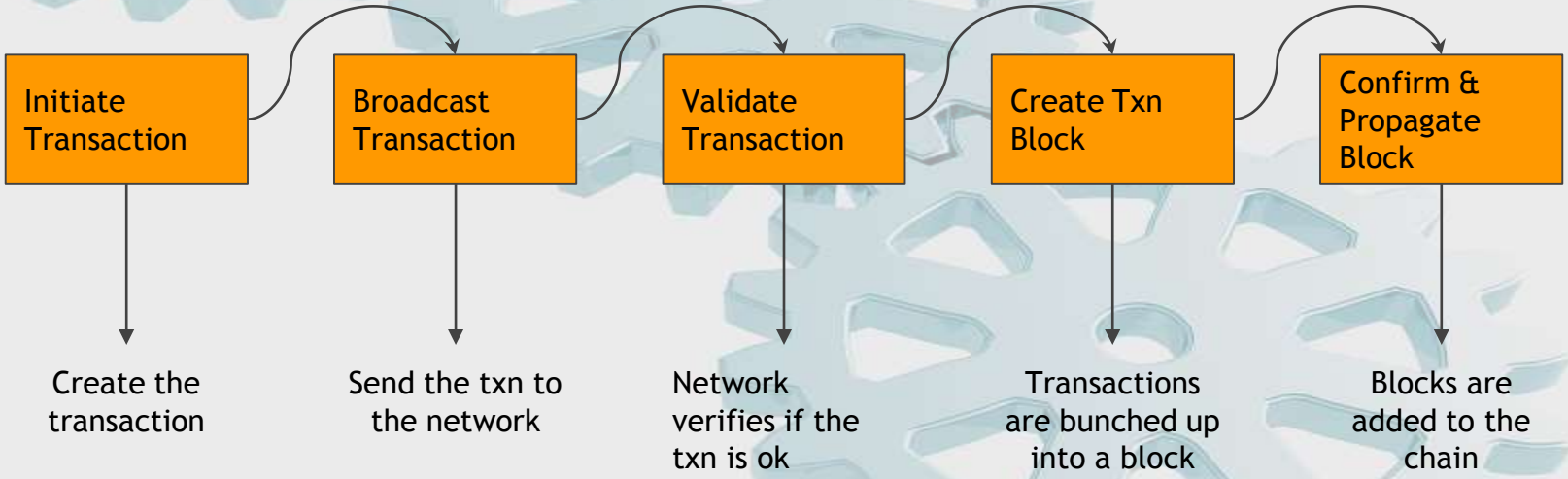

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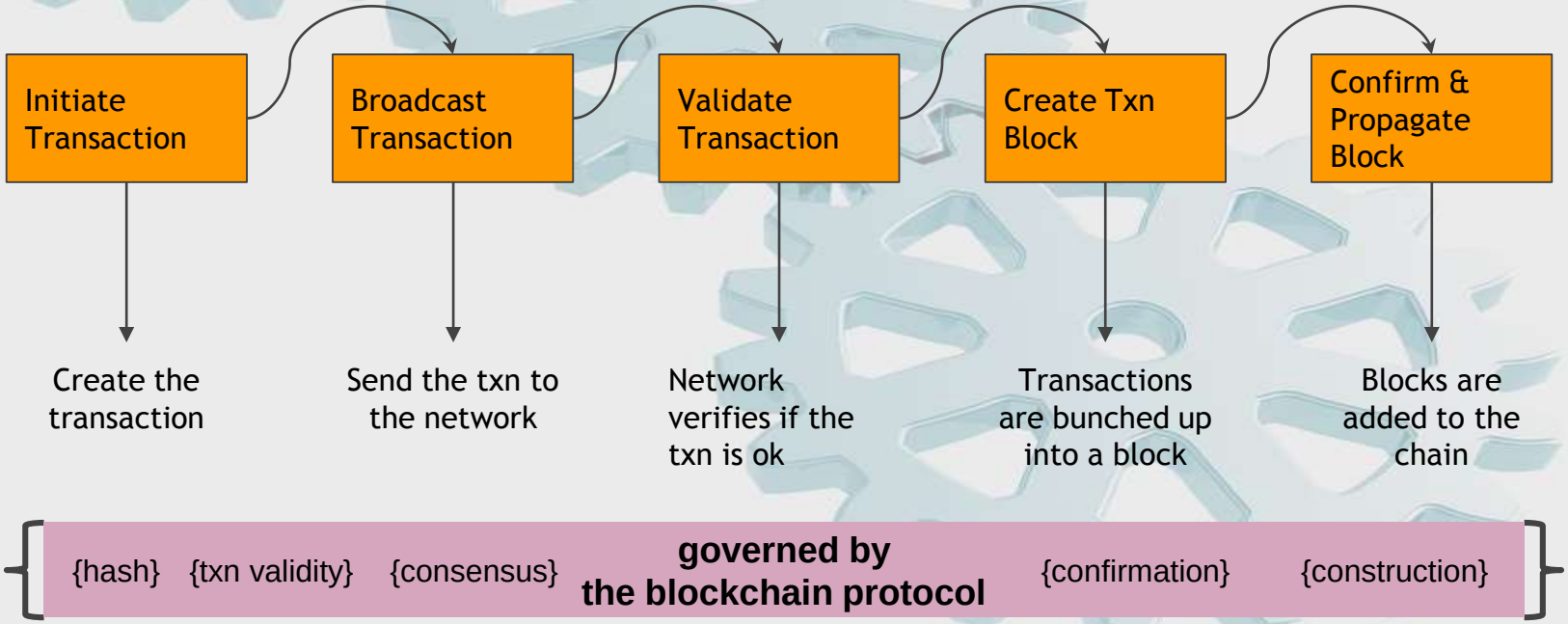

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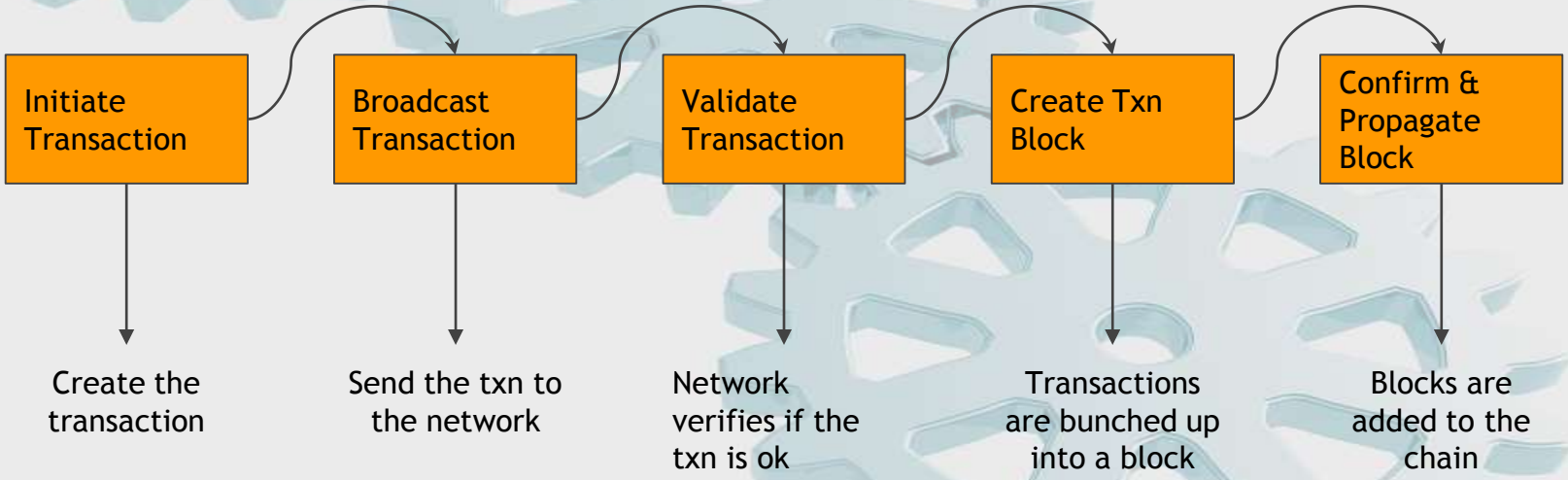

{hash} {txn validity} {consensus} **governed by the blockchain protocol** {confirmation} {construction}

Thanks, BBC

Breaking it down, bitcoin by bitcoin

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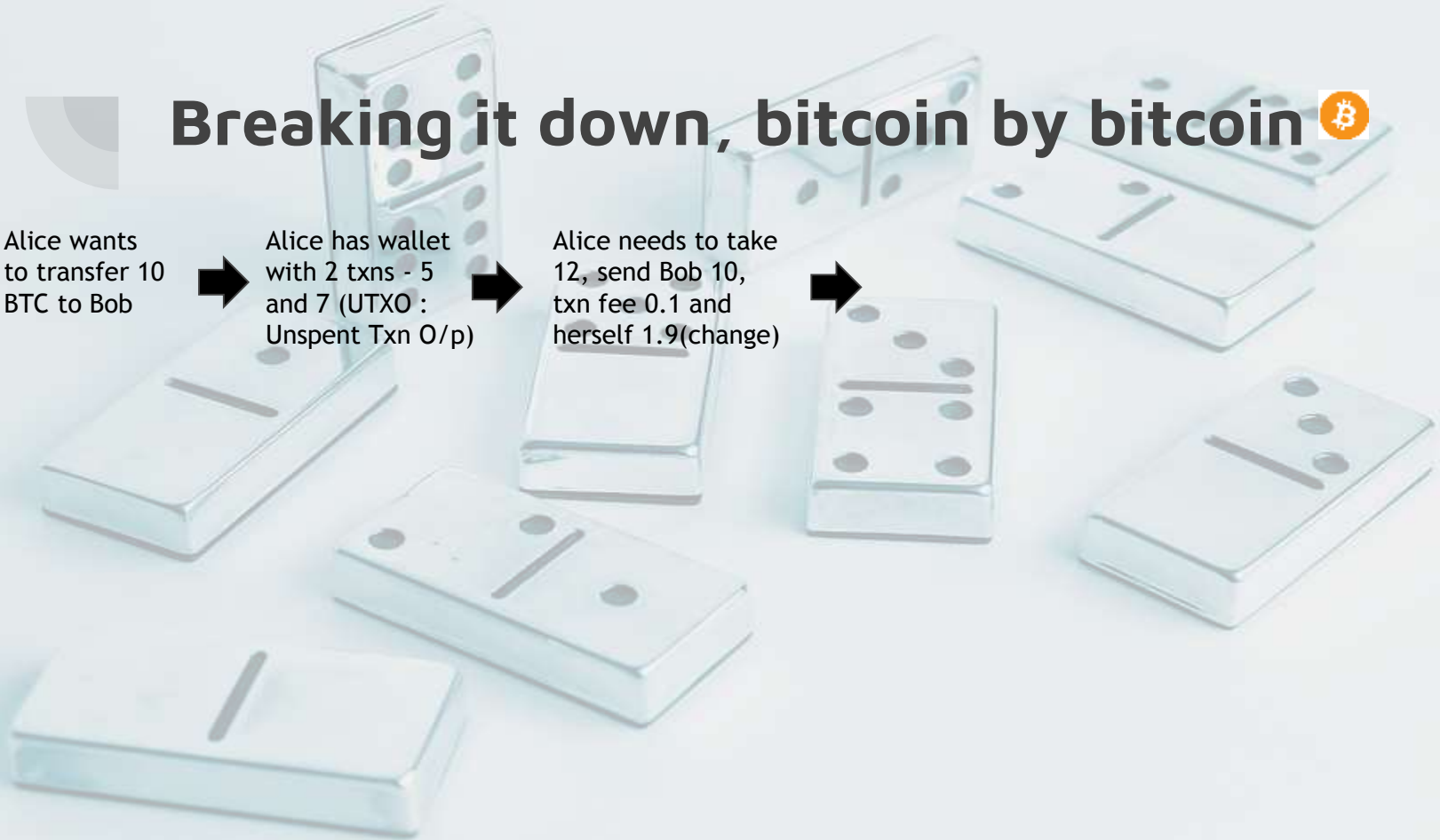

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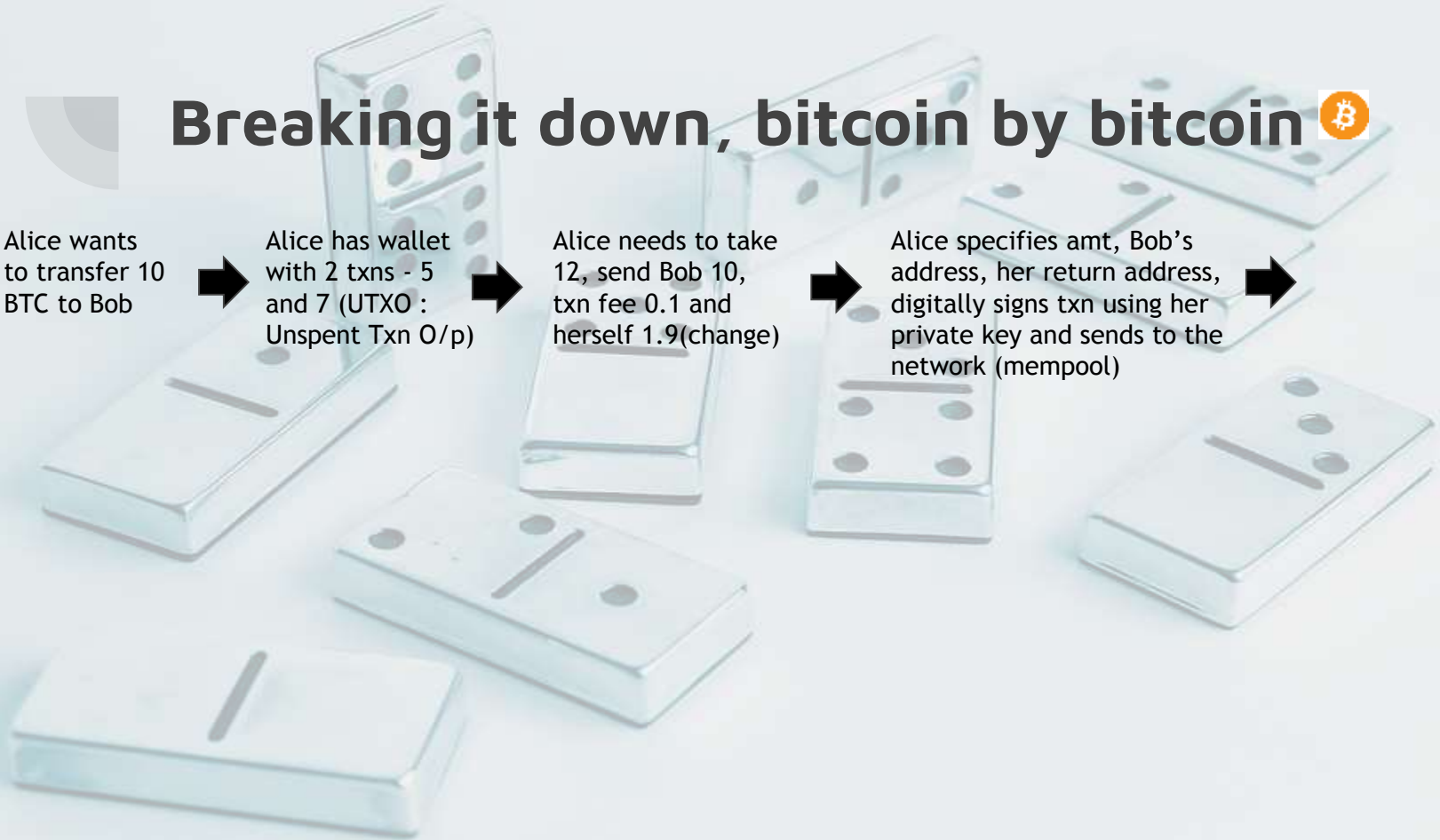

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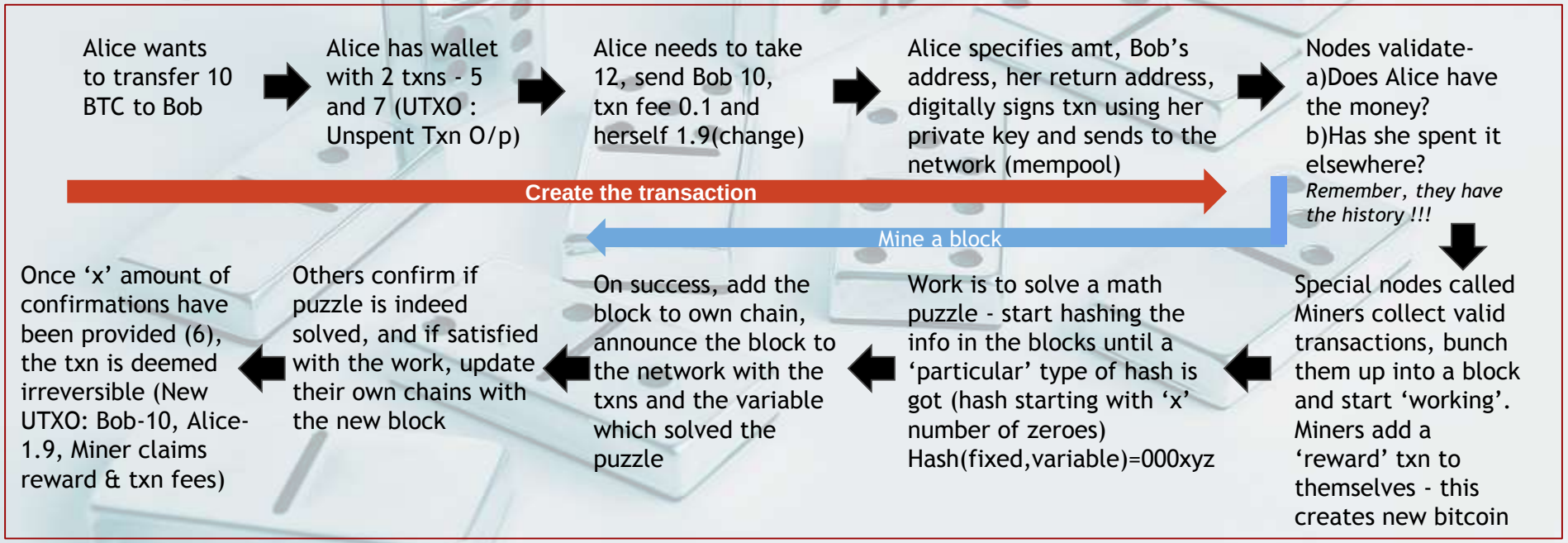

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Mine a block

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Arrive at consensus

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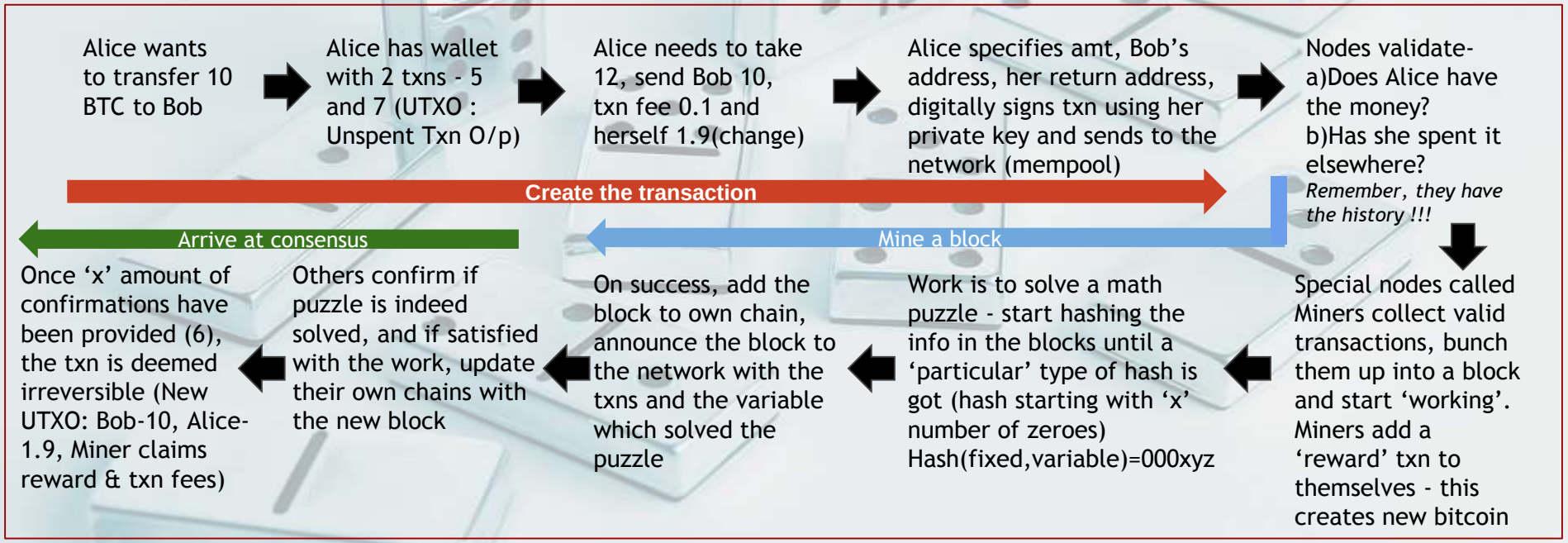
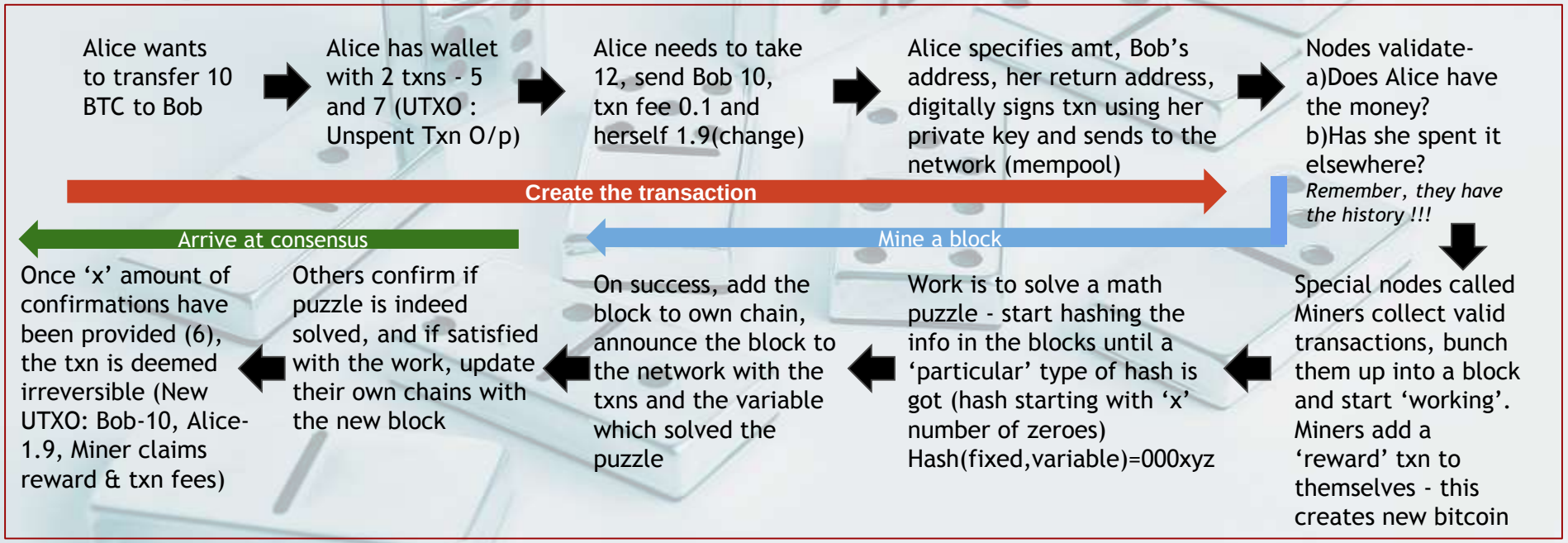


By the way - Bitcoin = the network, bitcoin = the currency (BTC) and 1 BTC = 100 million satoshi

Names used in Crypto examples - A for Alice, B for Bob, C…, D…,E for Eve,....., O for Olivia,.....,S for Sybil.....

Breaking it down, bitcoin by bitcoin



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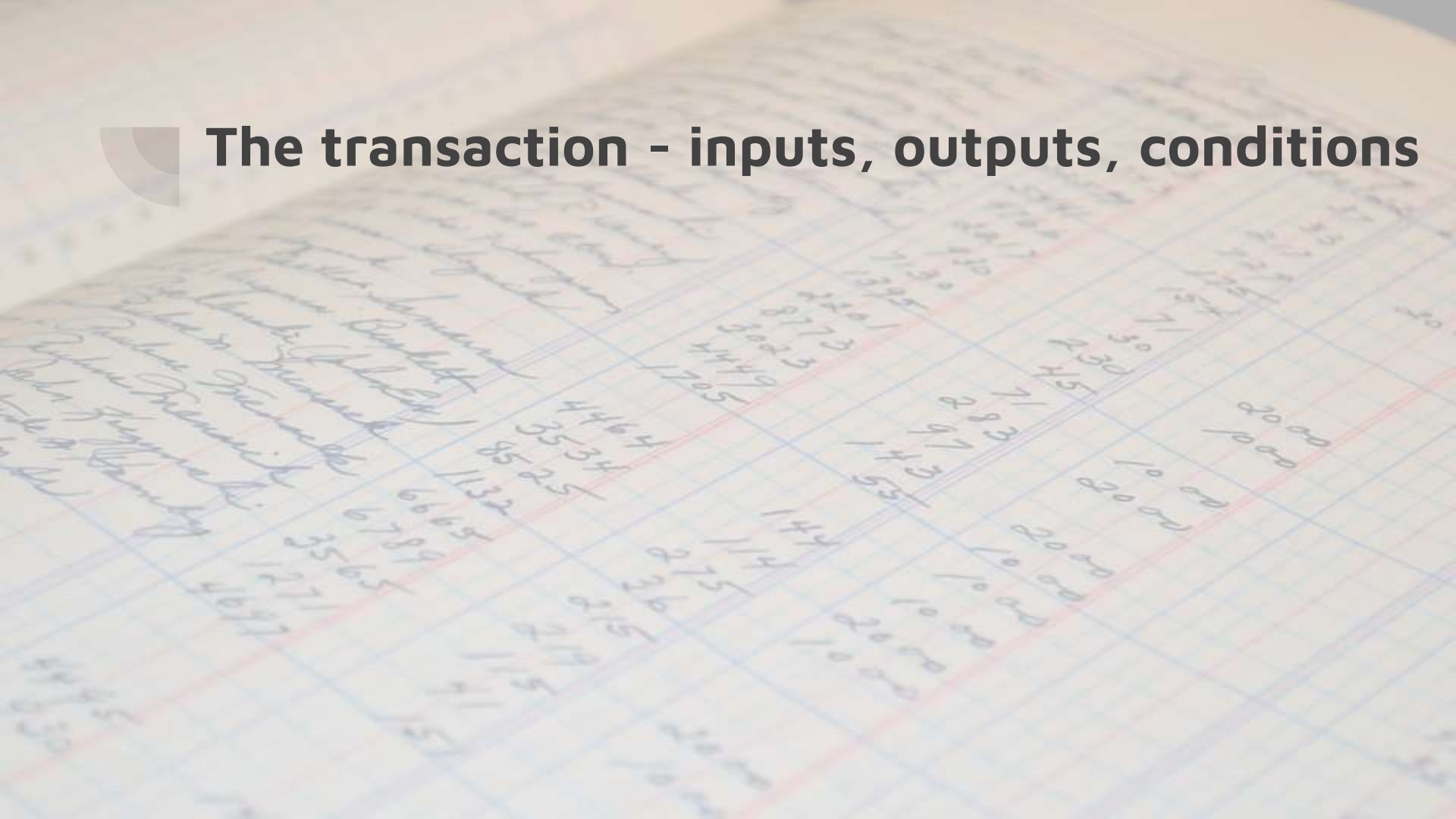
https://bitbonkers.com/

The transaction - inputs, outputs, conditions



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Inputs are where the money is coming from and Outputs are where the money is going to

The transaction - inputs, outputs, conditions

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It is a ledger of transactions and not balances - only sent and received details stored

You can only send what you have previously received (or mined, which is a txn to yourself)

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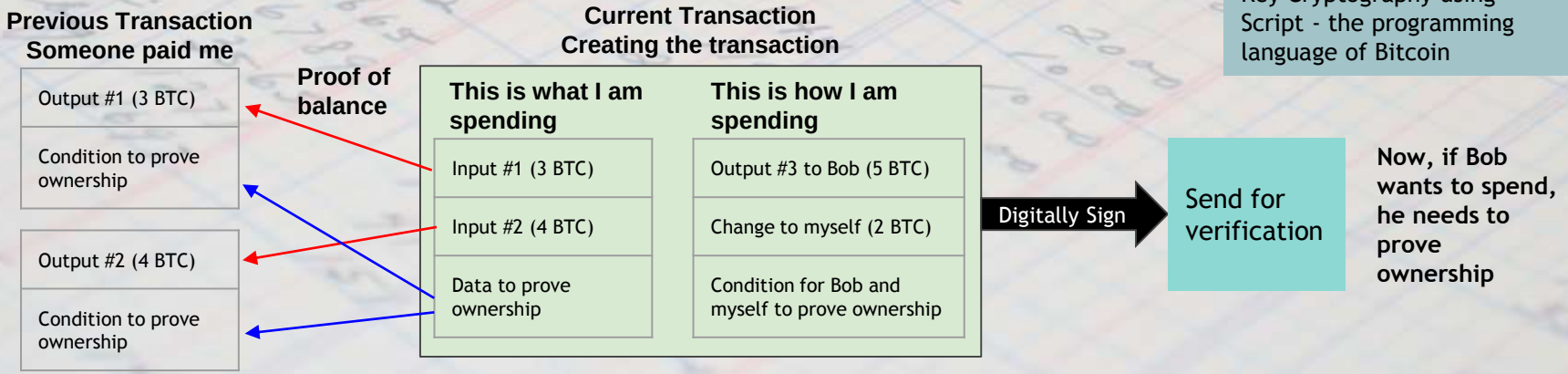
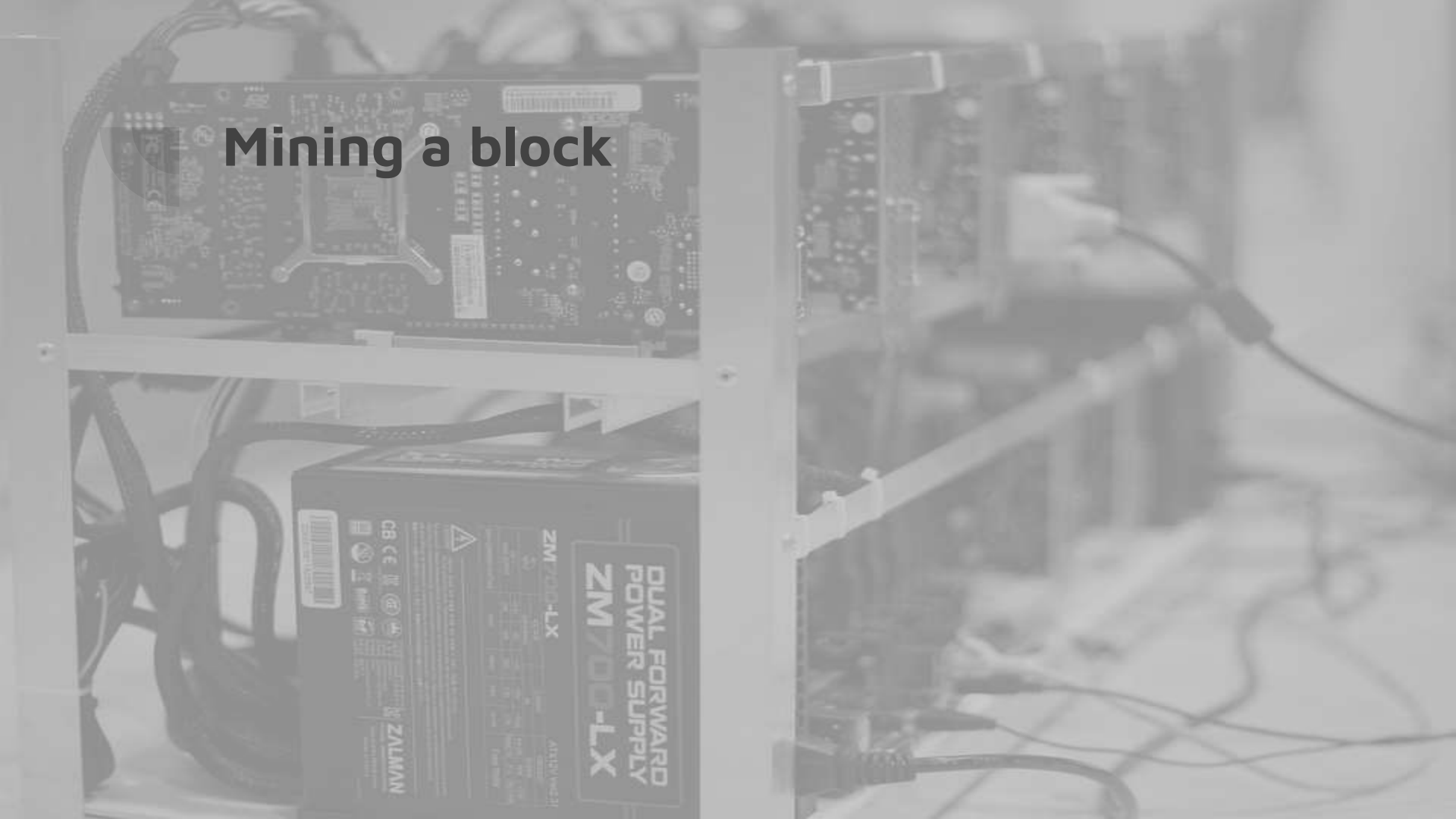


Mining a block



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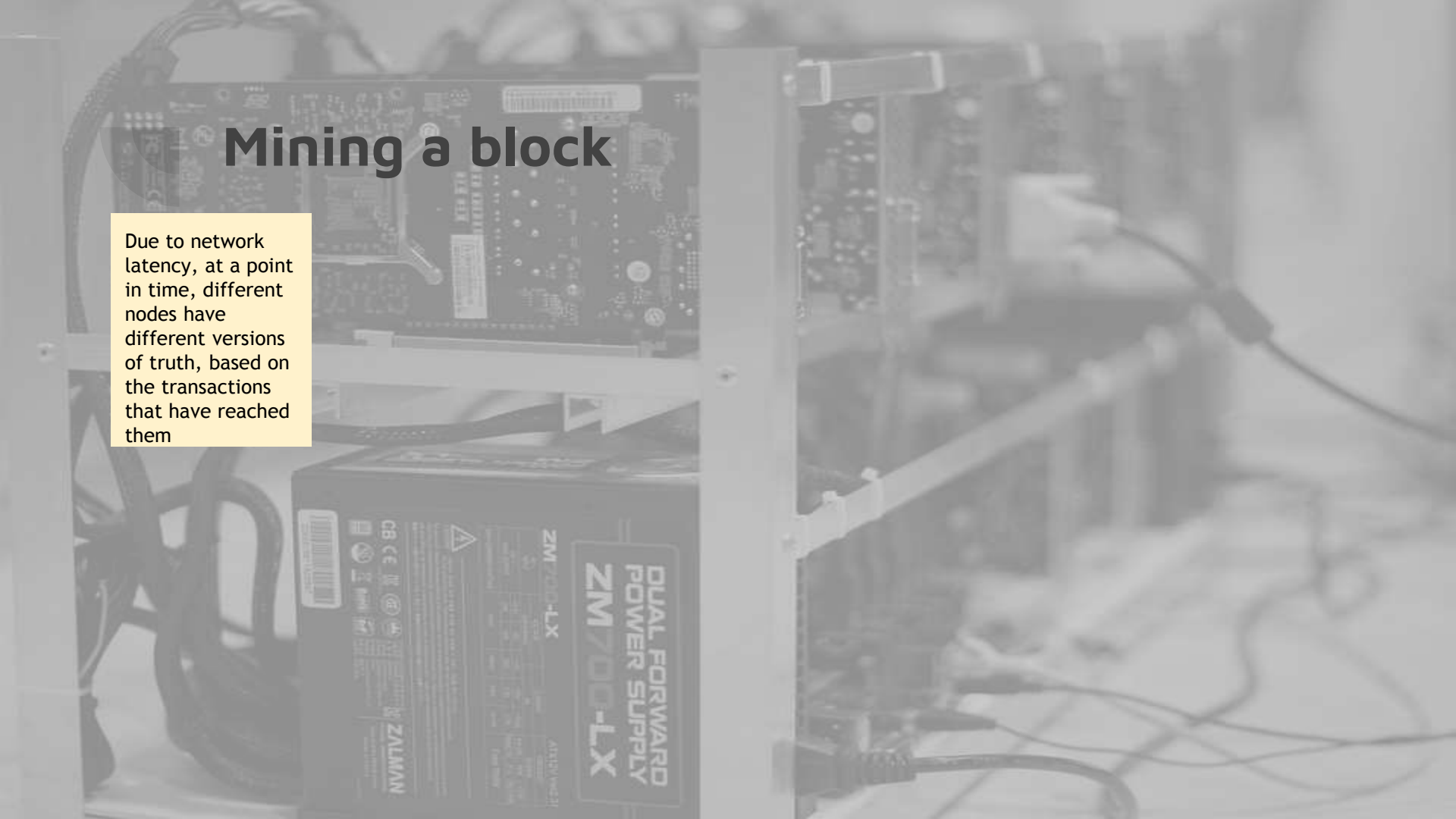

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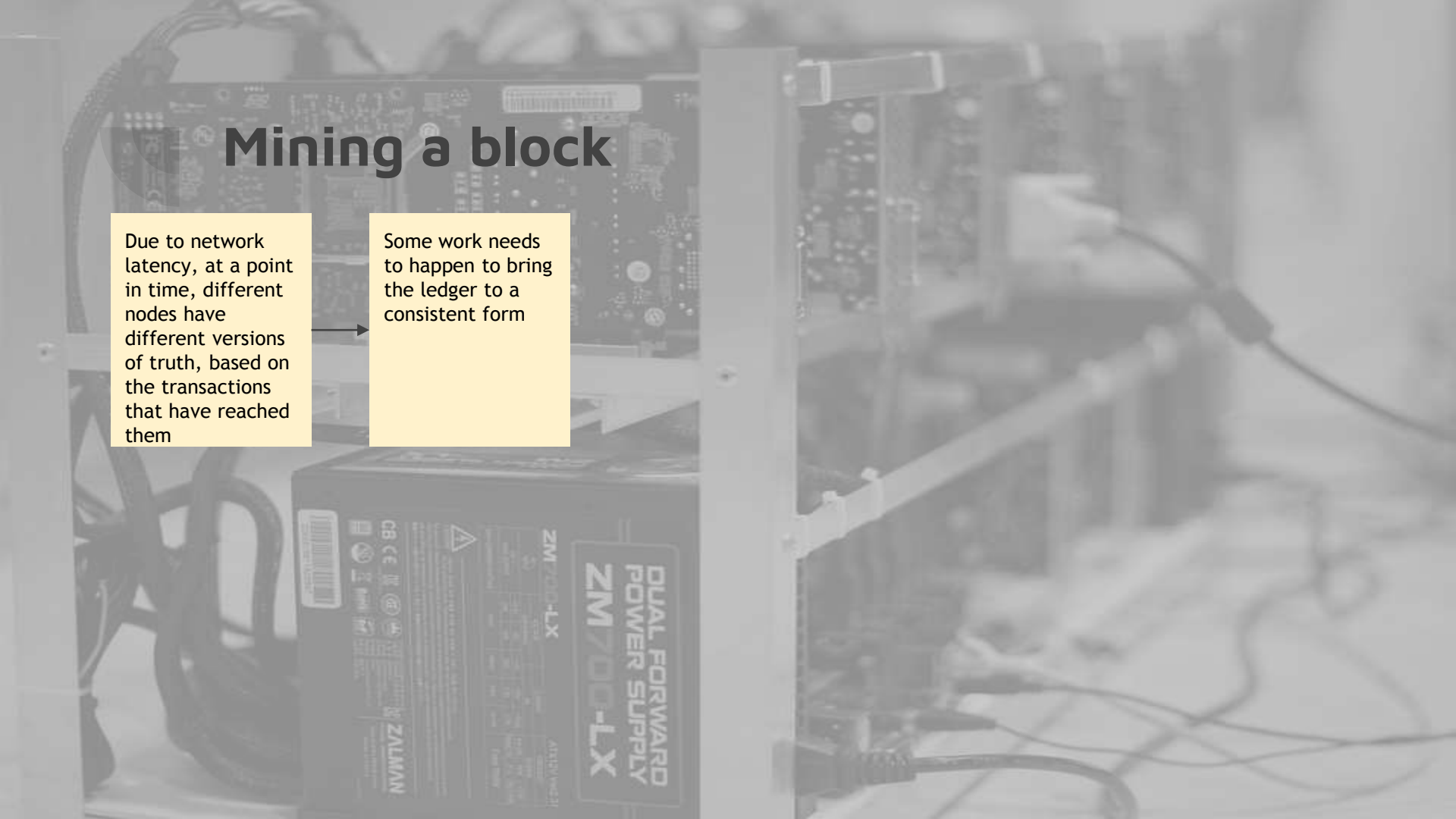

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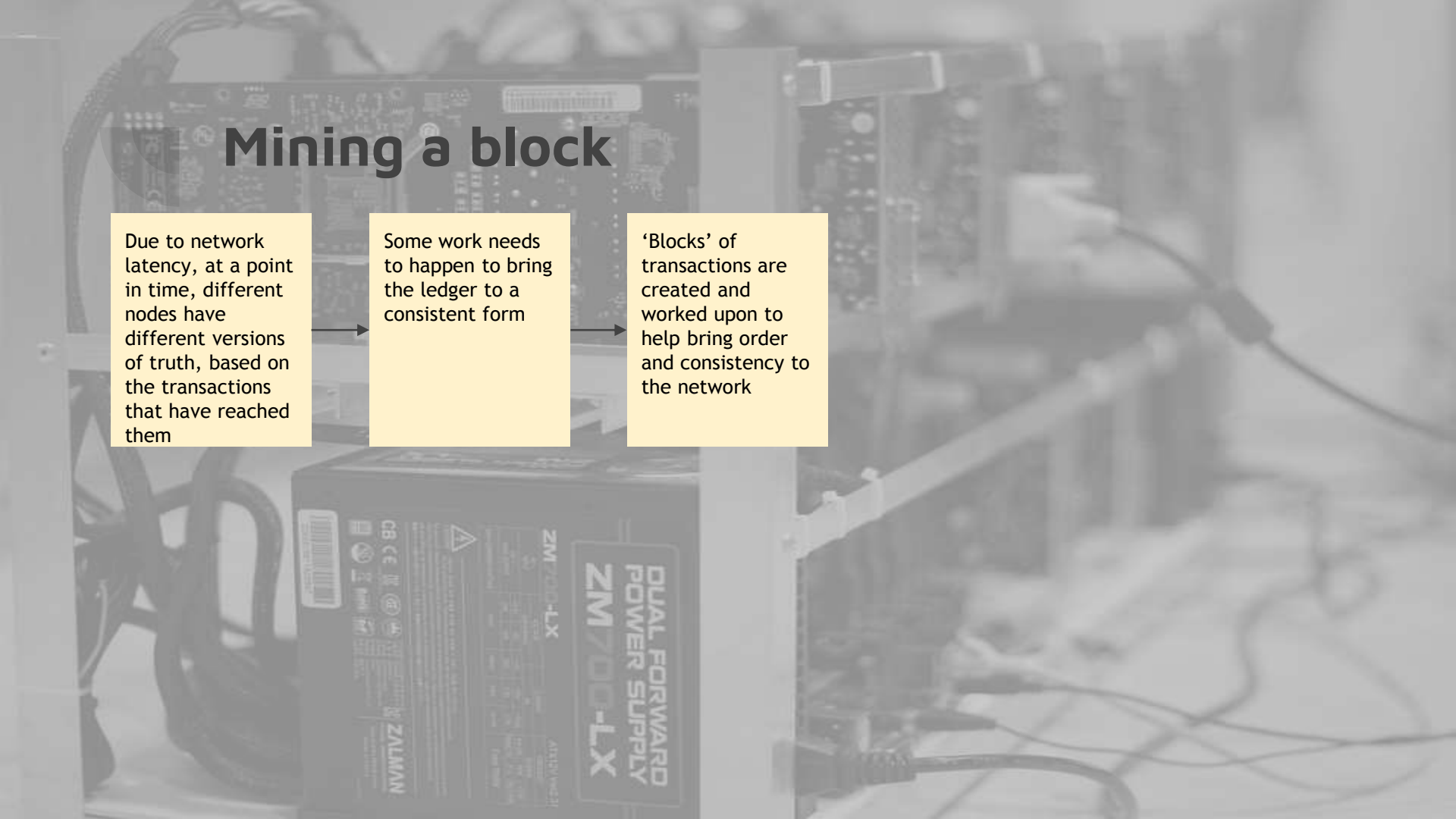

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- The transactions are confirmed in a trustless, distributed manner
- Money has been generated through the reward

The mining process

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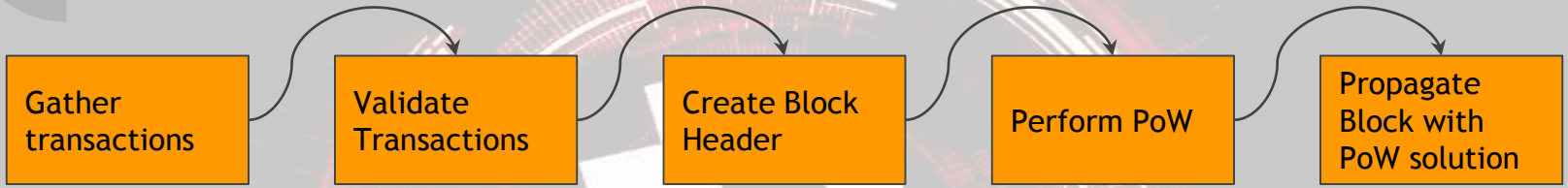

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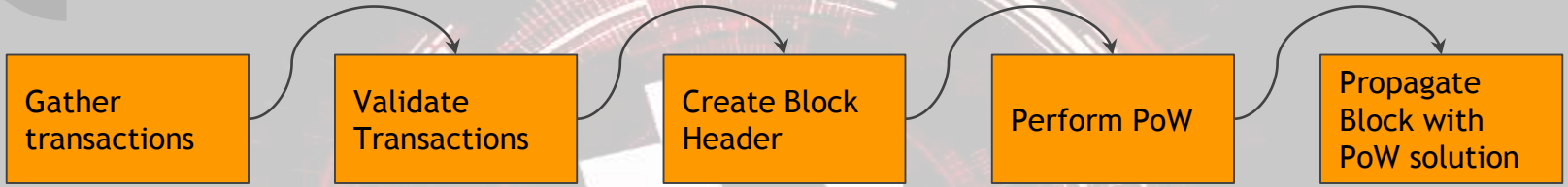
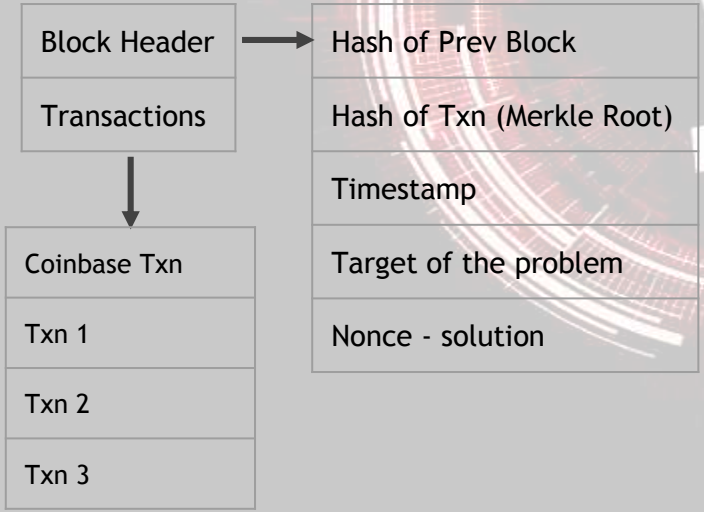


Block structure



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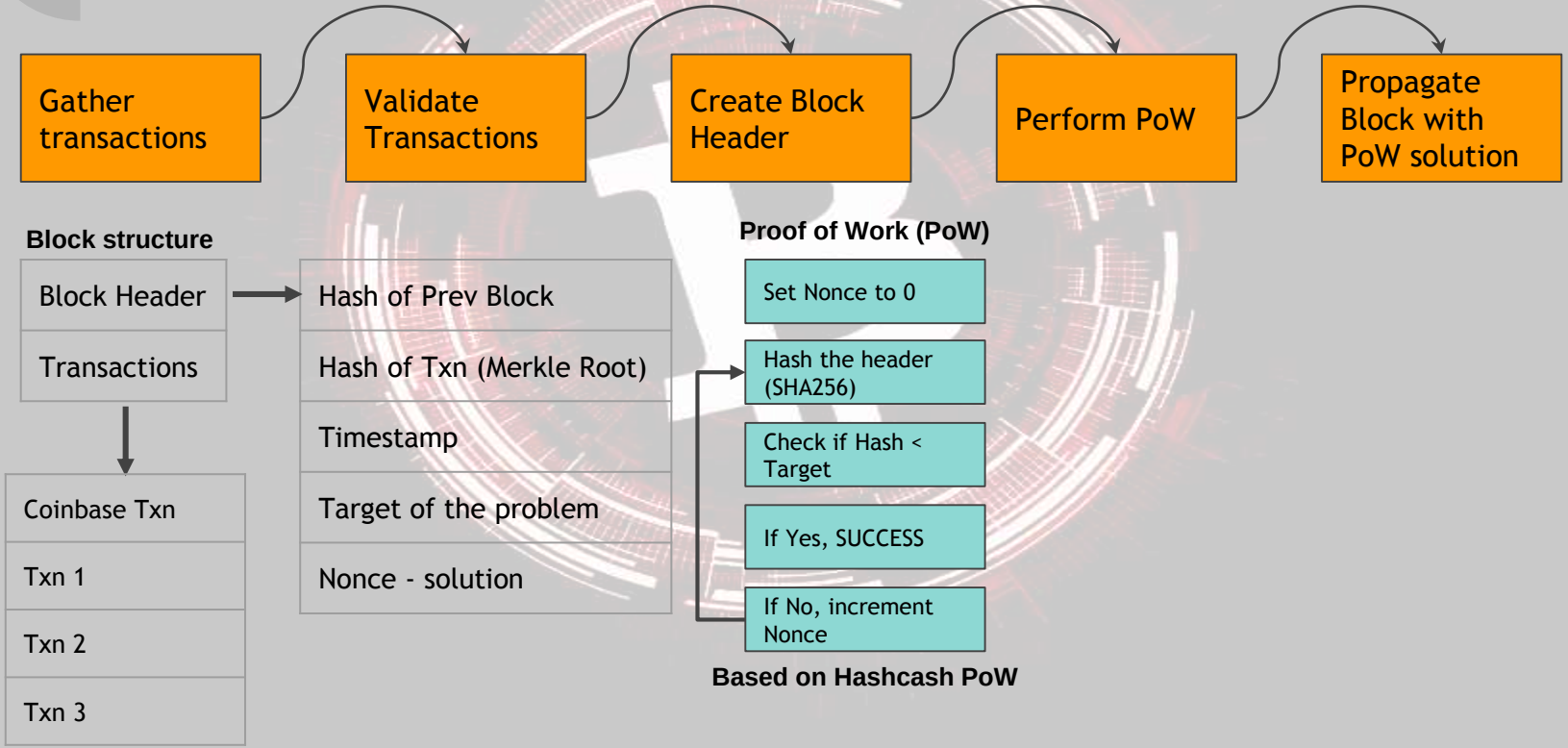

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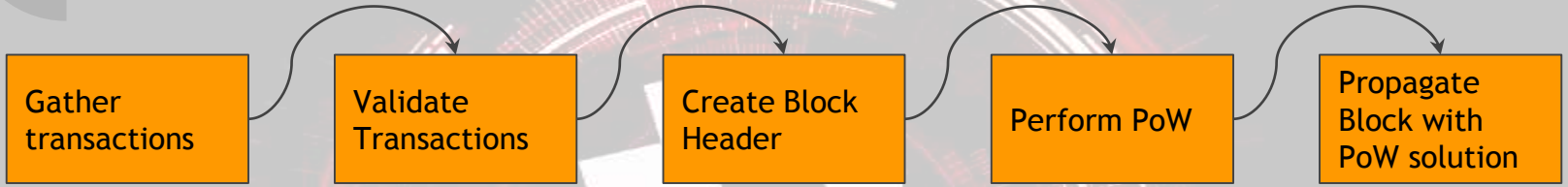


Block structure

- Block Header
  - Hash of Prev Block
  - Hash of Txn (Merkle Root)
  - Timestamp
  - Target of the problem
  - Nonce - solution
- Transactions
  - Coinbase Txn
  - Txn 1
  - Txn 2
  - Txn 3

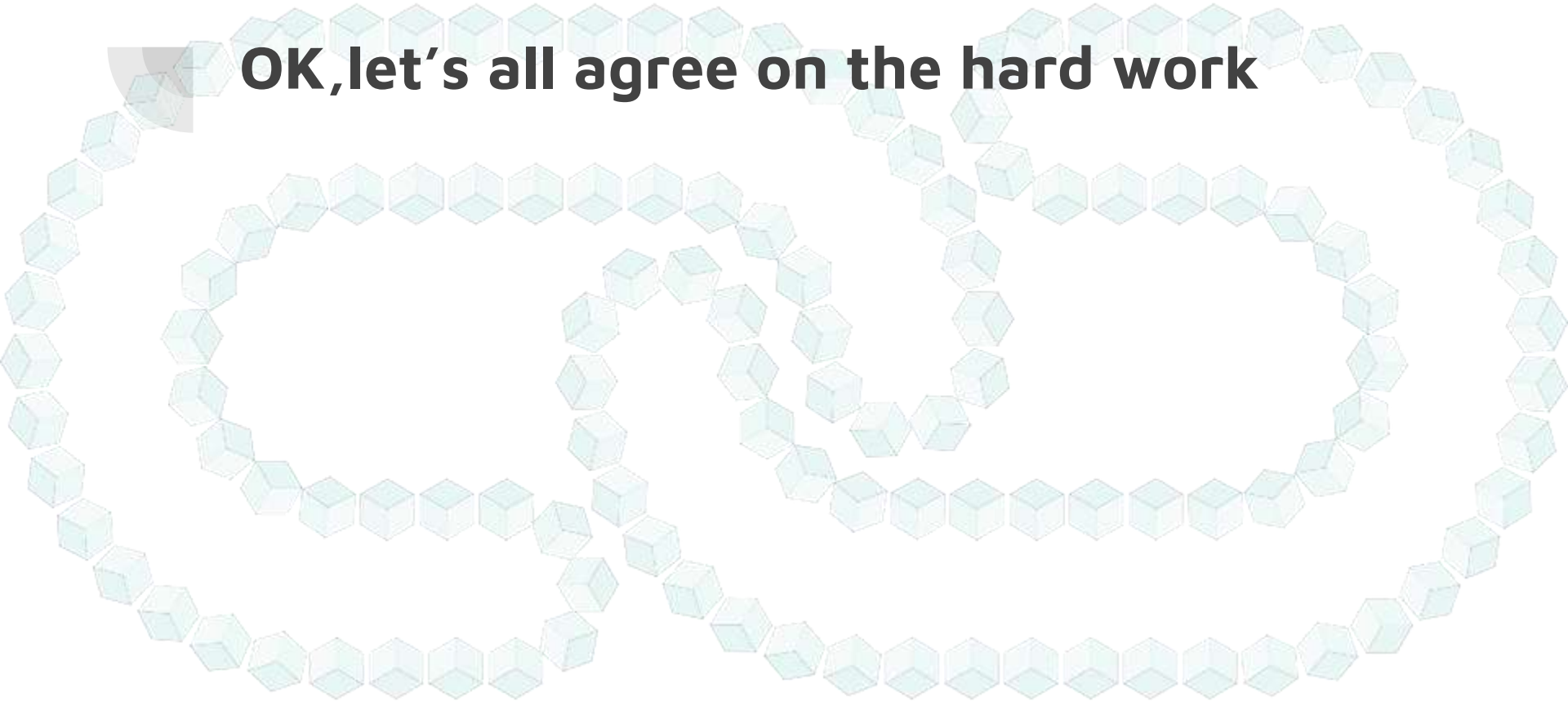
Proof of Work (PoW)

1. Set Nonce to 0
2. Hash the header (SHA256)
3. Check if Hash < Target
4. If Yes, SUCCESS
5. If No, increment Nonce

Based on Hashcash PoW

- Blocks are created every 10 mins on average
- If compute power (hashrate) increases, target changes to bring block creation time back to 10 mins
- Nonce - Number used Once
- Reward for a block started with 50 BTC, halves every 210000 blocks, currently 12.5
- At around 21 million, there will be almost Zero reward (c. 2140)
- Miners will then get txn fee for mining blocks
- The total reward (block reward + txn fees) is a ‘coinbase transaction’ inserted by miners, as a claim, in each block
- Since hash of previous block is included in hash of new block, changing prev block must ensure changing all subsequent blocks

OK,let's all agree on the hard work



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Building the chain

- ❑ Loads of transactions, lots of miners racing to find the solution, highly distributed
- ❑ Not a linear blockchain - possible that two miners find solutions at the same time unknown to each other
- ❑ What then? How will the nodes decide which one to add to the chain? How long to wait for the decision?

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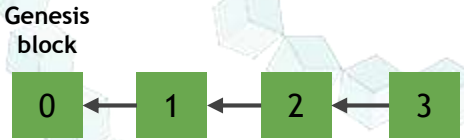

Txn Set B

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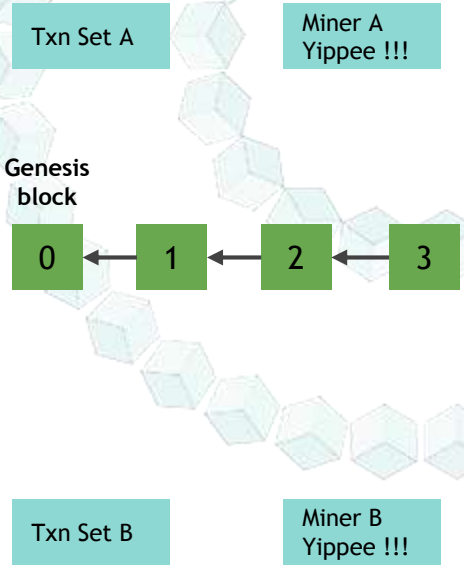

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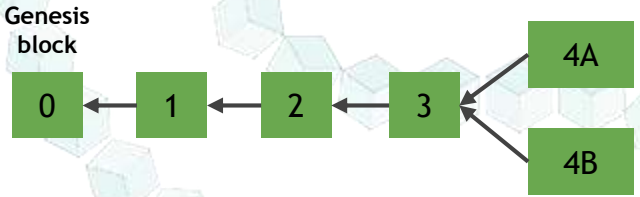
Txn Set A

Miner A
Yippee !!!

Nodes 1-10

Add Block 4A,Reject 4B
as its pointing to 3



Txn Set B

Miner B
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Nodes 11-20

Add Block 4B,Reject 4A
as its pointing to 3

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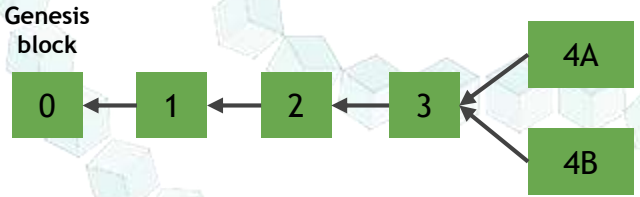

Txn Set B

Miner B
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Nodes 11-20
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Node 14
Miner C
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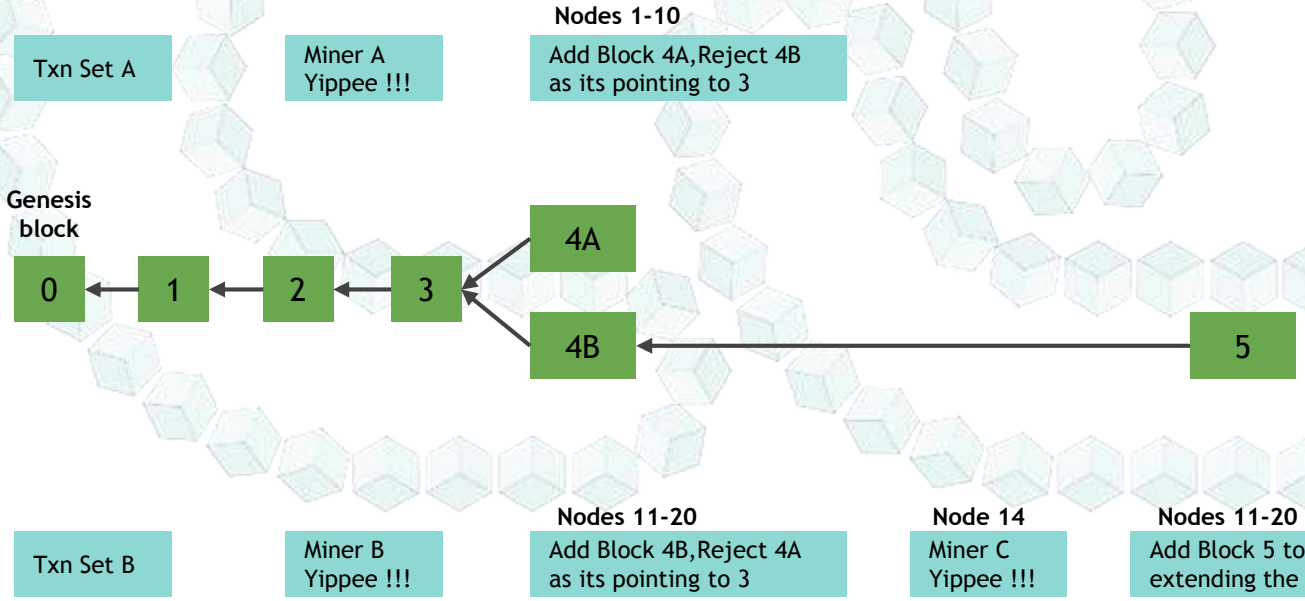

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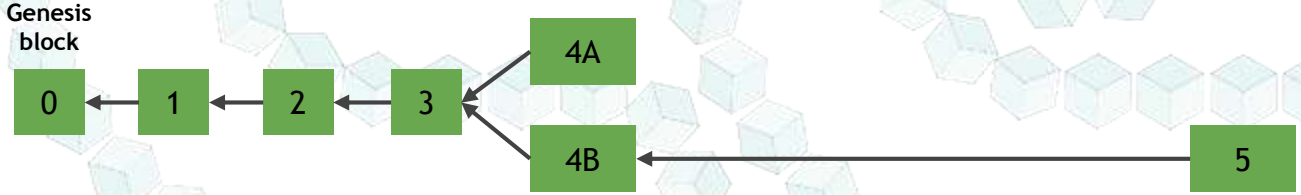
Nodes 1-10
See 2 Chains
a)3-4A and b)3,4B,5



Txn Set B

Miner B
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Nodes 11-20
Add Block 4B,Reject 4A
as its pointing to 3

Node 14
Miner C
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Nodes 11-20
Add Block 5 to 4B as its
extending the chain

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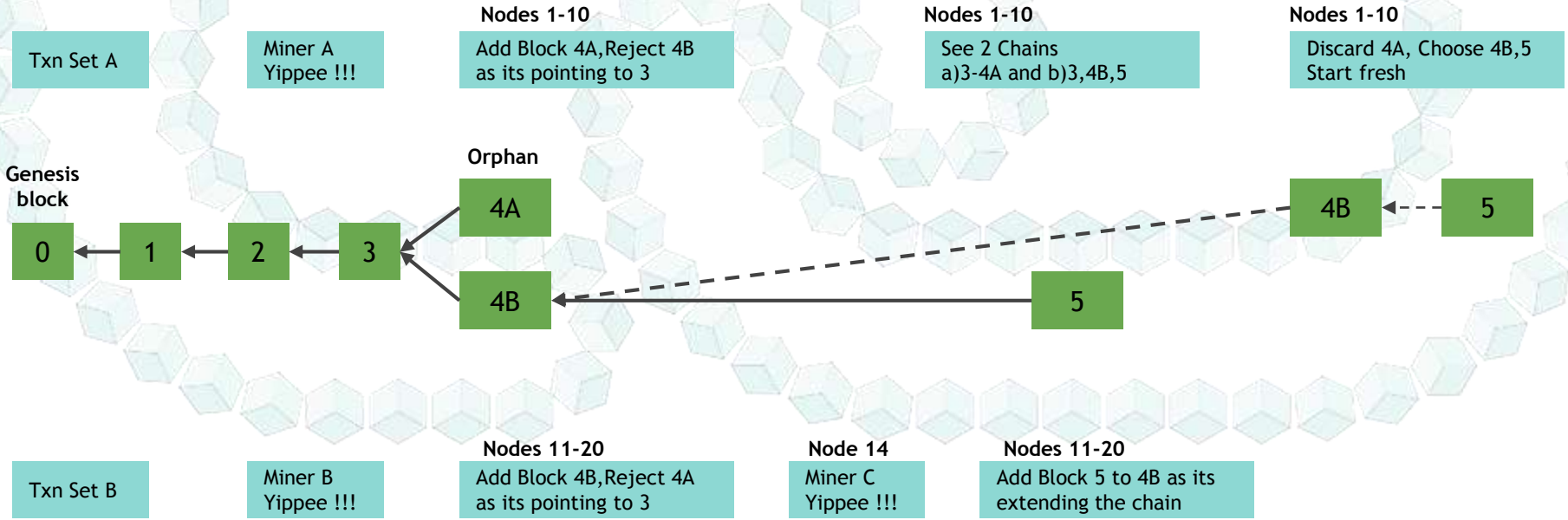

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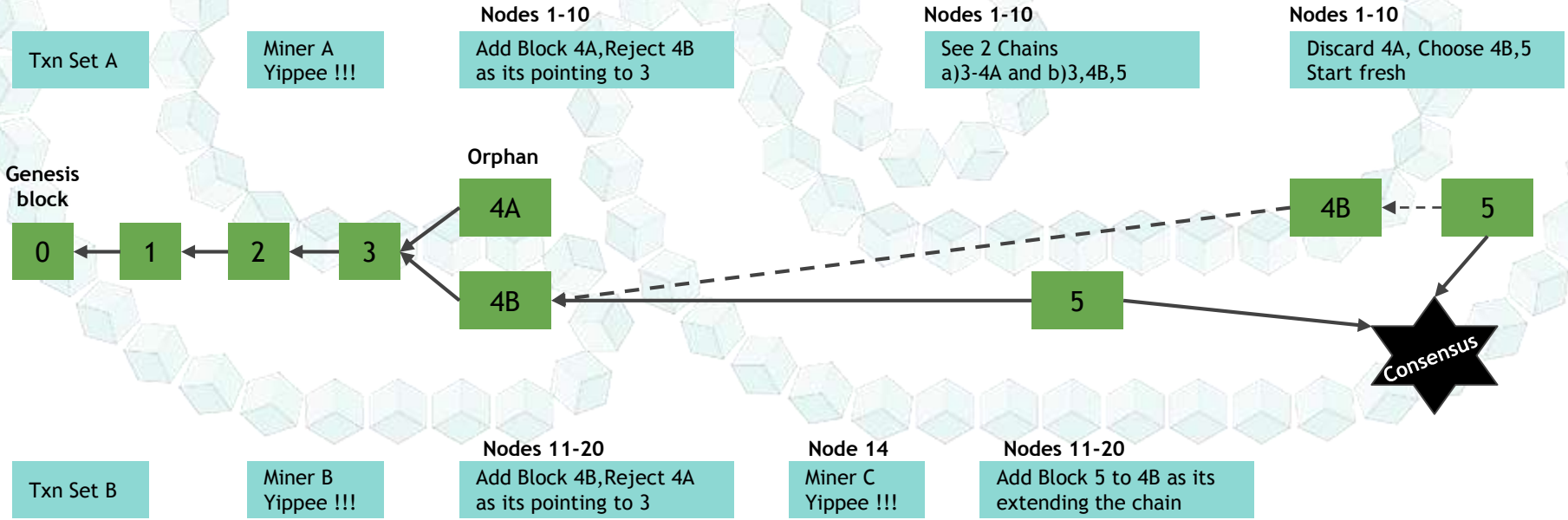

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Nodes 1-10
Add Block 4A,Reject 4B
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See 2 Chains
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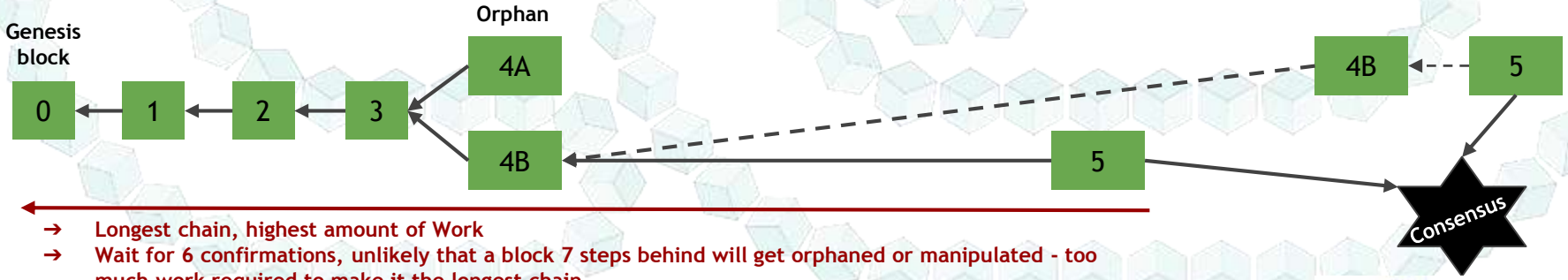
Nodes 1-10
Discard 4A, Choose 4B,5
Start fresh



- ➔ Longest chain, highest amount of Work
- ➔ Wait for 6 confirmations, unlikely that a block 7 steps behind will get orphaned or manipulated - too much work required to make it the longest chain

Txn Set B

Miner B
Yippee !!!

Nodes 11-20
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Node 14
Miner C
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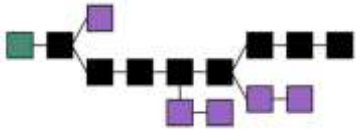

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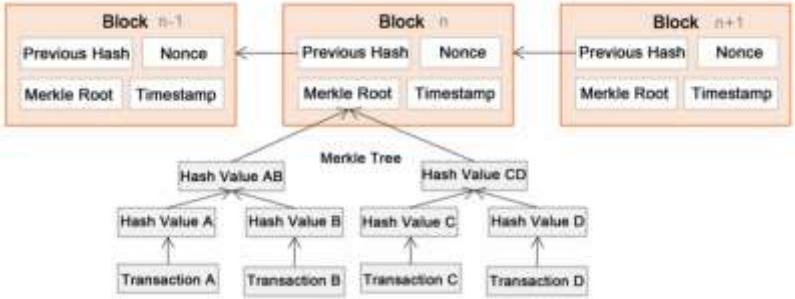

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I am in control

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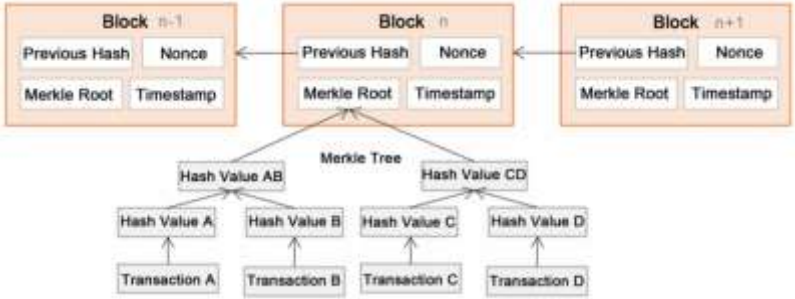

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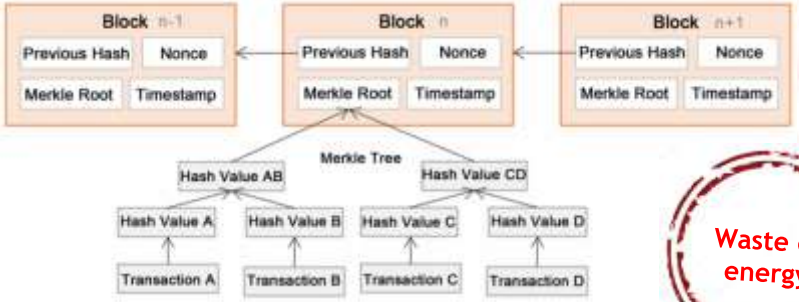

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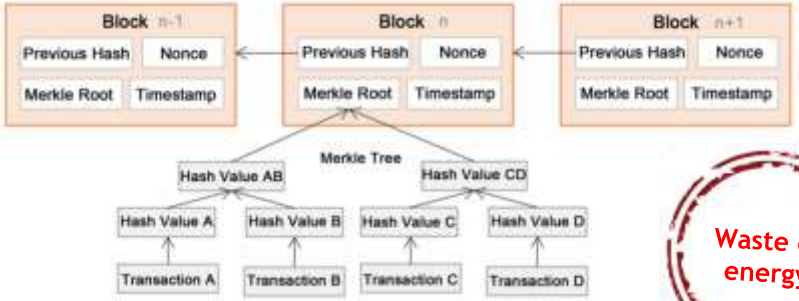

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Reversal?

Hard forks

Blockchain 2.0 - Smart Contracts

Blockchain 2.0 - Smart Contracts

- What if we wanted to do more than just transfer digital money around? What about other industries? Can they benefit? What's required for that?
- We need to be able to run complex code / computer programs on the blockchain.
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- We need a blockchain that can store 'programs' and 'execute' them based on instructions

Blockchain 2.0 - Smart Contracts

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- Enter **ETHEREUM**, a platform built to host and execute these programs in a decentralized manner
- These programs are called '**smart contracts**'

Ethereum - programmable blockchain

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- Uses the same blockchain consensus (Proof of Work) as in Bitcoin, but a different PoW - Ethash (ASIC resistant)
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- Externally Owned Accounts (EOA) - user accounts, with private keys
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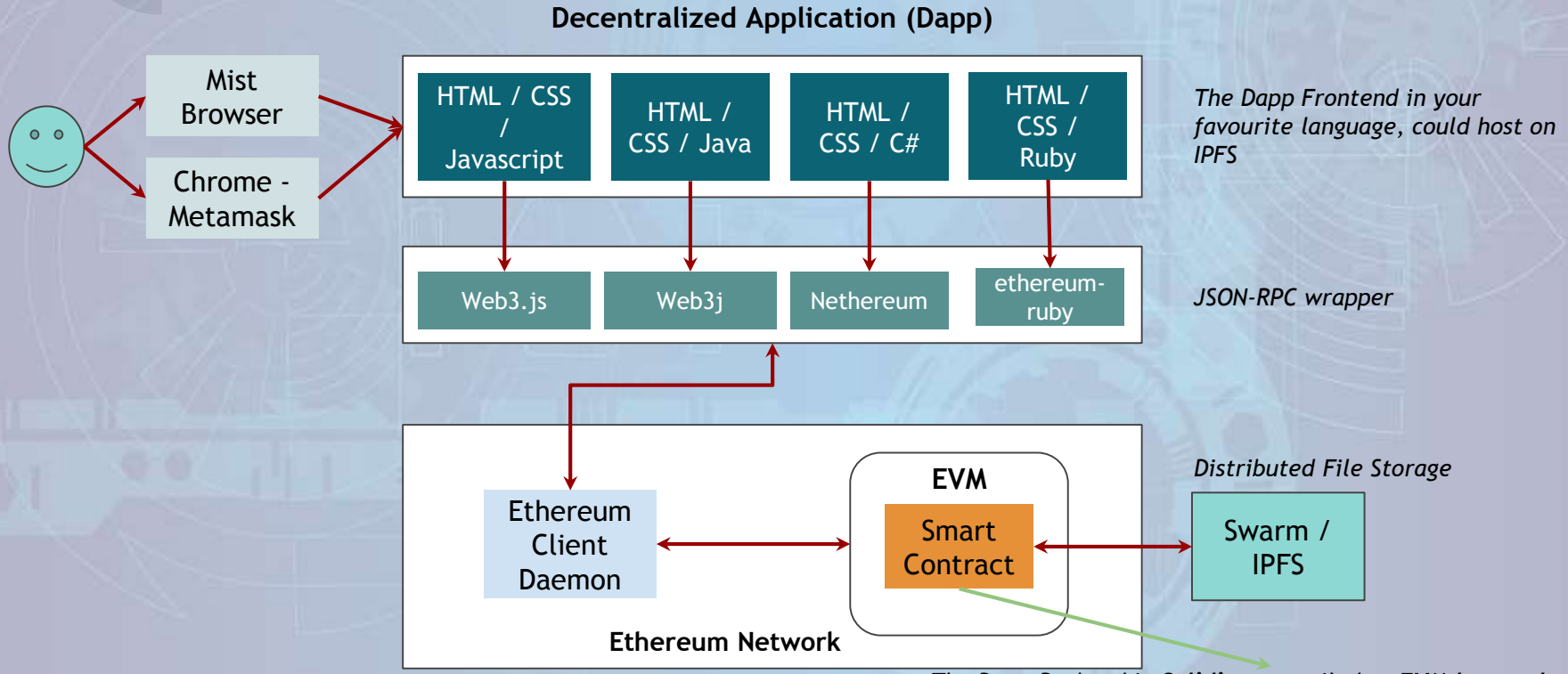
Consensus - Blocks get created every 14 secs or so. Miners earn 3 ETH / block mined. Orphan blocks (Uncles) are also rewarded to promote decentralization.

Ethereum ecosystem

Ethereum ecosystem



https://www.stateofthedapps.com

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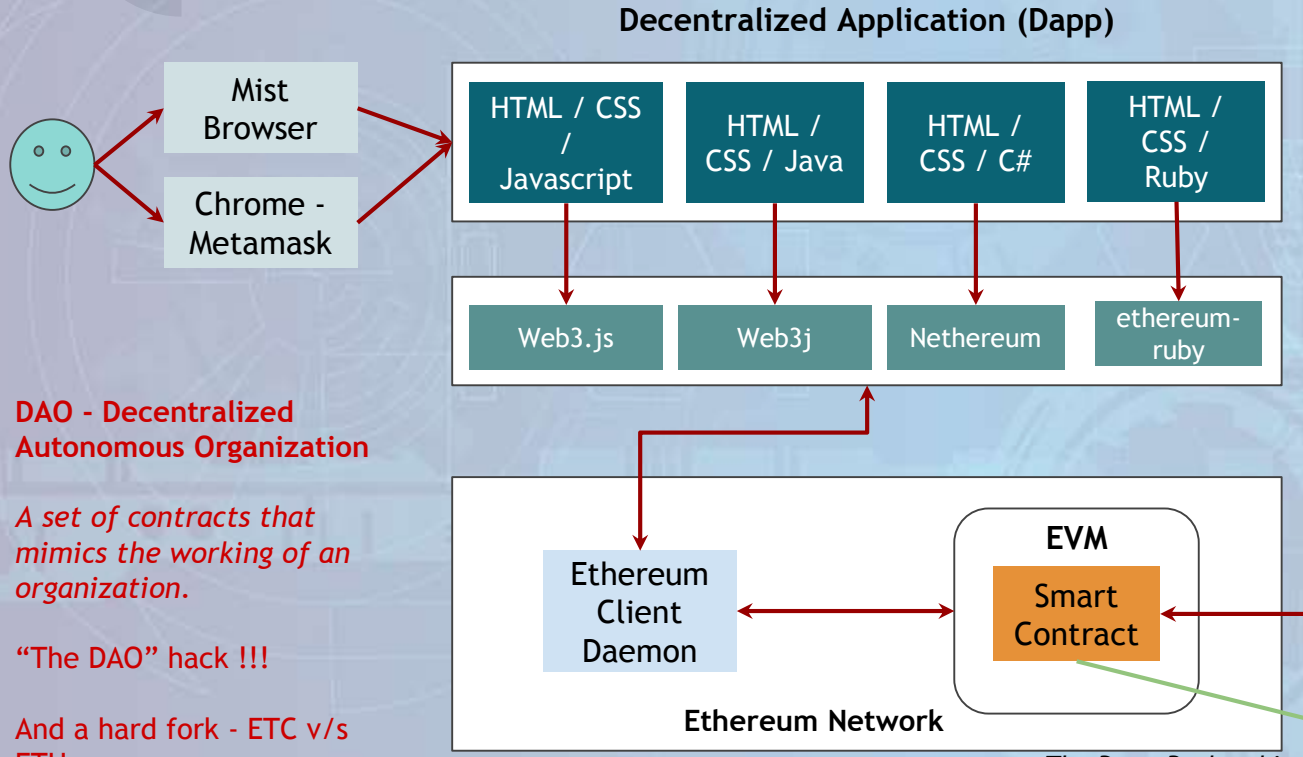


The Dapp Frontend in your favourite language, could host on IPFS

JSON-RPC wrapper

Distributed File Storage

DAO - Decentralized Autonomous Organization

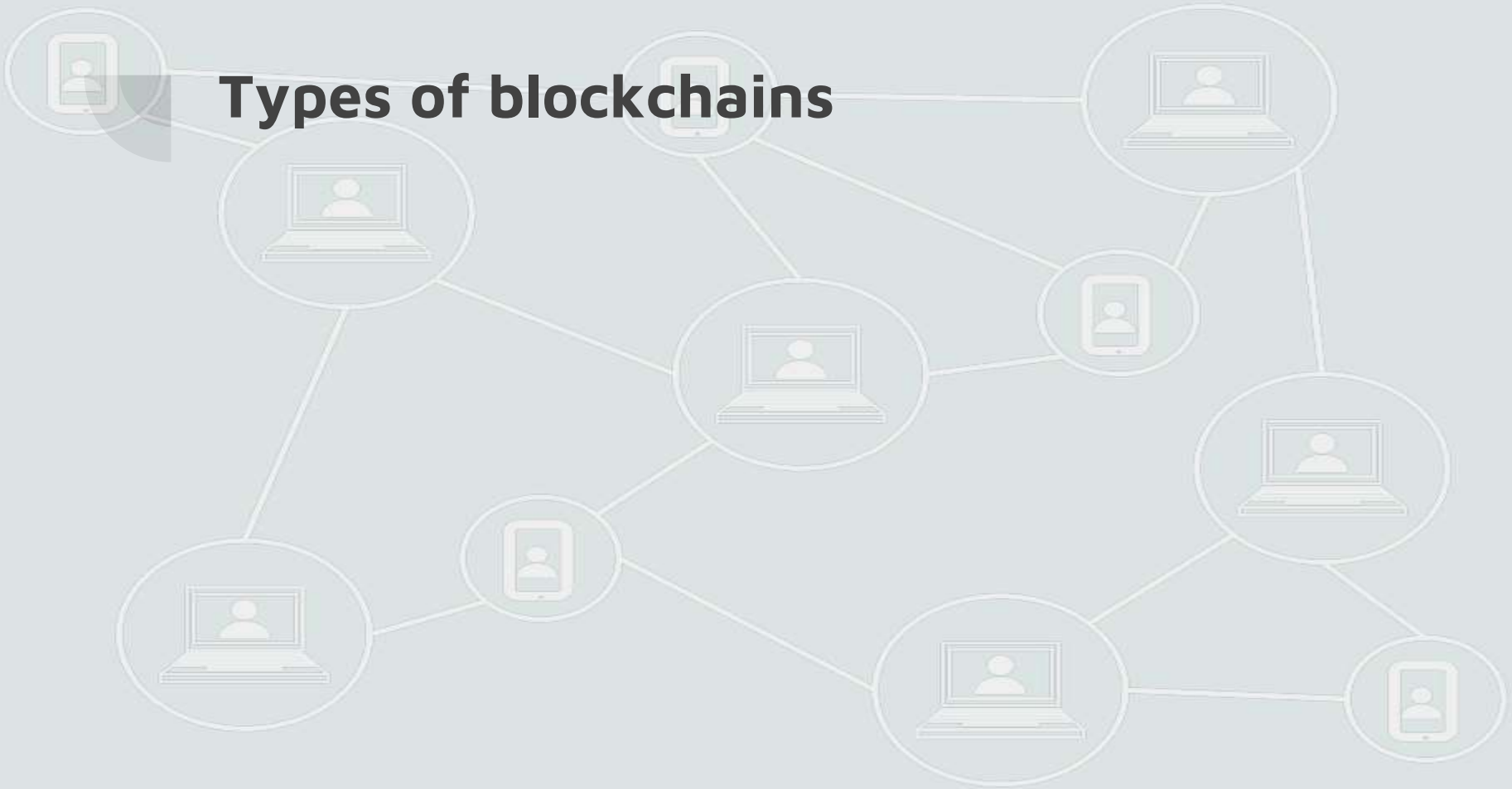
A set of contracts that mimics the working of an organization.

"The DAO" hack !!!

And a hard fork - ETC v/s ETH

*The Dapp Backend in **Solidity**, compiled to **EVM bytecode***
***Truffle** is a popular development framework, **Remix** is the IDE*

Types of blockchains



Types of blockchains

Permissionless	❏ No control ❏ Public, open for all (like Internet ?)	Bitcoin, Ethereum
Permissioned	❏ Controlled ❏ Completely private, where no public access is allowed - within the organization (like Intranet ?) ❏ Consortium or federated, for a set of organizations (like Extranet ?) ❏ Hybrid - some data is public, some private	❏ Platforms - Multichain, Hyperledger Fabric, Corda (R3), Monax ❏ Ripple ❏ Enterprise Ethereum Alliance (EEA) - Quorum (JP Morgan)

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Blockchain as a Service - BaaS

- ❏ Microsoft (Azure) - Corda, Ethereum, Hyperledger Fabric, Quorum, Chain Core
- ❏ IBM (Bluemix) - Hyperledger
- ❏ Amazon (AWS) - Sawtooth, Corda, PokitDok, Samsung Nexledger
- ❏ Oracle (coming soon) - Hyperledger

Blockchain++

Blockchain++

Solving the Scalability issue

- Storage
  - Segwit, Sharding
- Alternate consensus mechanisms
  - Proof of Stake (PoS), Asynchronous Byzantine Fault Tolerant
- Layer 2
  - Off-chain (Lightning, Raiden), Sidechain
- **Non blockchain architecture?**
  - **Tangle (IOTA), Lattice (Nano), Hashgraph (Swirlds)**

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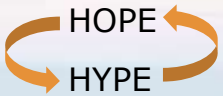
Platforms other than Bitcoin & Ethereum

- Cardano
- EOS
- Neo
- IOTA
- Nano
- Tezos
- Qtum
- Vechain
- Lisk
- Stellar
- Nem
- Icon

Blockchain marketplace



Blockchain marketplace

HOPE
HYPE

IDC Market Glance: Blockchain

Source: IDC, 4Q17

For areas that IDC covers, the top 3-5 market share leaders are represented. For areas that IDC does not cover, vendor selection is up to analyst discretion.

For more information about IDC Market Glance: Blockchain, 4Q17 (Doc #US43185017), contact permissions@idc.com.

Coindesk - State of Blockchain Q4, 2017
https://media.coindesk.com/uploads/research/state-of-blockchain/2017/q4/sob2017q4-2018.pdf

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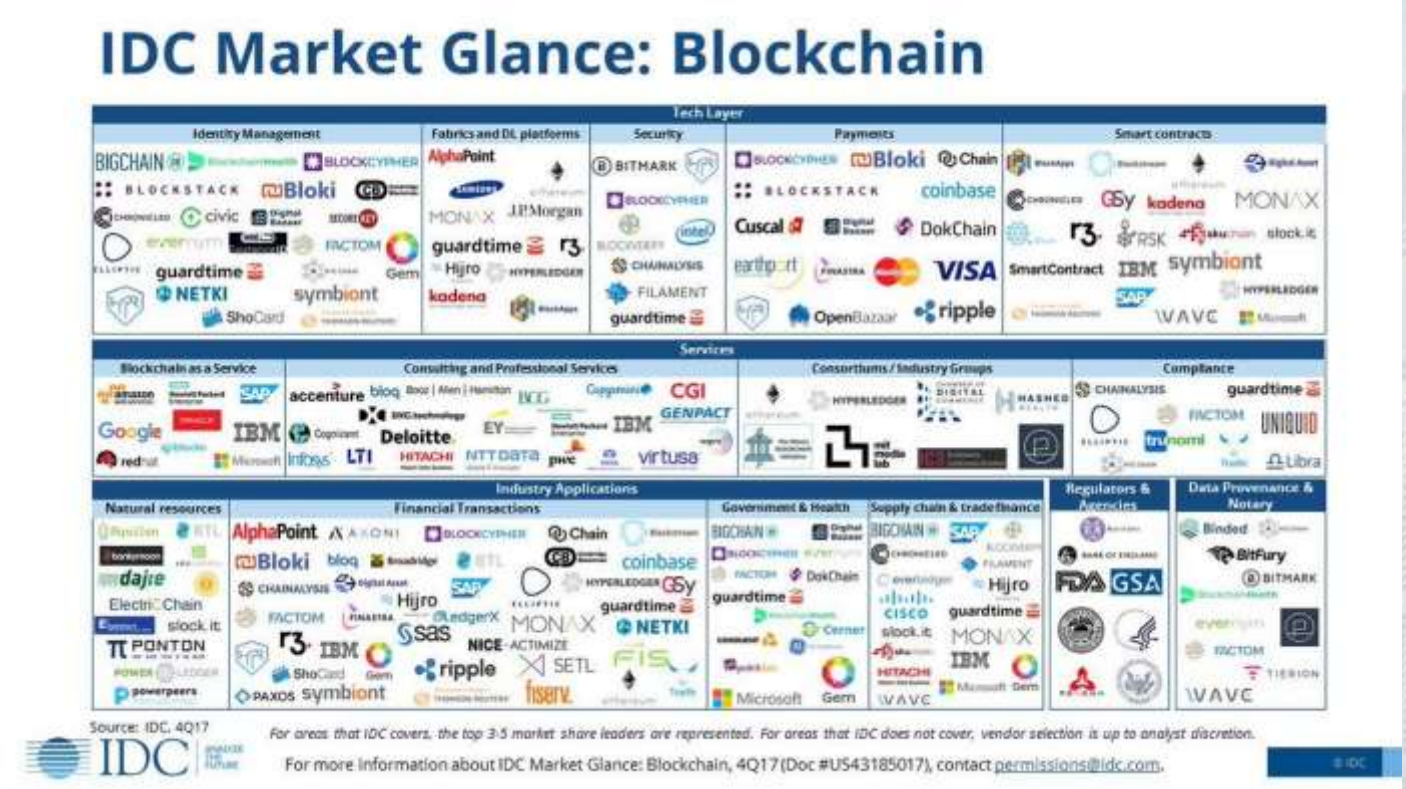

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- Digital Signatures
- Byzantine Generals' Problem
- Byzantine Fault Tolerance
- Merkle, Patricia trees
- Mining Pools
- Full nodes, Light nodes
- Exchanges and buying
- Wallets, storing and "HODL"

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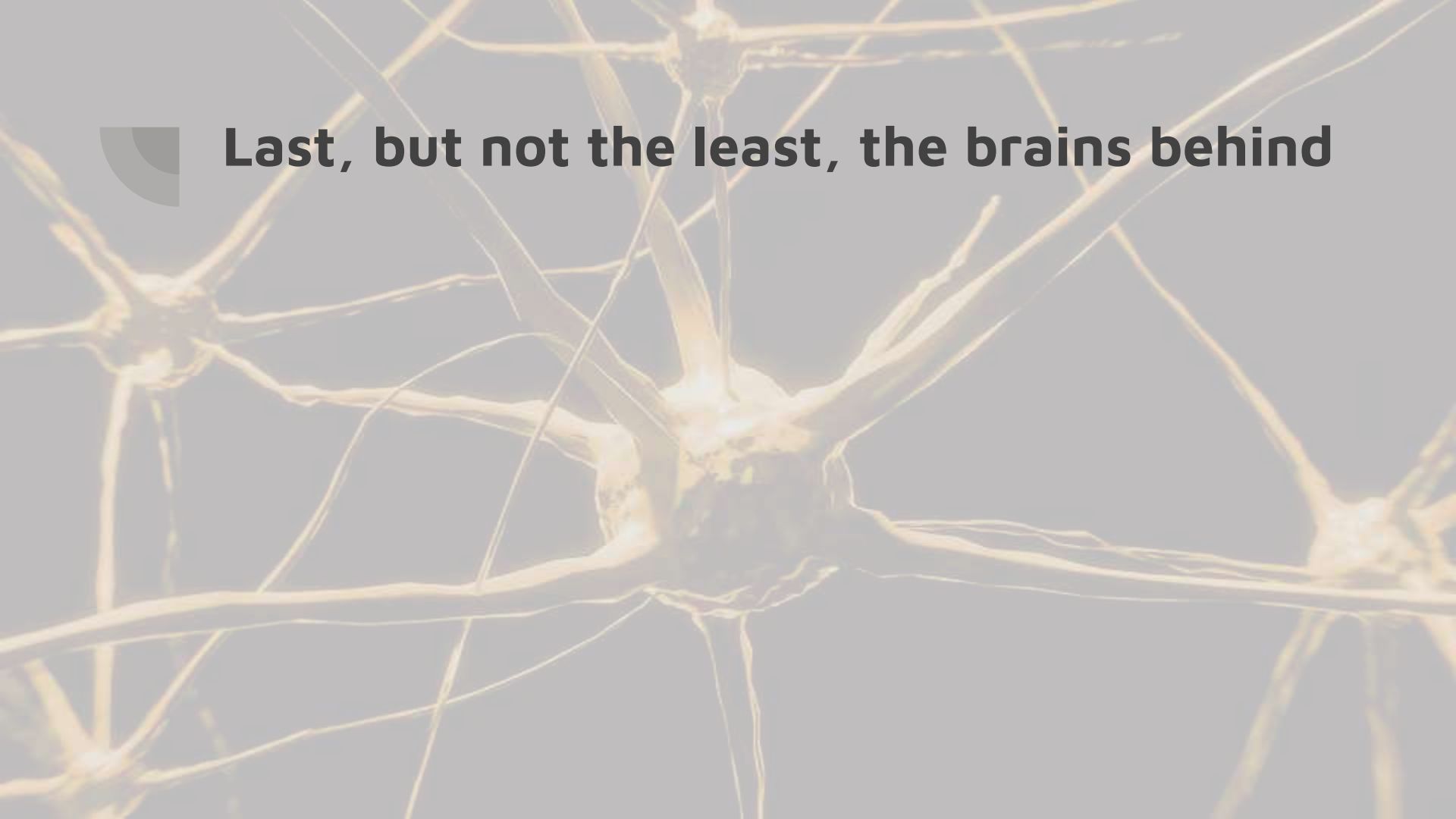

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Vitalik Buterin	Created Ethereum
Gavin Andresen	Took over as Bitcoin Core Dev Lead after Satoshi
Thanks to the below for helping me in my learning journey	
Andreas Antonopoulos	Blockchain expert, public speaker, author of must-read books - Mastering Bitcoin (technical) and The Internet of Money. Explains stuff really well !!!
Jackson Palmer	Dogecoin creator, Youtuber, awesome content
Ivan on Tech	Youtuber -made things simple to start with

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