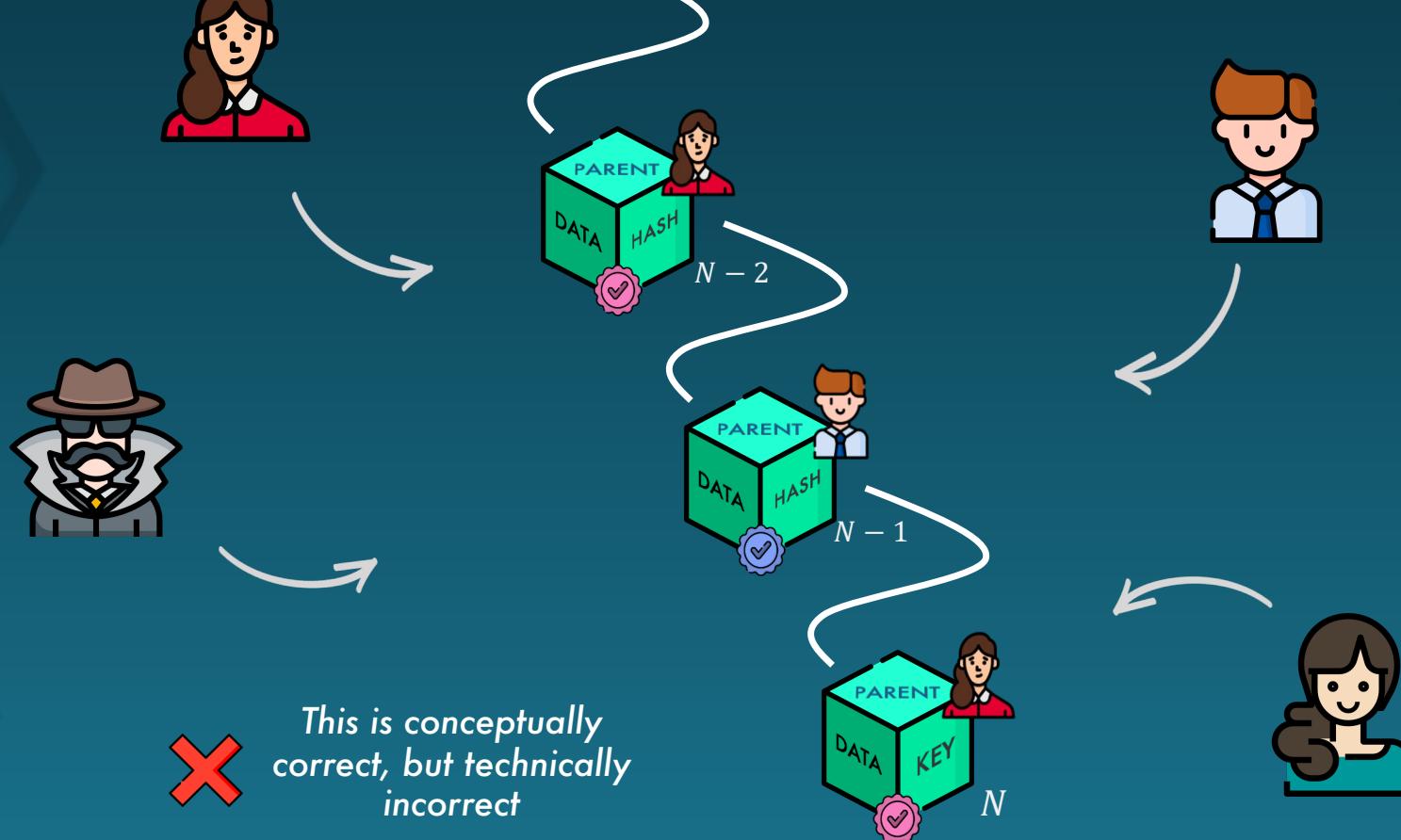


Blockchain et Applications

Chapter 4

Decentralization

Blockchain



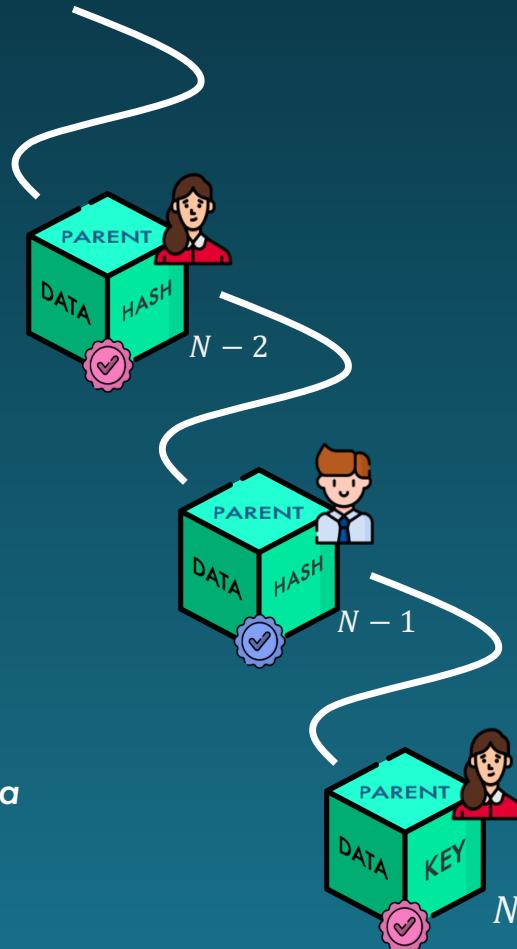
Where is the blockchain ?



Cloud ?

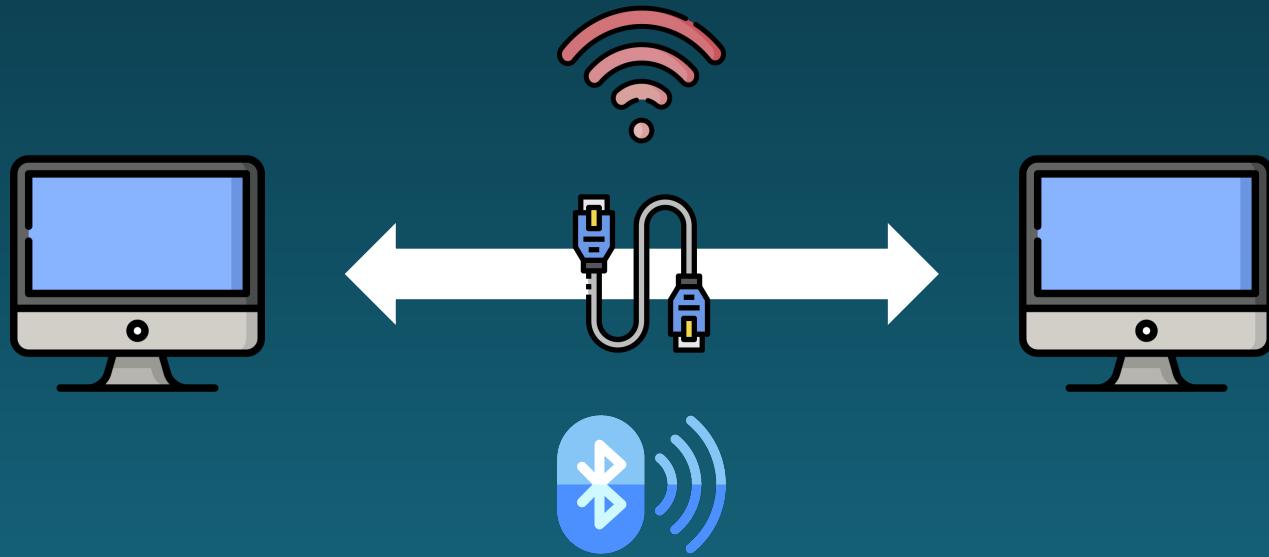


Maintained by a
crowd ?



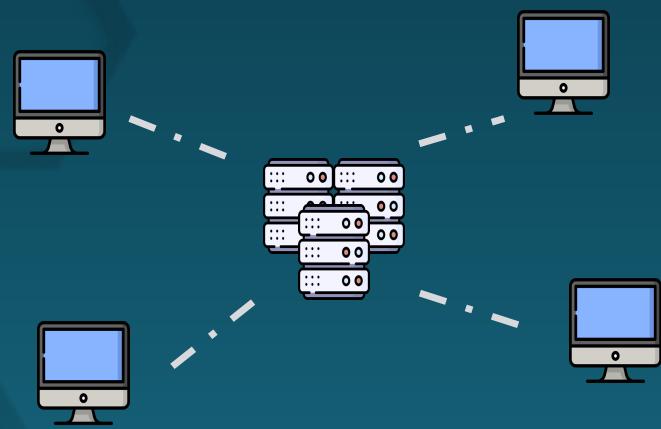
Data center ?

Network

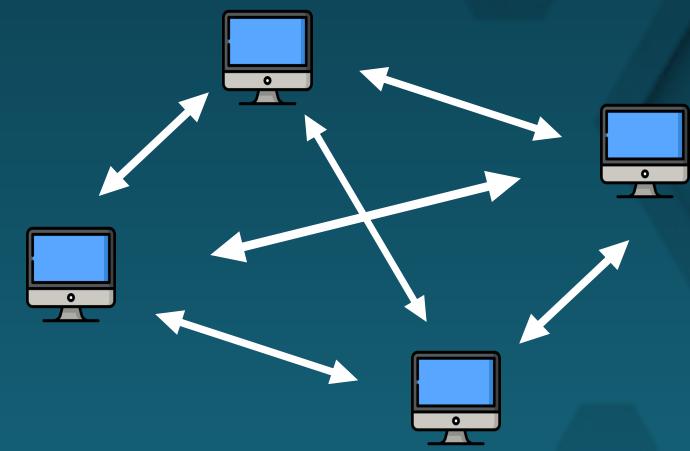


Network = collection of entities that are connected to each other and can exchange information

2 types of network

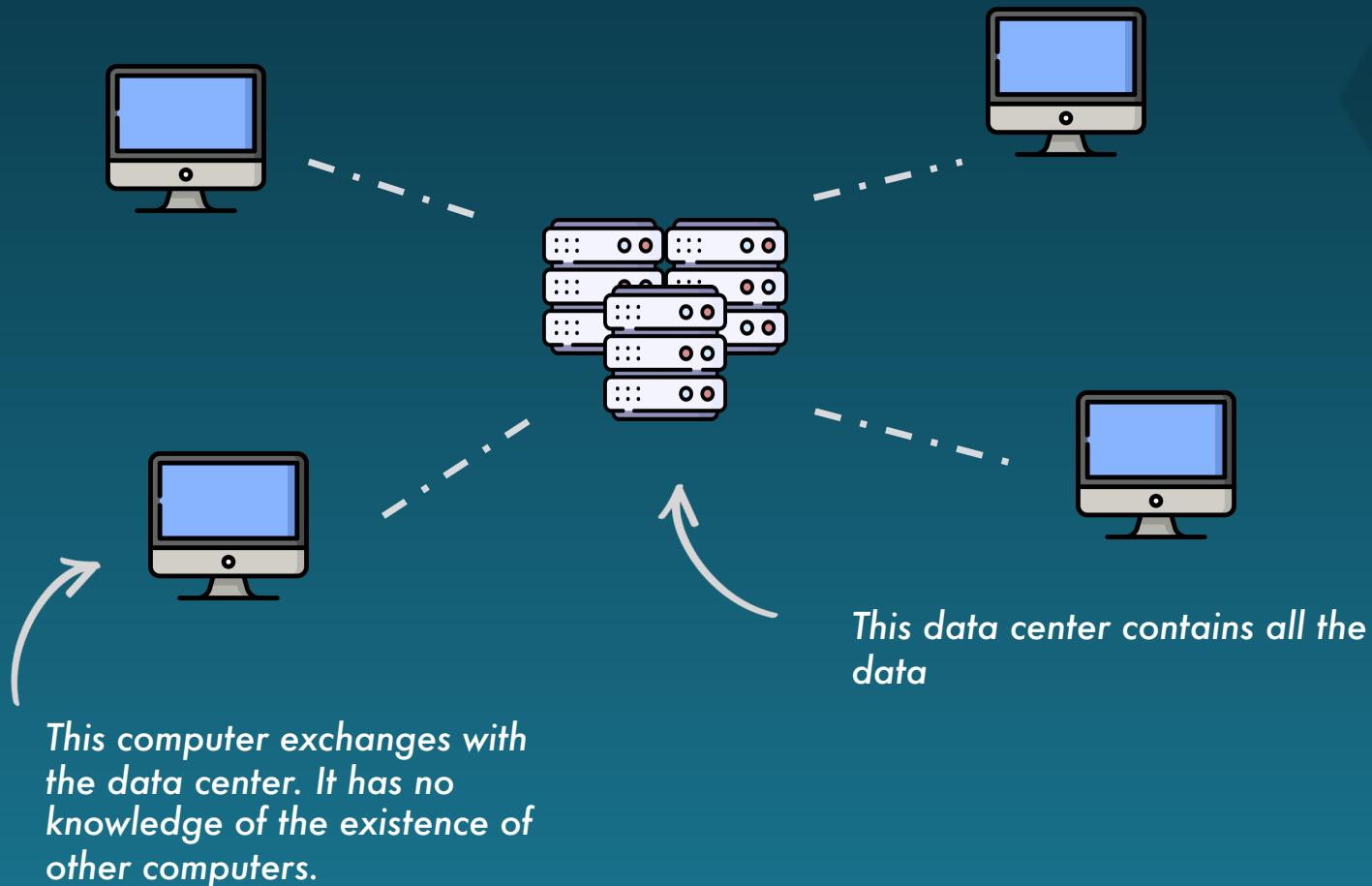


Centralized



Decentralized

Centralized network



Examples of centralized networks



Gaming LAN

Centralized network

Perks



Easy to connect



Optimized



Maintained



Coherence

Centralized network

Problems



Subject to failure



Censorship



Controls your data

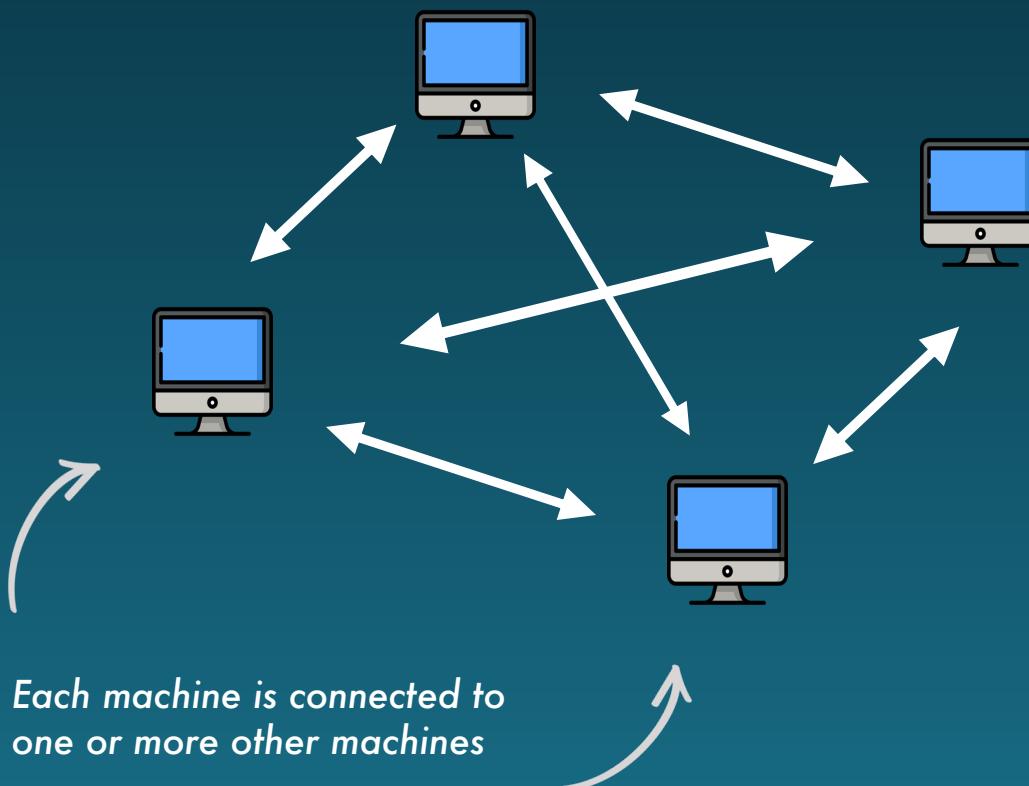


Hackable



Low scalability

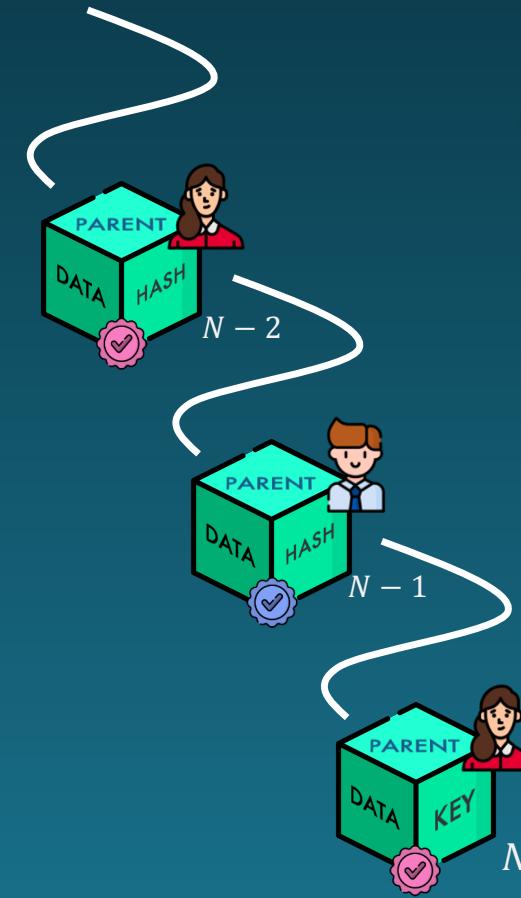
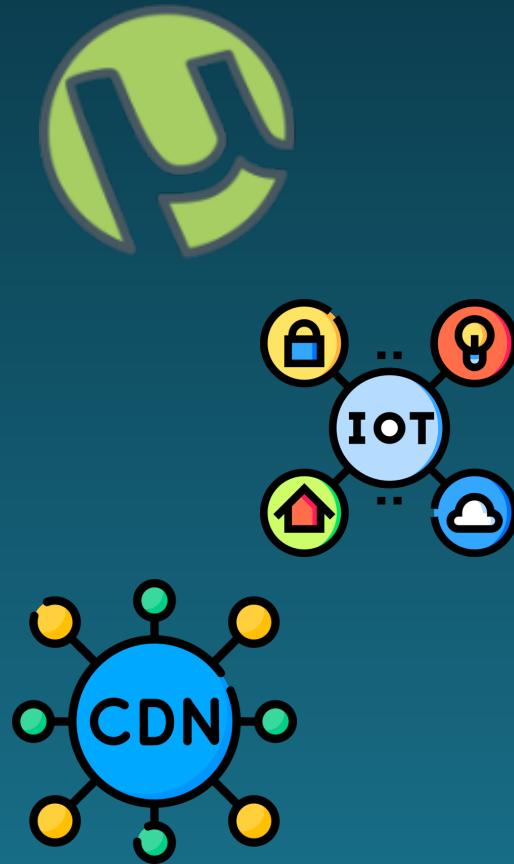
Decentralized network



*Each machine is connected to
one or more other machines*

*Each machine serves its own
purpose inside the network*

Examples of decentralized networks

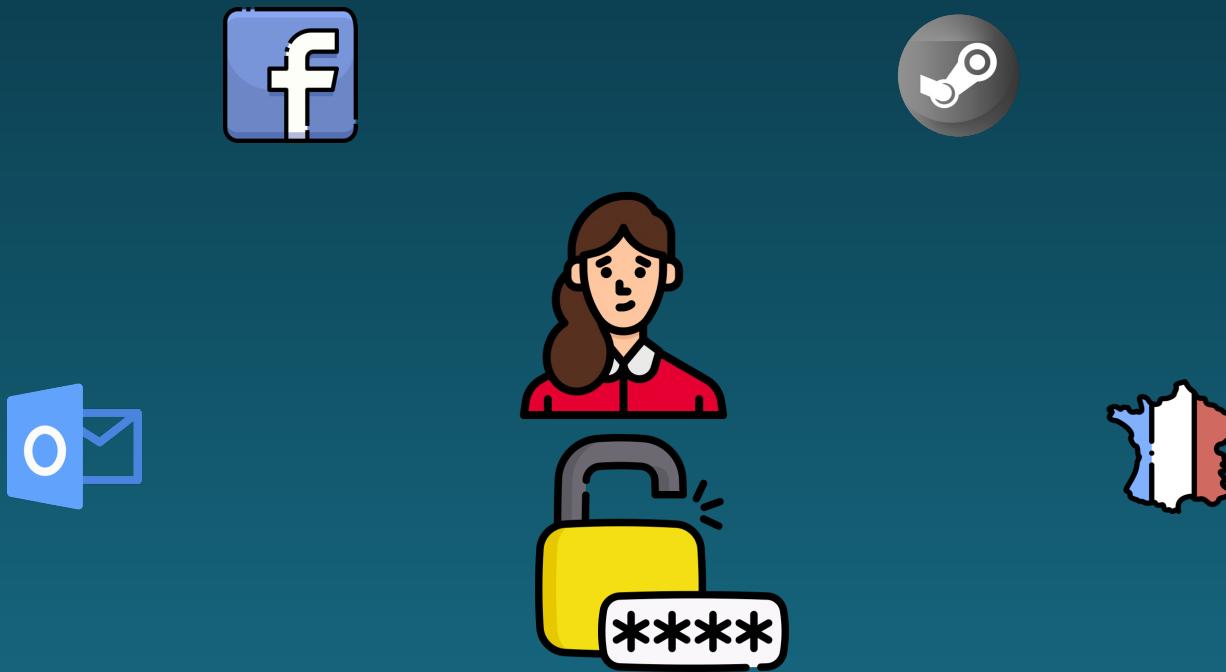


Decentralized network

Perks and Problems

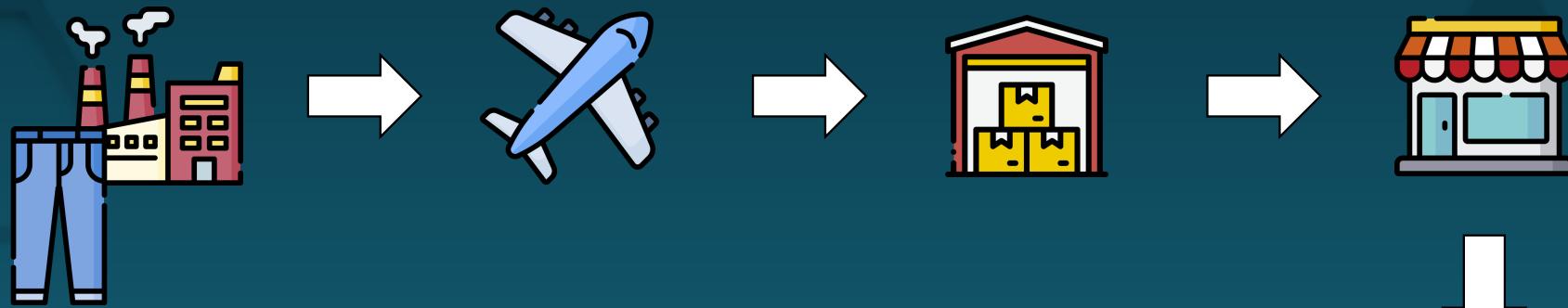


Need to decentralize



Too many centralized systems yield too much information and too many processes

Need to decentralize

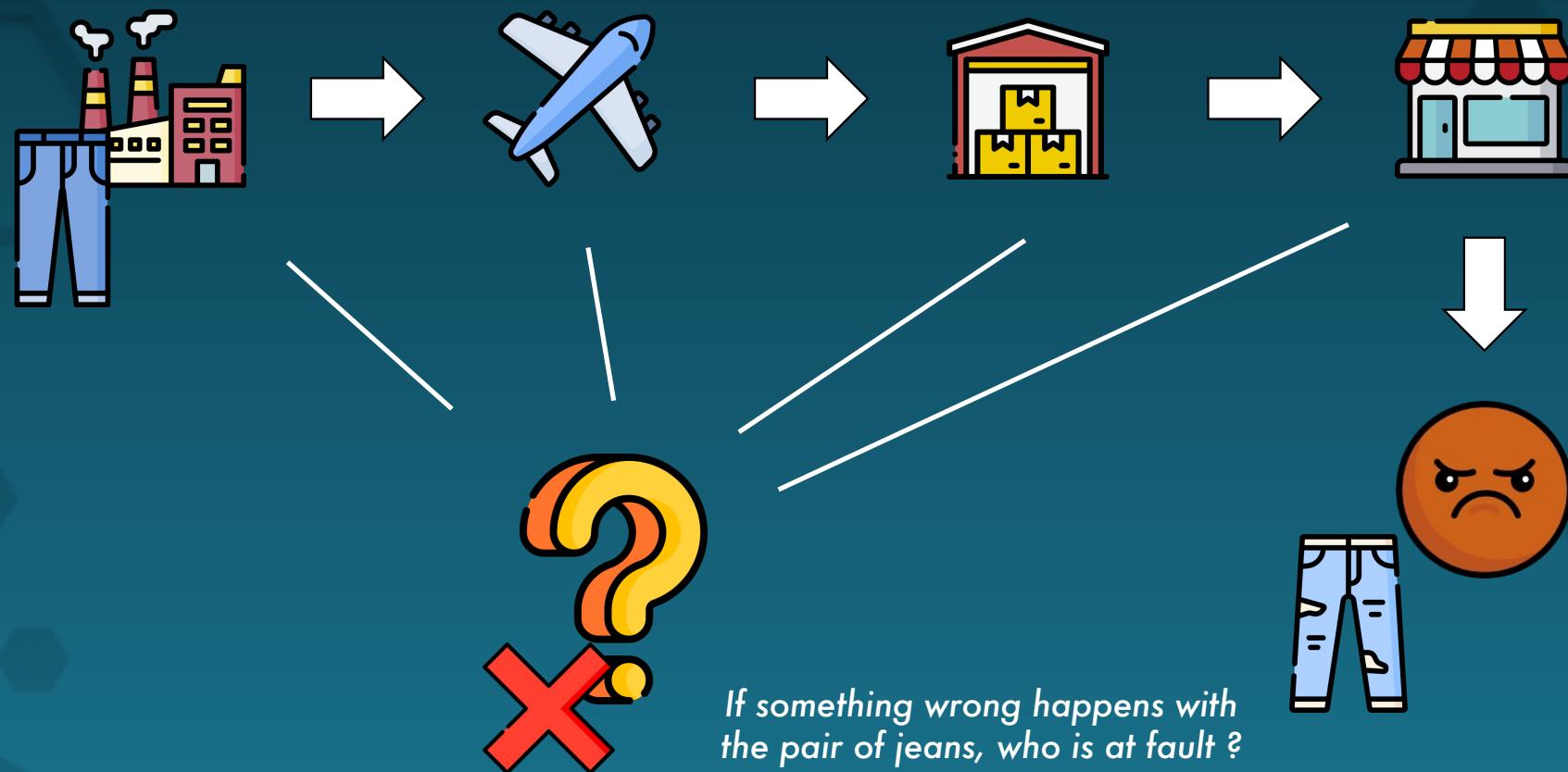


Example : Supply Chain.

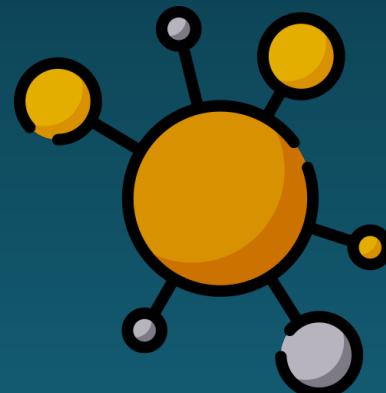
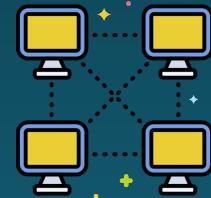
From manufacturer to customer, a pair of jeans goes through a lot of processing.

Each company register the jeans through the process their own way and independently.

Need to decentralize



Need to decentralize



You are here



Decentralized

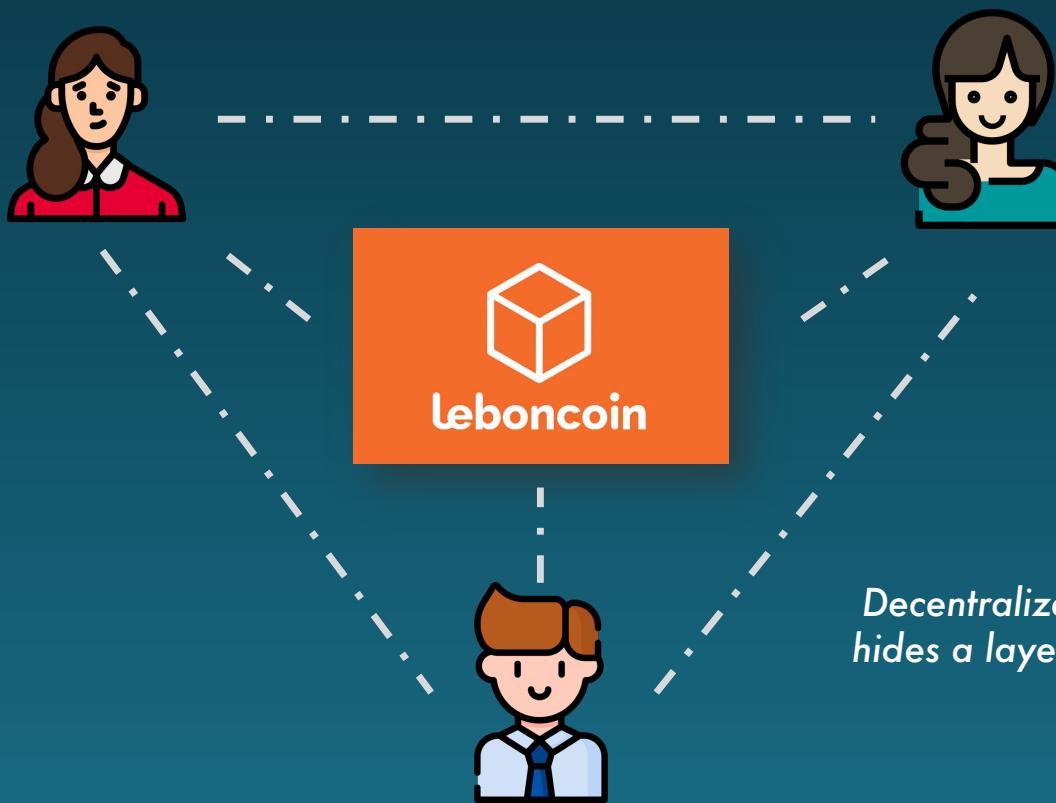
Centralized



Decentralized



“Decentralized”



*Decentralization today often
hides a layer of centralization*

WHY ?

David Chaum – 1982

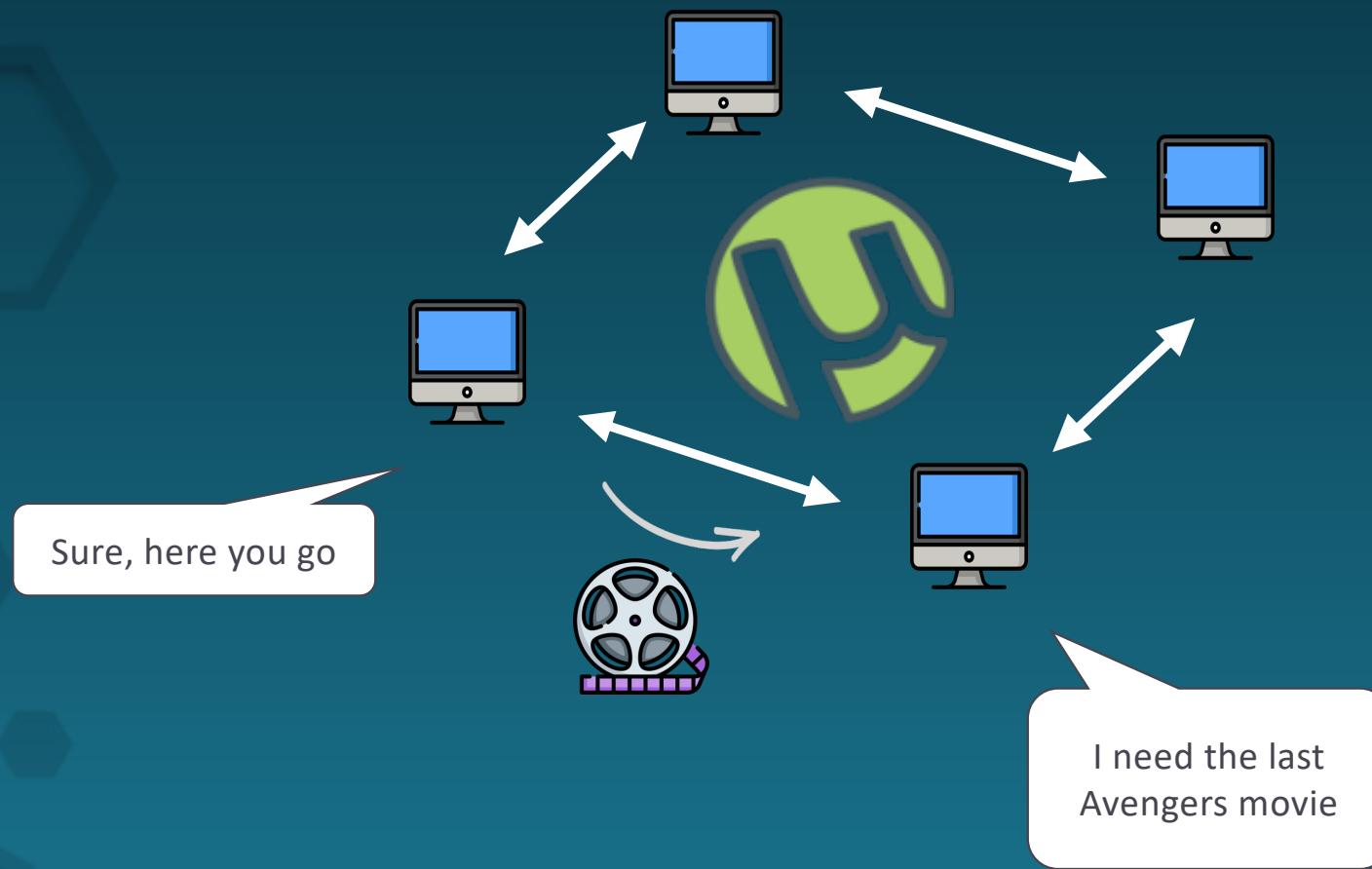


1982 – “Computer systems established, maintained and trusted by mutually suspicious groups”

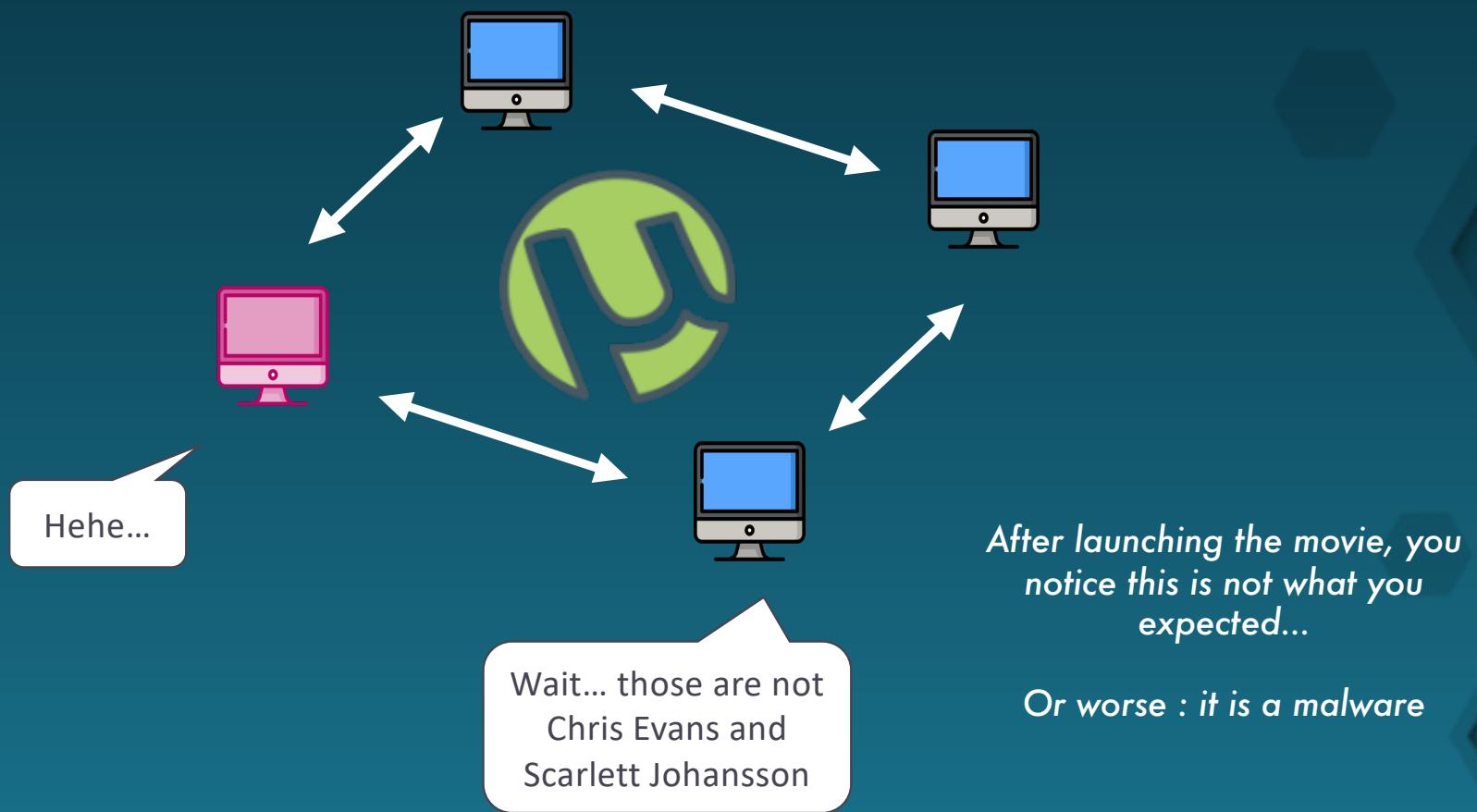


This is the critical part !

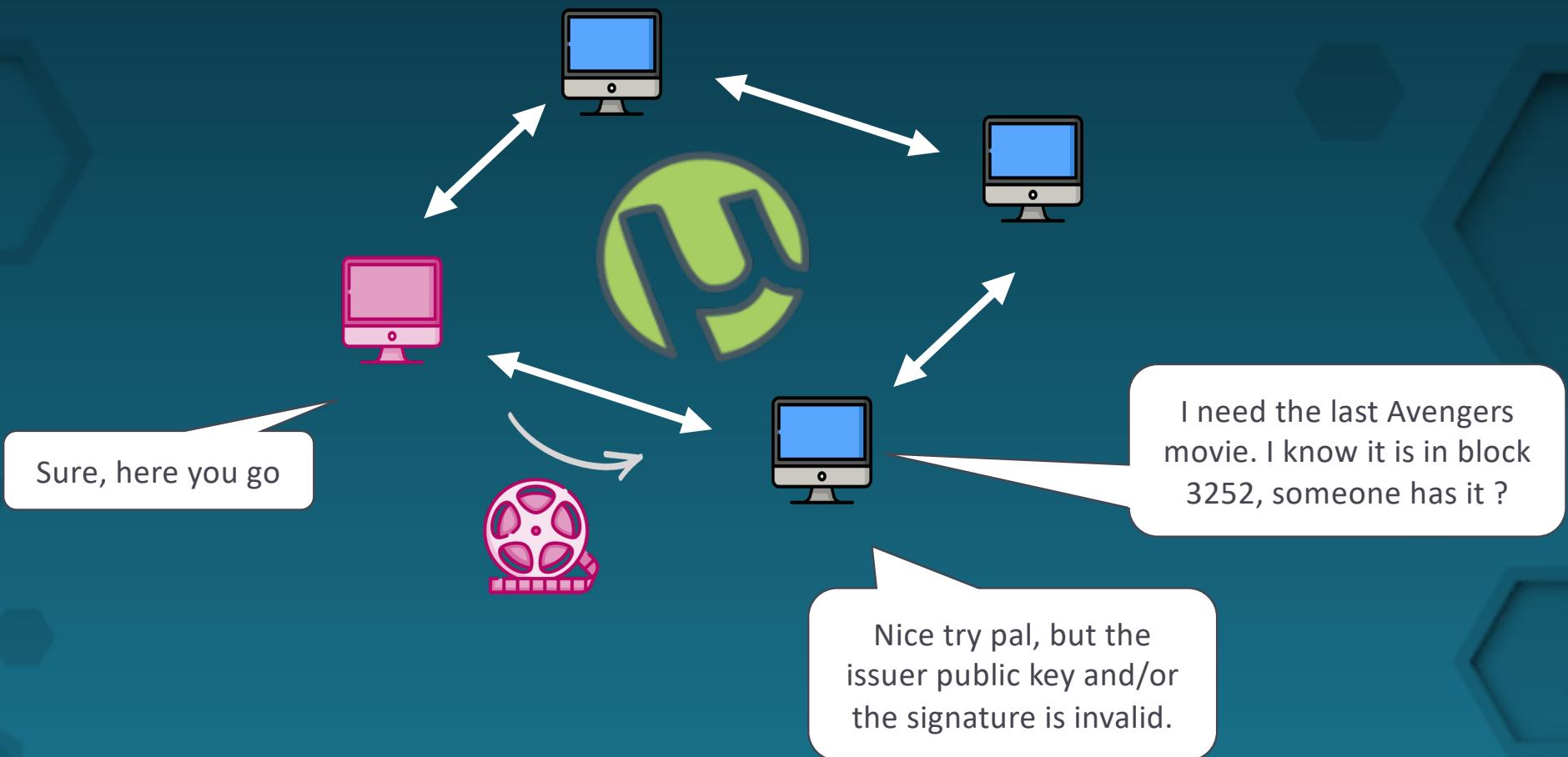
Torrent : a fully decentralized system



Torrent : a fully decentralized system

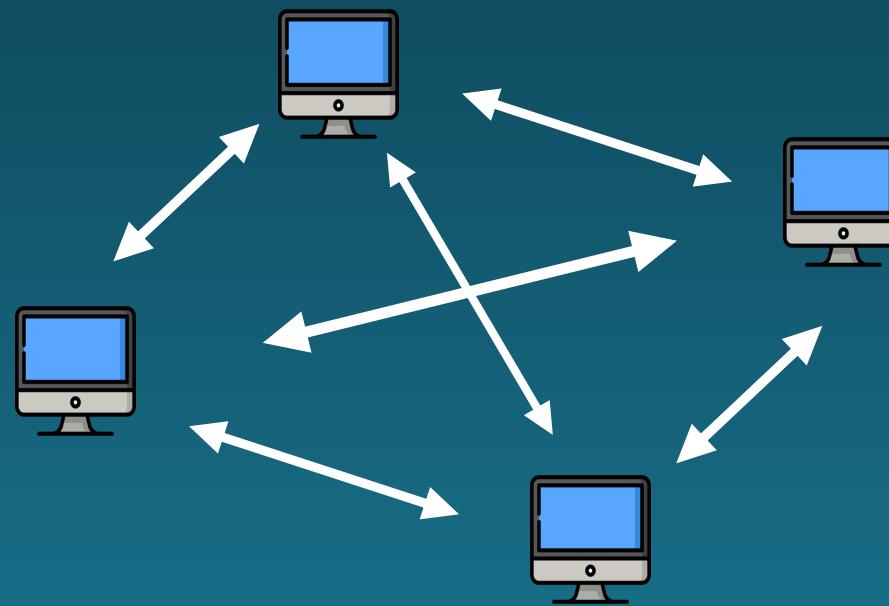


Torrent with blockchains

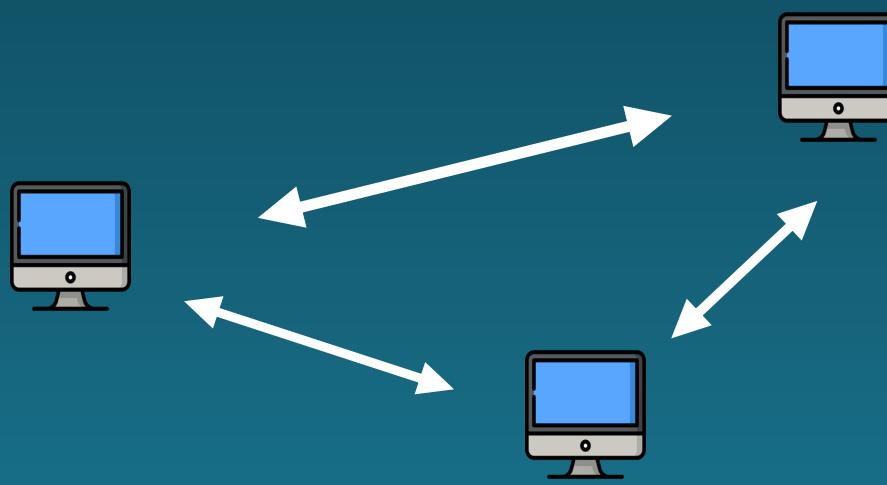


Decentralized network : why participating ?

Heck, why on earth would I pay for electricity to share files with others ?



Decentralized network : why participating ?

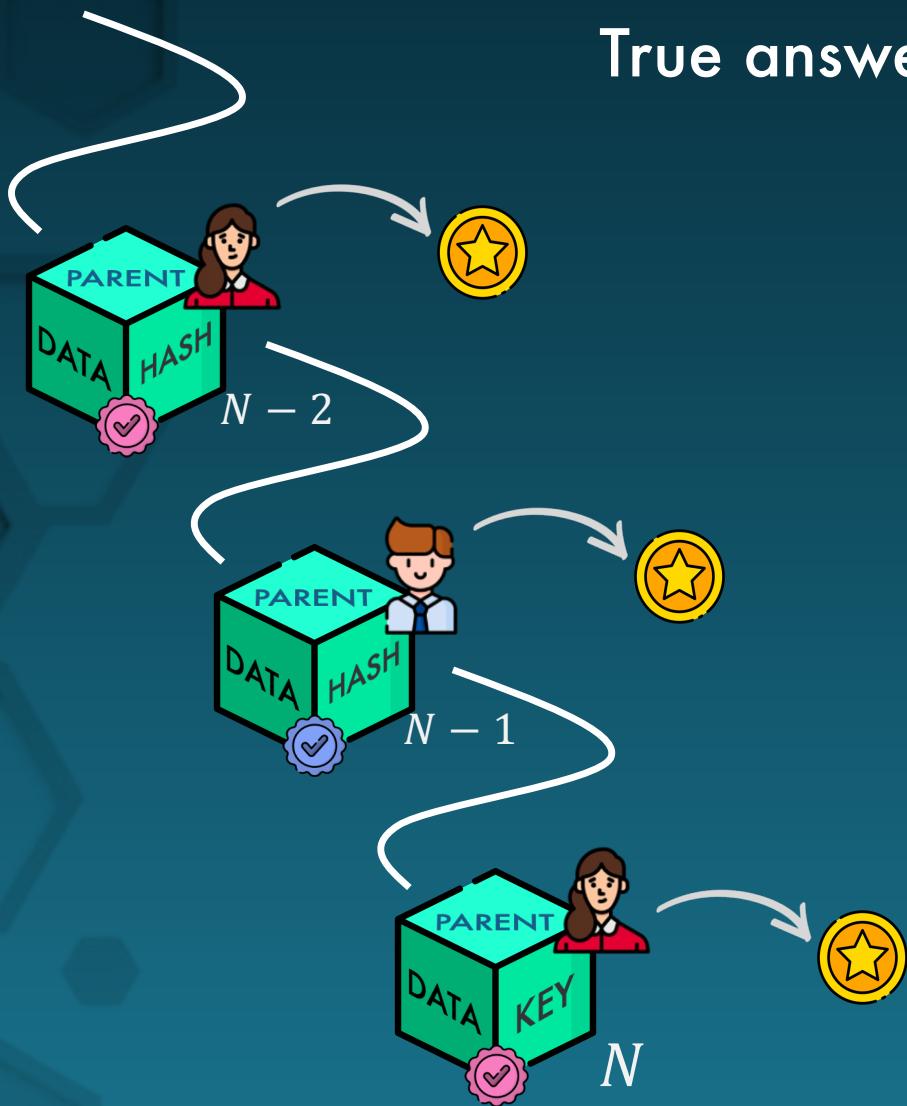


One answer : Gamification



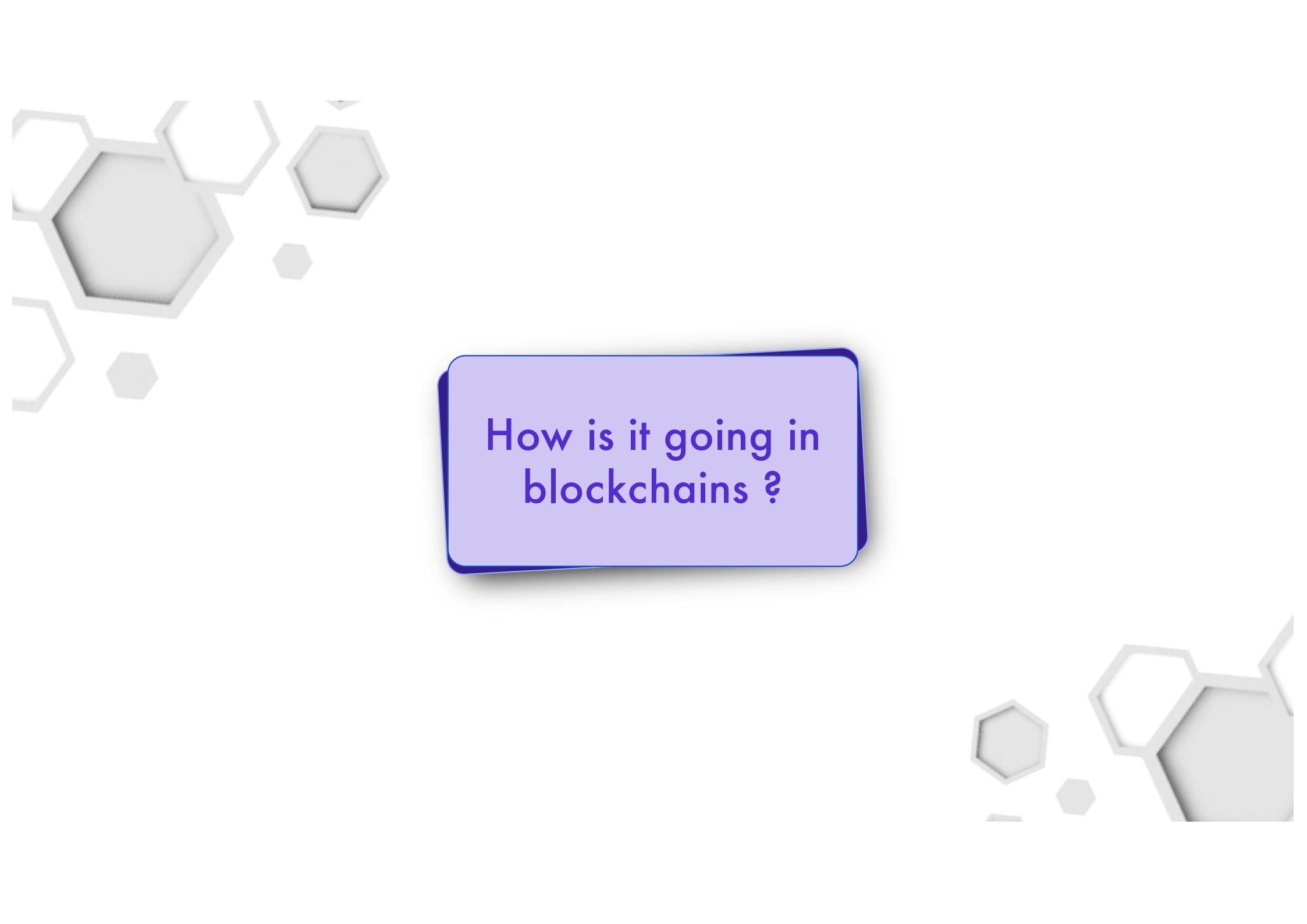
Volkswagen piano staircase, Stockholm's speed lottery, Charity miles, Eco driving score, ...

True answer : MONEY



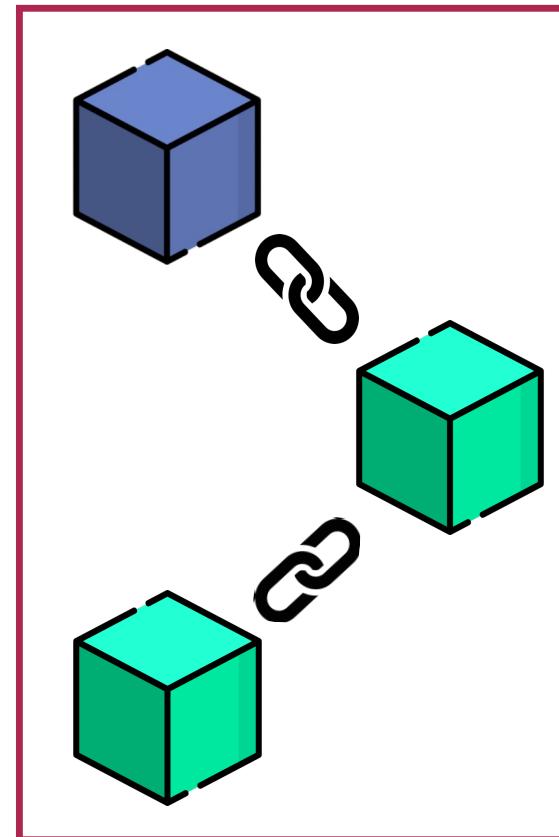
The same way you wouldn't be working 8 hours a day in your life if it was not for money and staying alive, you wouldn't be engaging money into a blockchain if there were no reward for it...

...mostly



How is it going in
blockchains ?

Theory vs Reality



*Conceptually, there is
only one blockchain.*

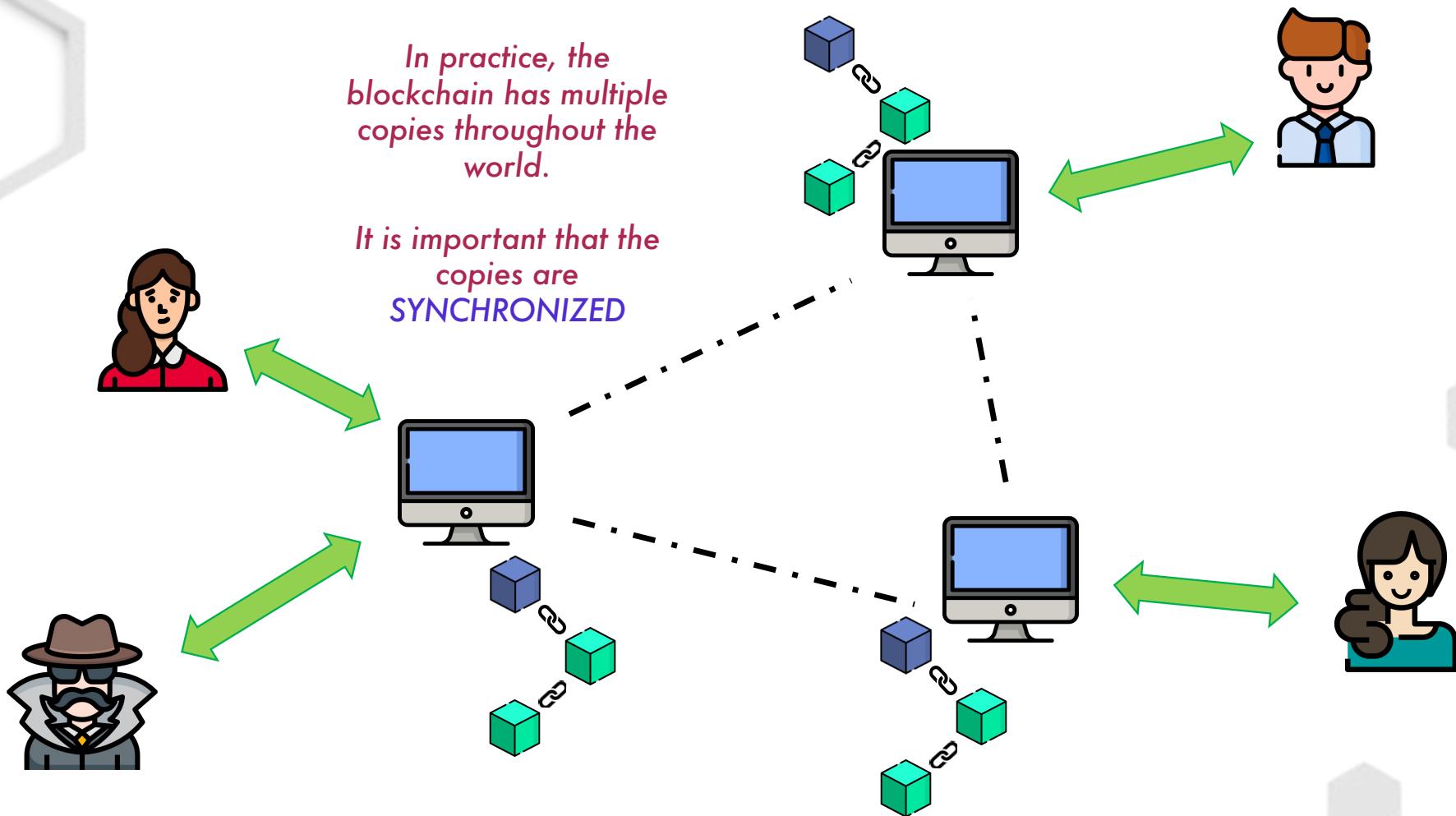
*How is it possible,
considering it should
be accessed from
anywhere on earth ?*



Theory vs Reality

In practice, the blockchain has multiple copies throughout the world.

It is important that the copies are SYNCHRONIZED



Theory

Multiple actors



Actor

Reality

User



∈

Node



∈

Validator



User vs Node vs Validator

	User	Node	Validator
Has private/public keys	✓		✓
Has a copy of the blockchain		✓	✓
Exchanges certificates		(✓)	✓
Can forge blocks and discard invalid certificates			✓



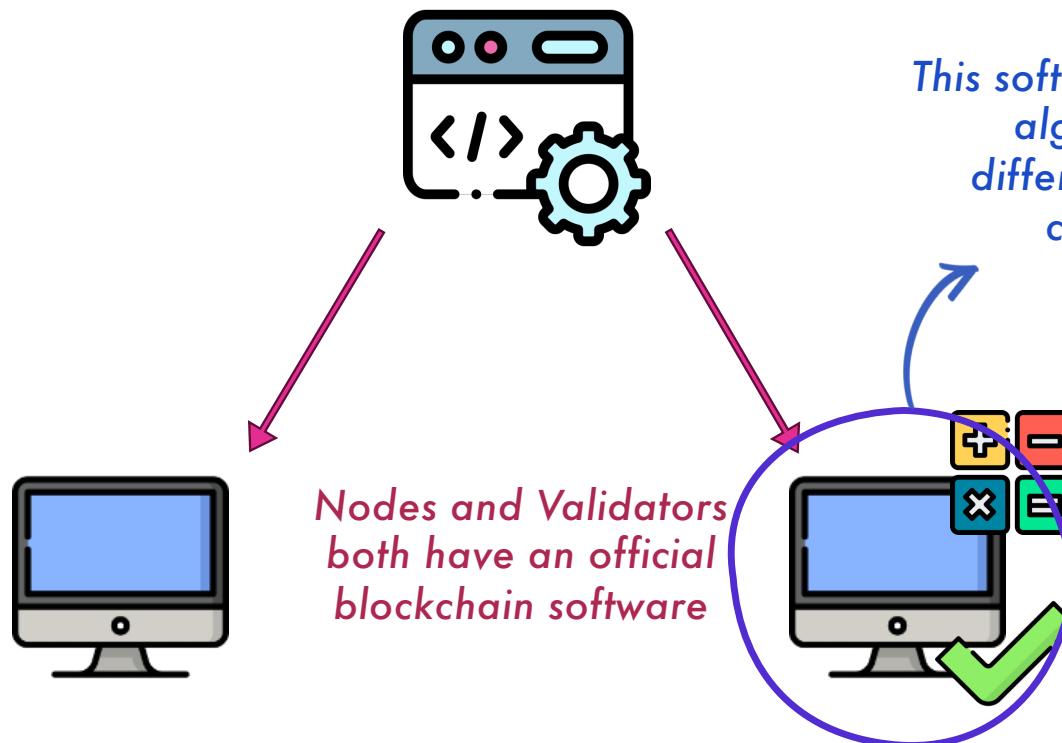
∈



∈



Blockchain software

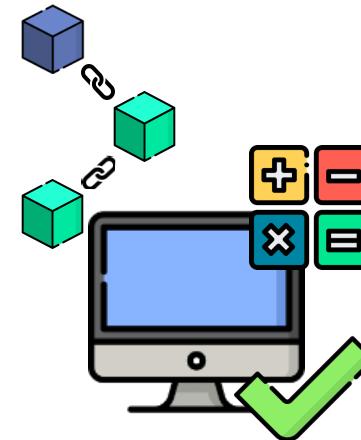


Viewing blockchain

I want to check
where my pair of
jeans is



Reads blockchain



Reads blockchain



Since blockchains are exposed,
no trouble reading the data
directly

Transaction Details

etherscan.io

Overview

② Transaction Hash: [0x6f9fb01022150eca37db772fc9b9a2444612bd7344b7e66b1690d8fe1c91deea](#)

② Status: Pending

② Block: (Pending)

② Time Last Seen: 00 days 00 hr 00 min 25 secs ago (Apr-14-2021 11:59:17 PM)

② Estimated Confirmation Duration: < 45 secs | Gas Tracker

② Pending Txn Queue: 0% 100%

etherscan.io hosts a node that
contains the whole Ethereum
blockchain

② From: [0xab41b92c6d43e4b8a670b75879f5bb809646602e](#)

② To: [0xa33c8f687250f748cdade9a514b9293dbf49c4a9](#)

② Value: 0.037290222 Ether (\$90.67)

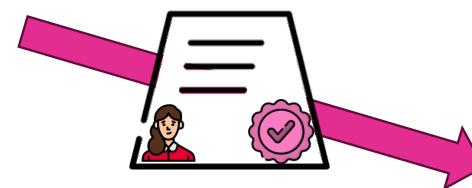
② Max Txn Cost/Fee: 0.002961 Ether (\$7.20)

Max fees paid to
validators

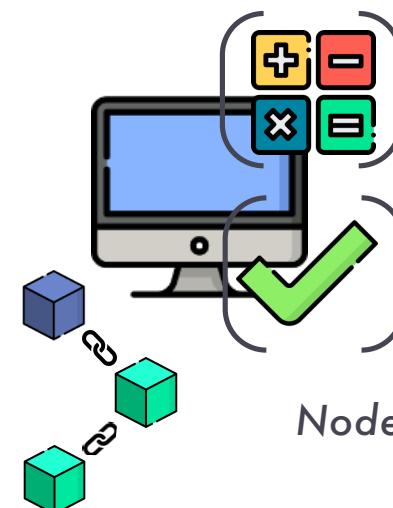
② Gas Price: 0.000000141 Ether (141 Gwei)

Writing in blockchain

I want to stake 3
Bamboozloos



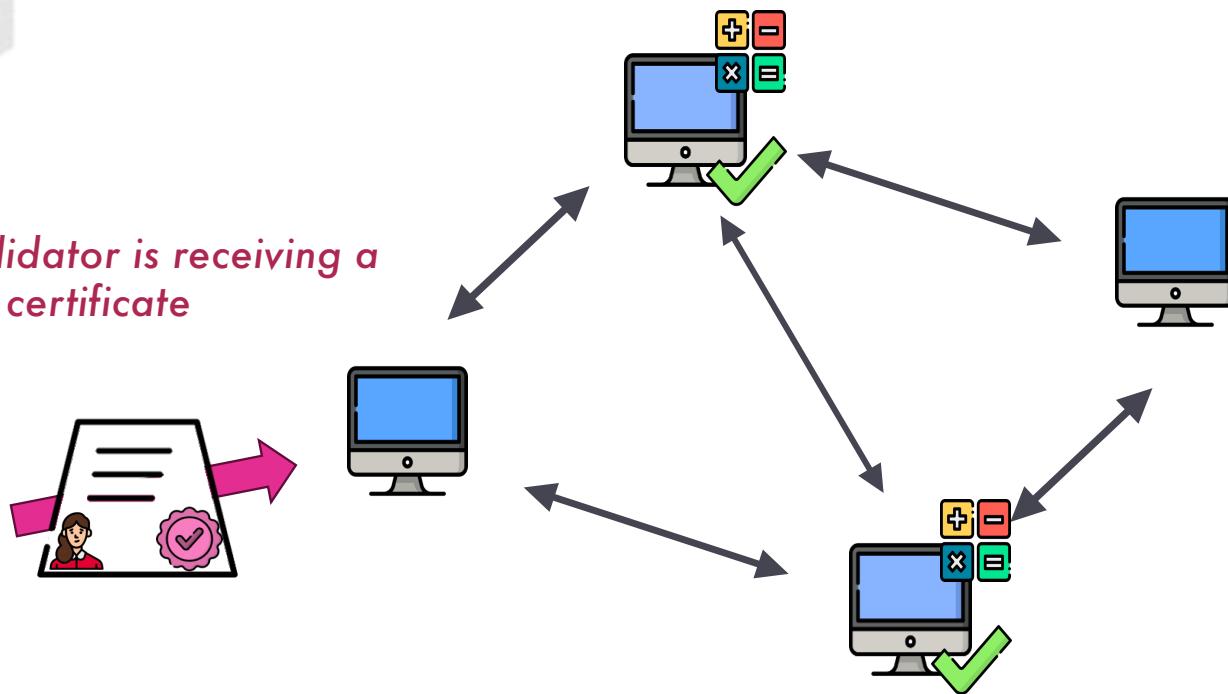
*Writes a certificate and give it
to any node*



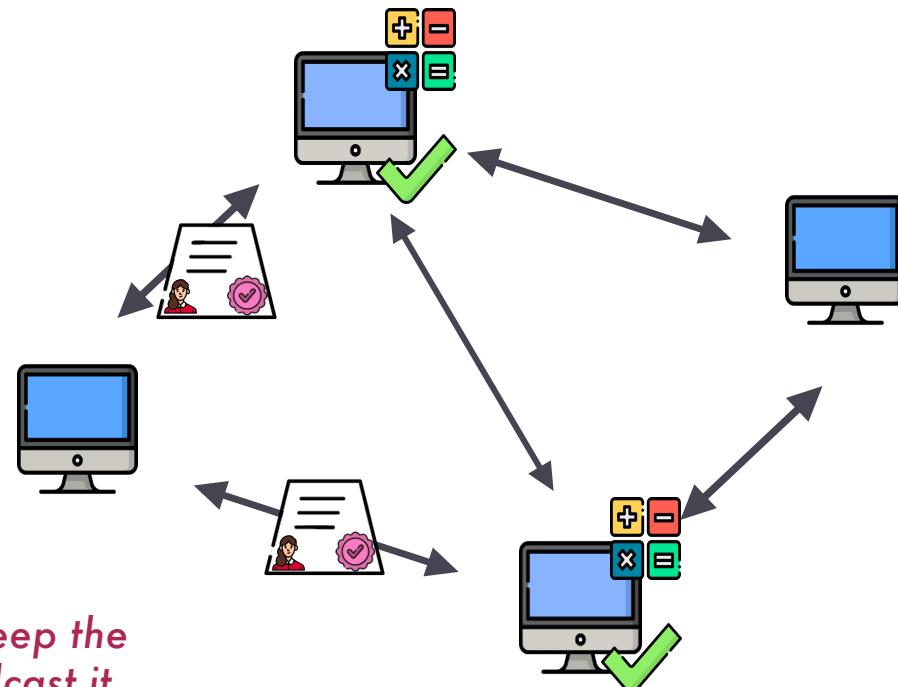
Node OR Validator

Certificate propagation

Node/Validator is receiving a certificate

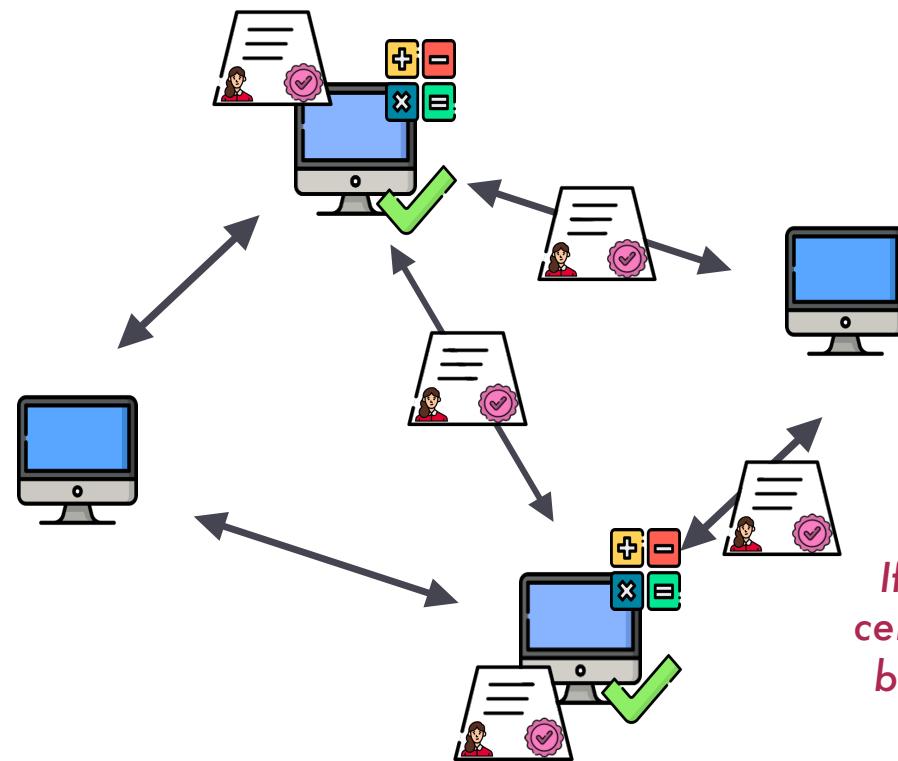


Certificate propagation



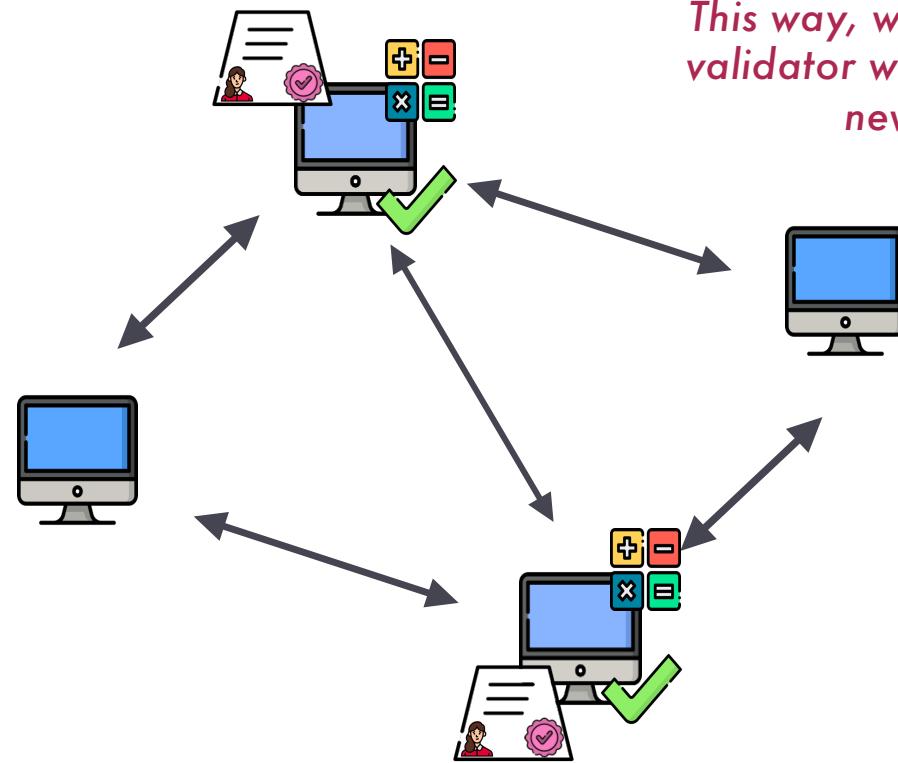
Simple nodes do not keep the certificate, they broadcast it immediately to neighbors

Certificate propagation



If a validator validates a certificate, they keep it and broadcast it to neighbors

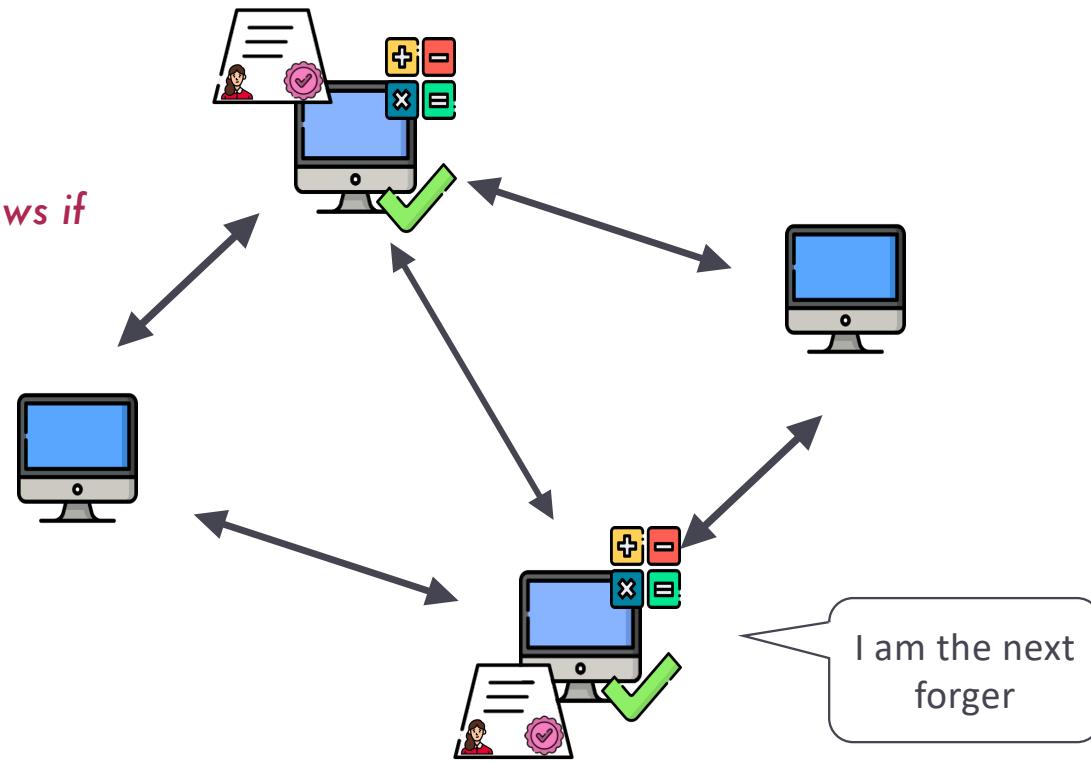
Certificate propagation



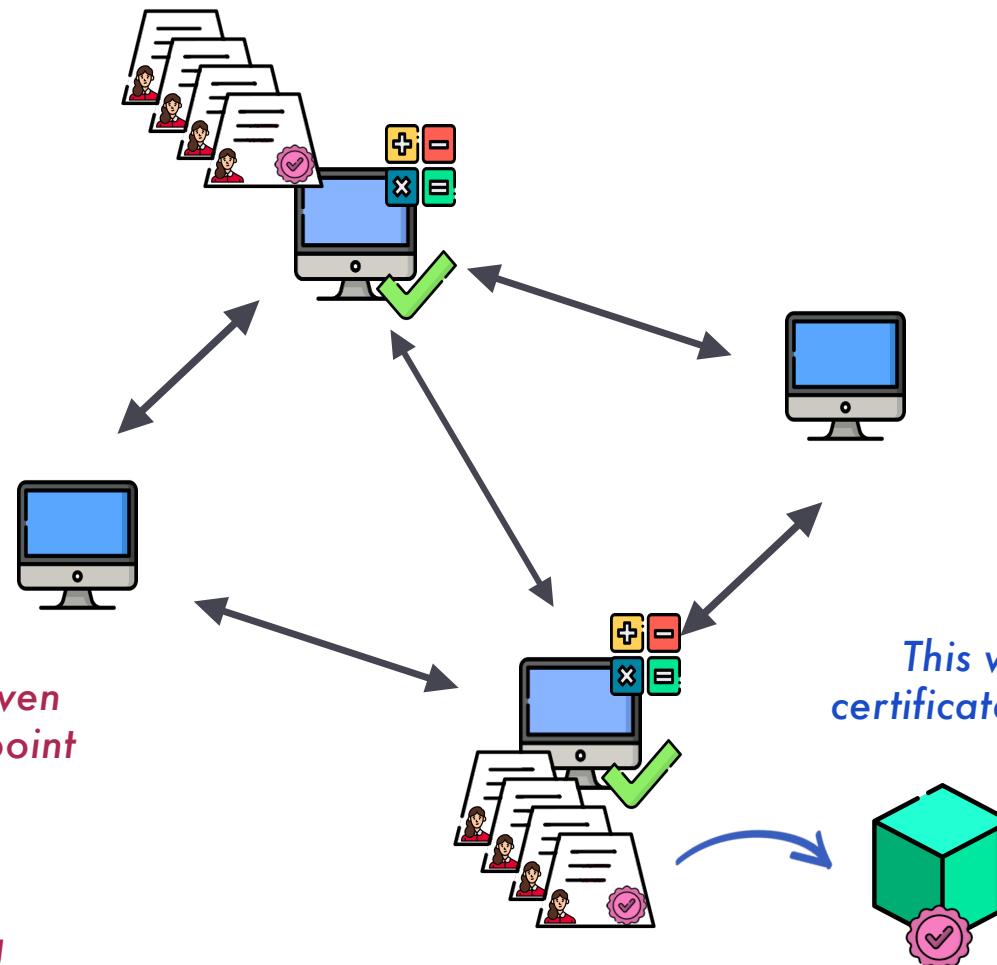
This way, we can be sure every validator will acknowledge any new certificate

Block forge

At any time, a validator knows if it is the next forger

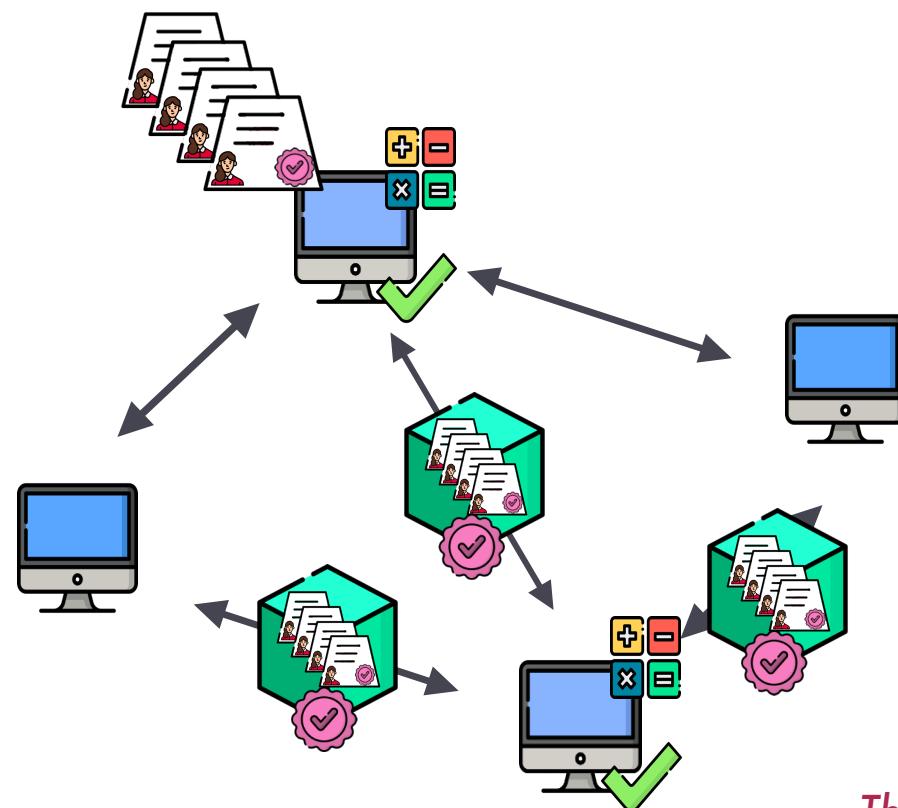


Block forge



For example, when N certificates are pending

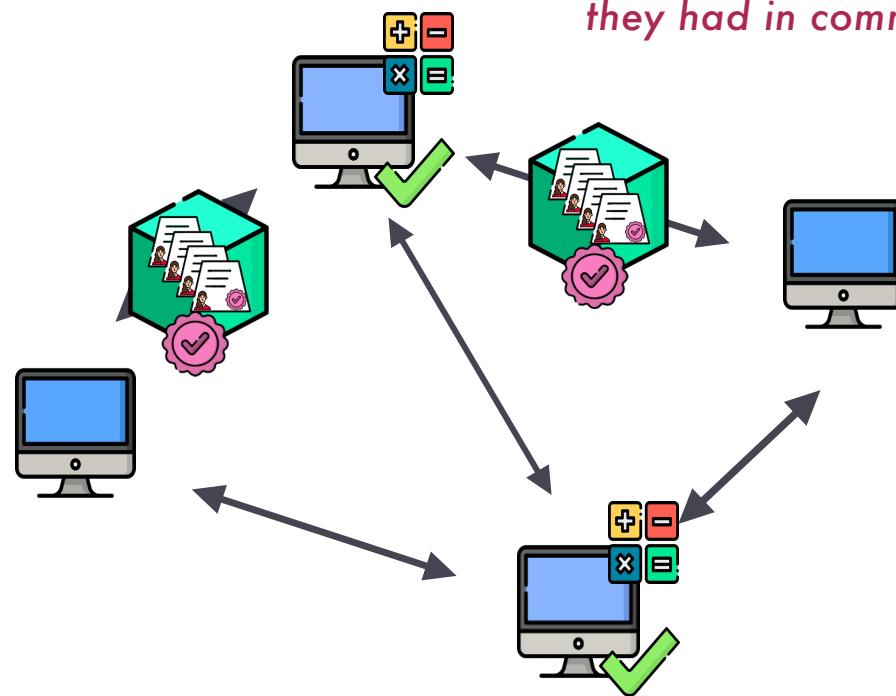
Block forge



*The new block is then
broadcasted to all neighbors*

Block forge

Validators that receive a new block remove all certificates they had in common



Certificate appliance

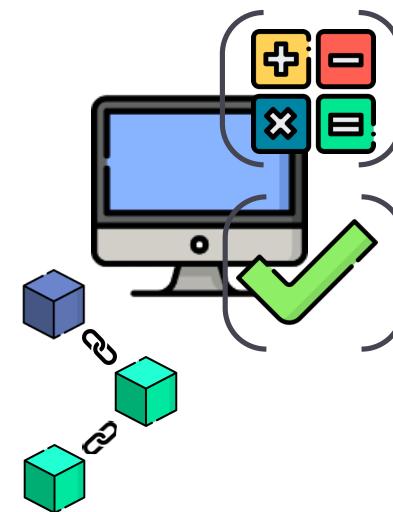
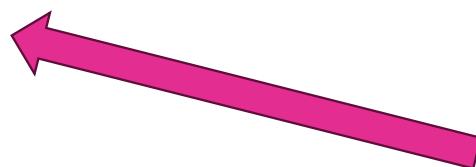
Great, I see my
staking operation
has been validated



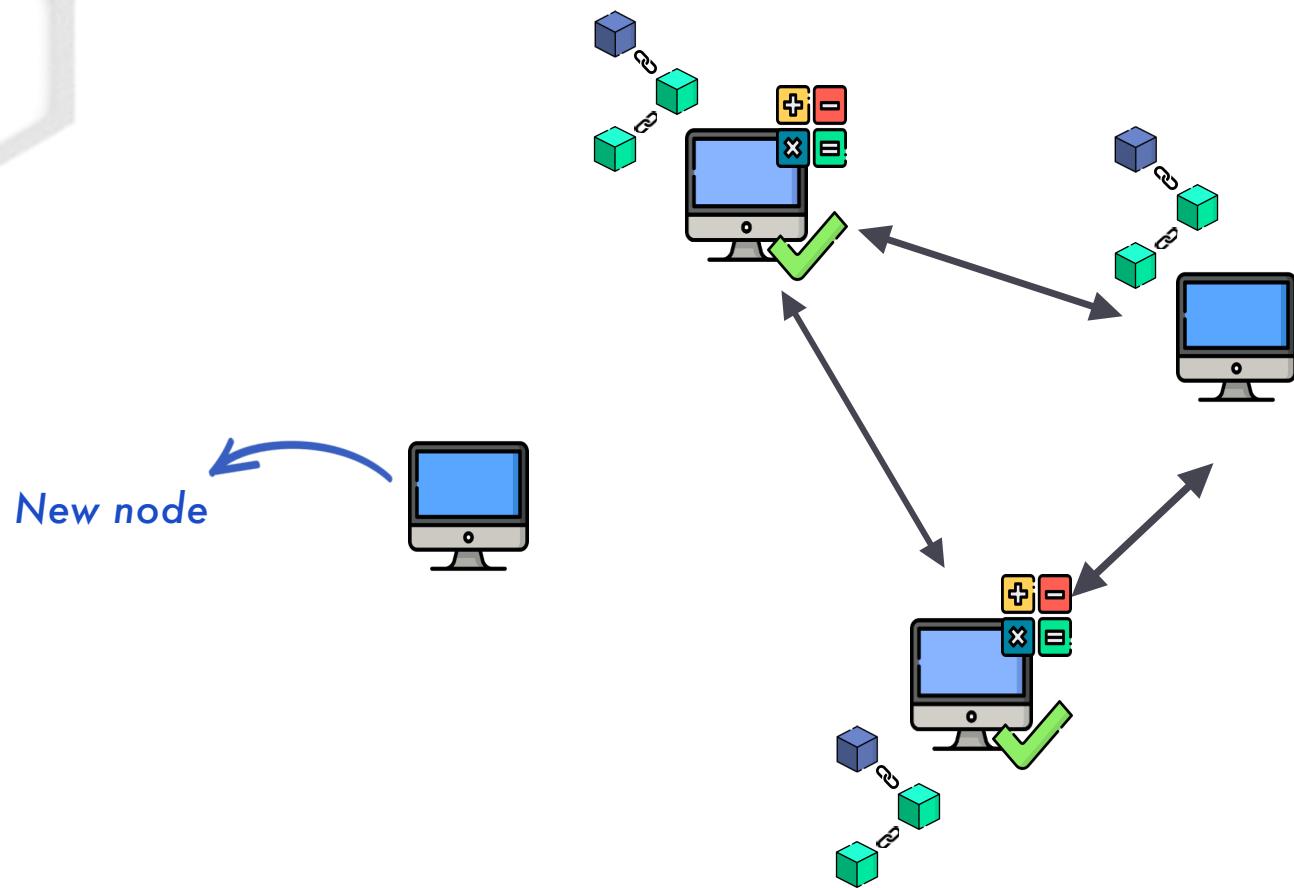
>Status:

Success

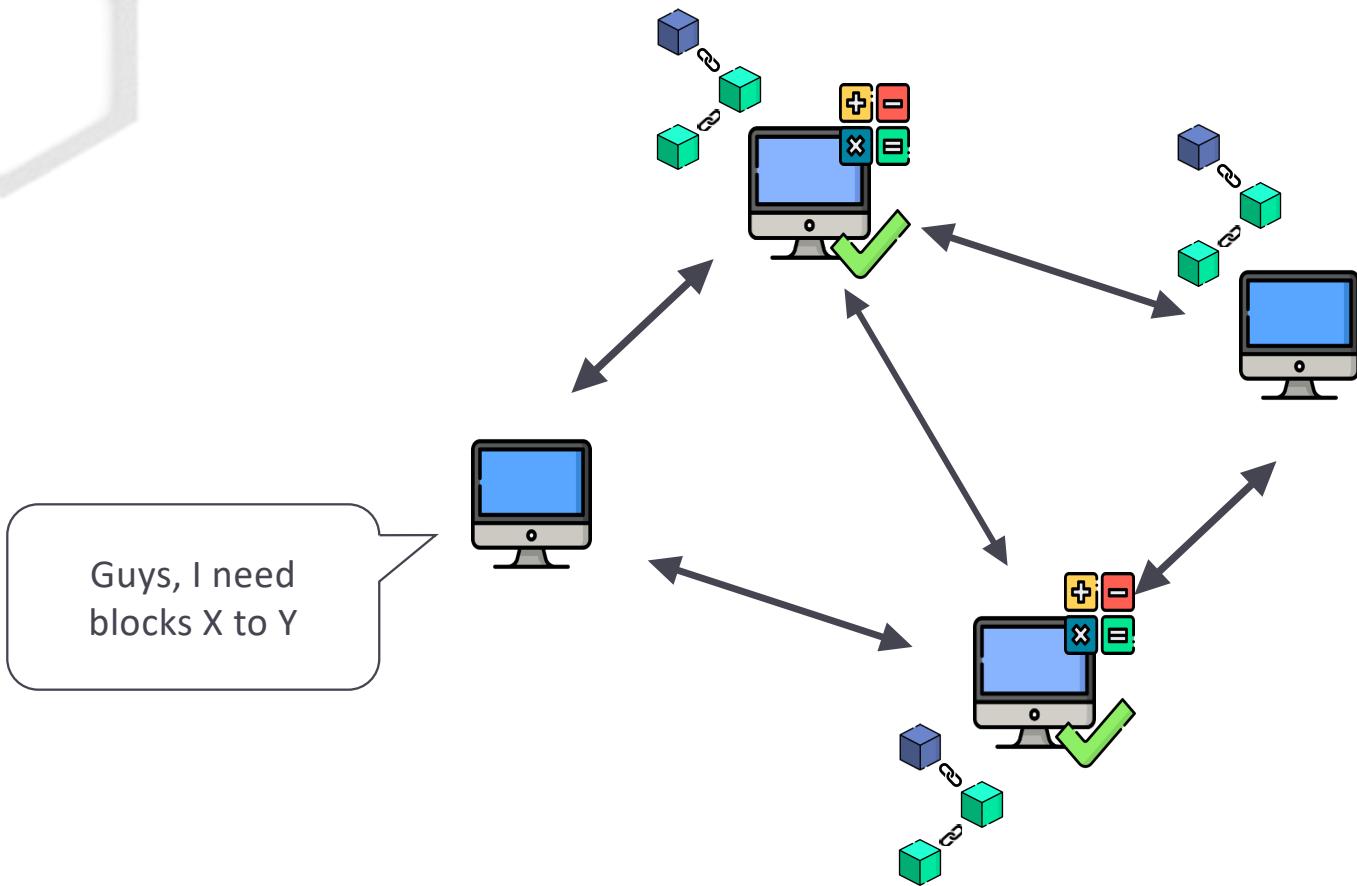
*Since the new block arrives to
Alice's target node, she knows it
has been accepted*



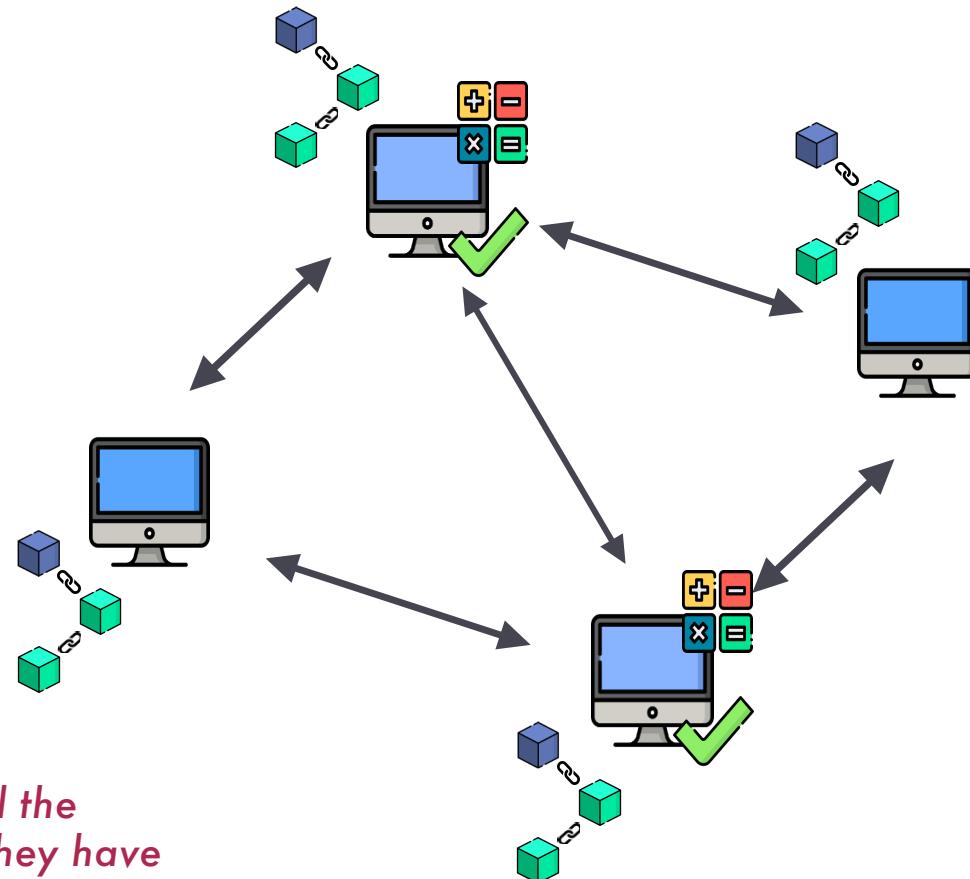
New nodes



New nodes

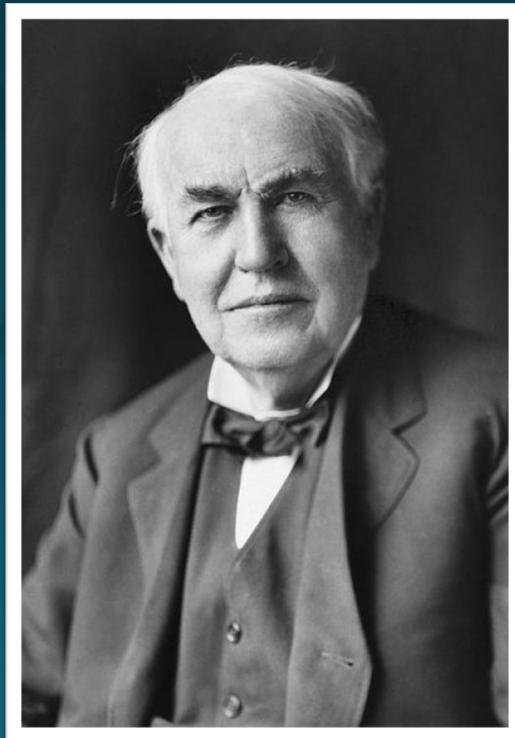


New nodes

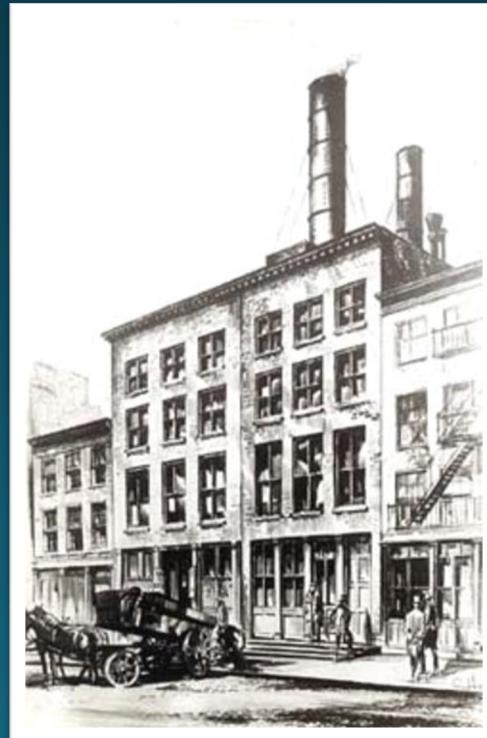


Neighbors send all the
corresponding blocks they have

Example : energy and smart grids



Thomas Edison



Pearl Street Station, 1882

The first true powerplant in the world

It powered the whole Manhattan neighborhood

Centralized powerplants



Power outage

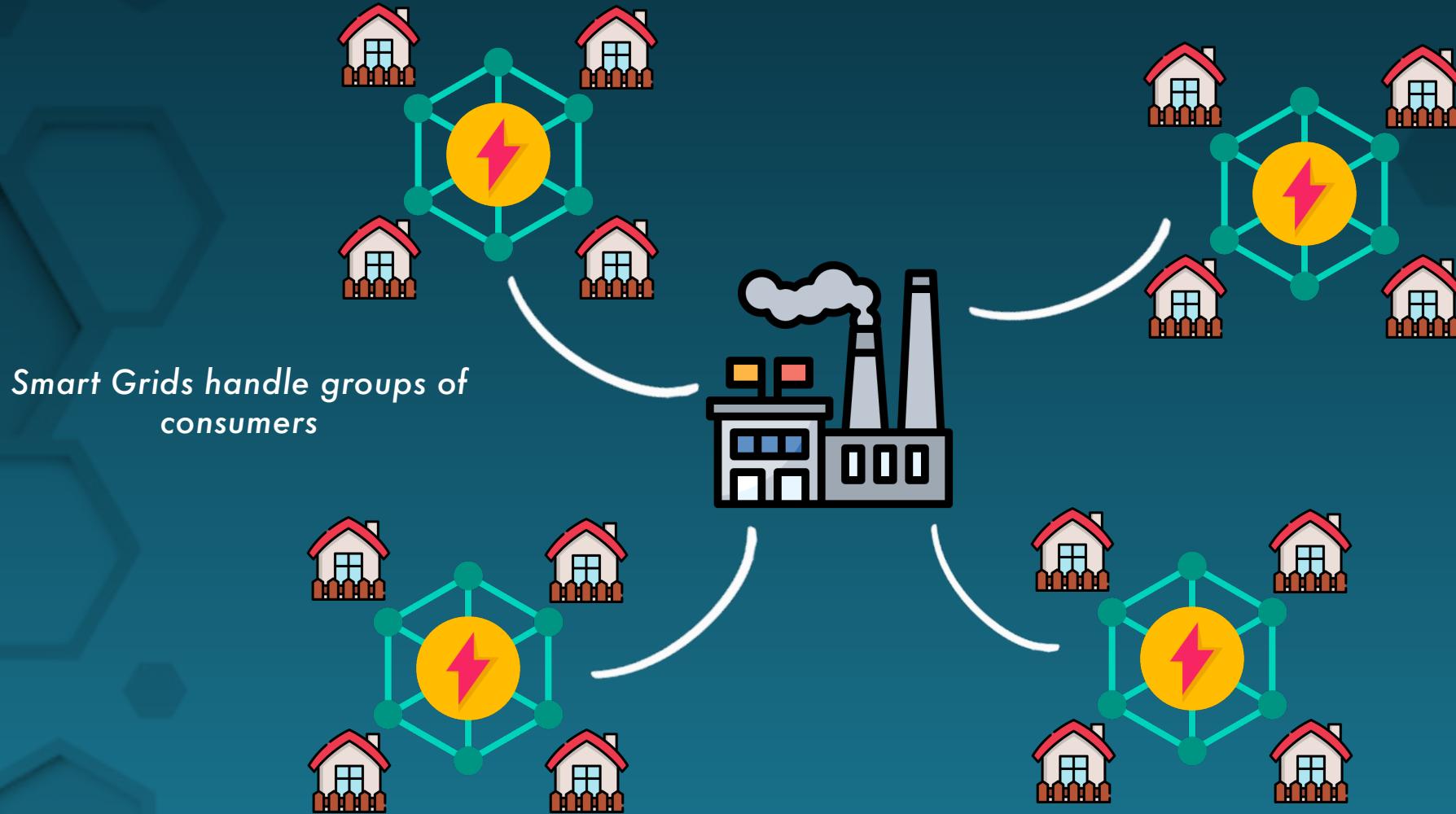


Power outage



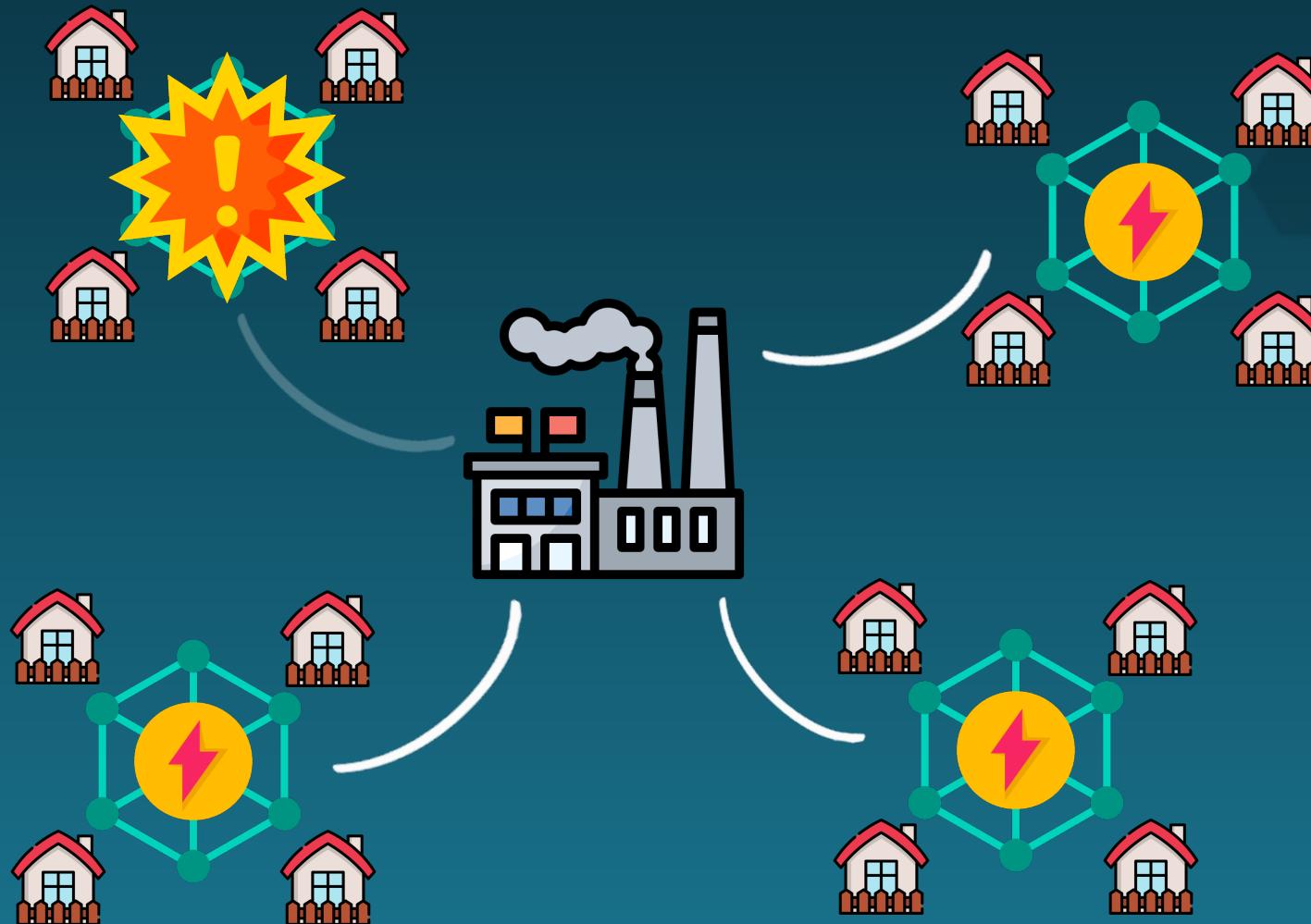
*Due to the nature of electricity,
the outage propagates, taking
down the whole neighborhood*

Smart Grids

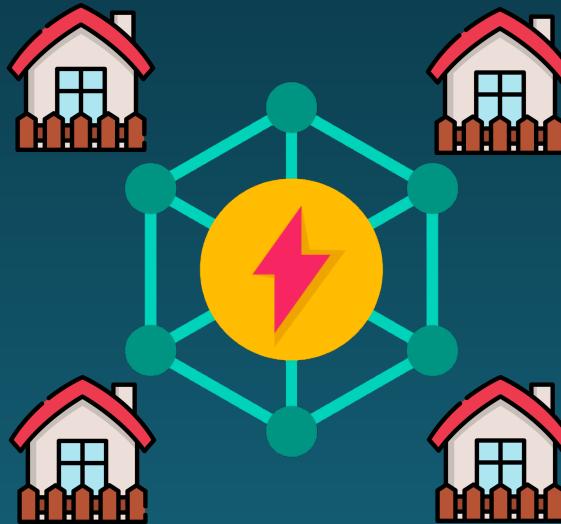


Smart Grids

If one is at fault, the system isolates it from the outside



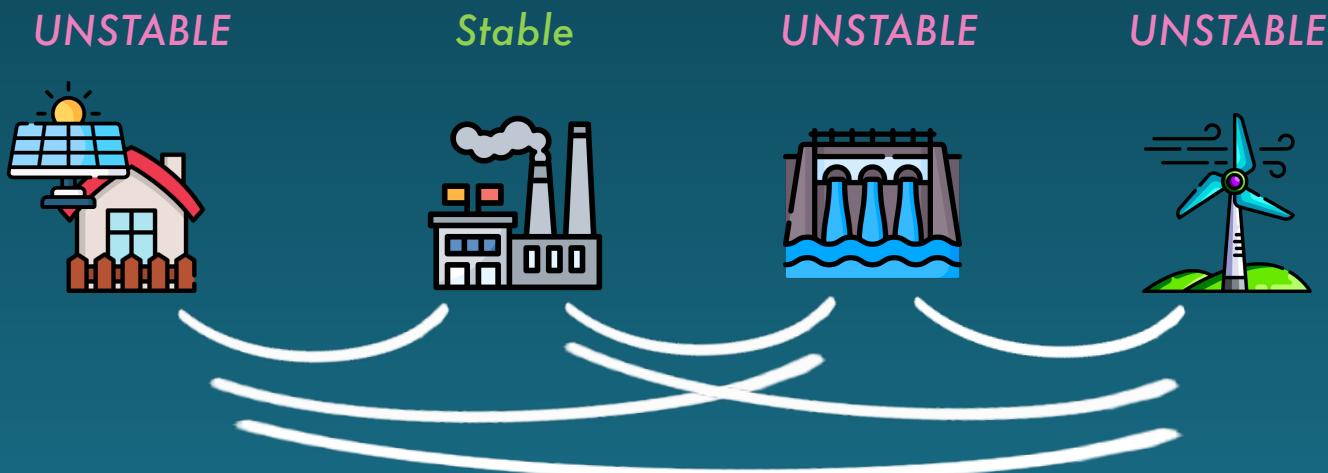
Smart Grids



*This can work thanks to thousands of sensors
dispatched across the grid, working in a
decentralized manner*

Energy source

Today, power sources are various and multiplicated



Synchronizing them is a tedious task

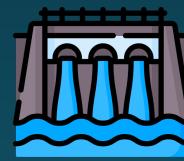
Resilience to outages



Local producers can maintain powerlines in case of failure



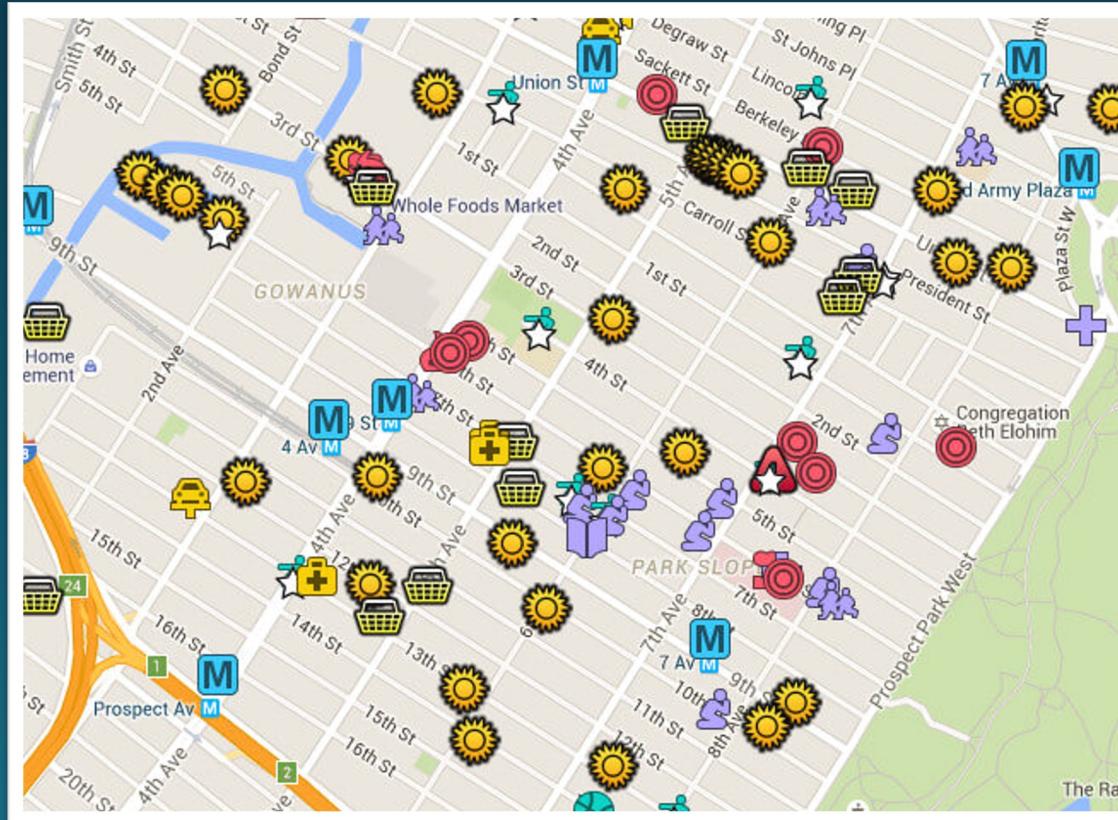
Origin of energy



*Where does your energy
come from ?*

=> blockchain tracking

Brooklyn microgrid



Blockchain et Applications

Quiz 4

Decentralization