Distributed Ledger Technology: An introduction to interoperability

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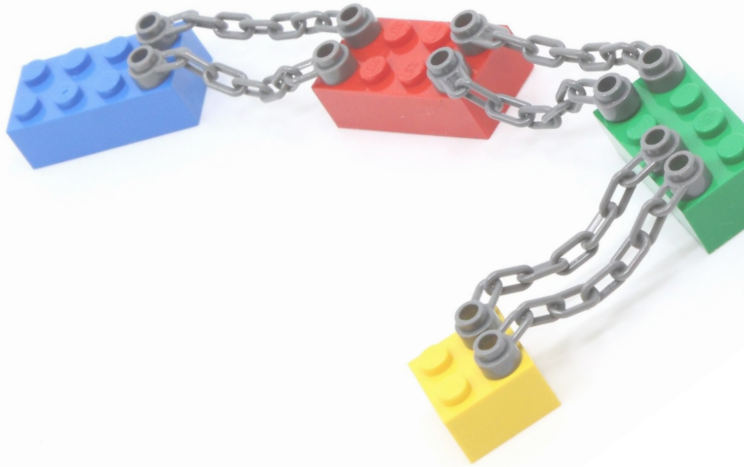
02/03/20

2009



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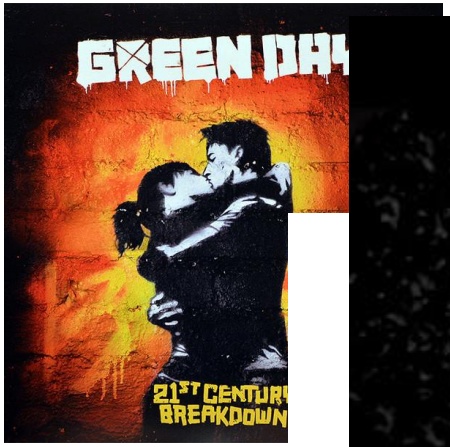

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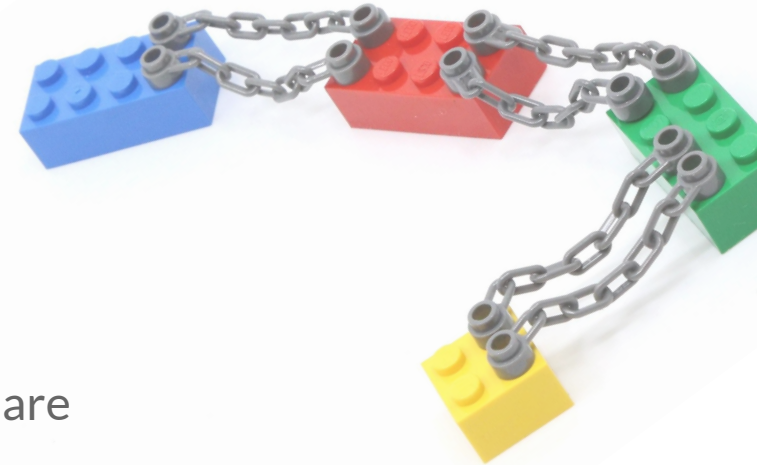
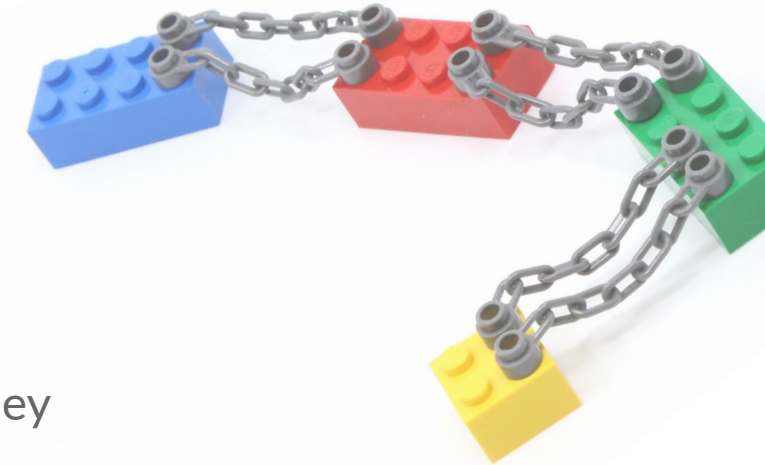


Bitcoin is a P2P payment system where nodes share the ledger of money Transactions, the Blockchain

The ledger is updated by the first node solving a hash search puzzle, Proof-of-Work (PoW), and gets rewarded with new coins

Bitcoin



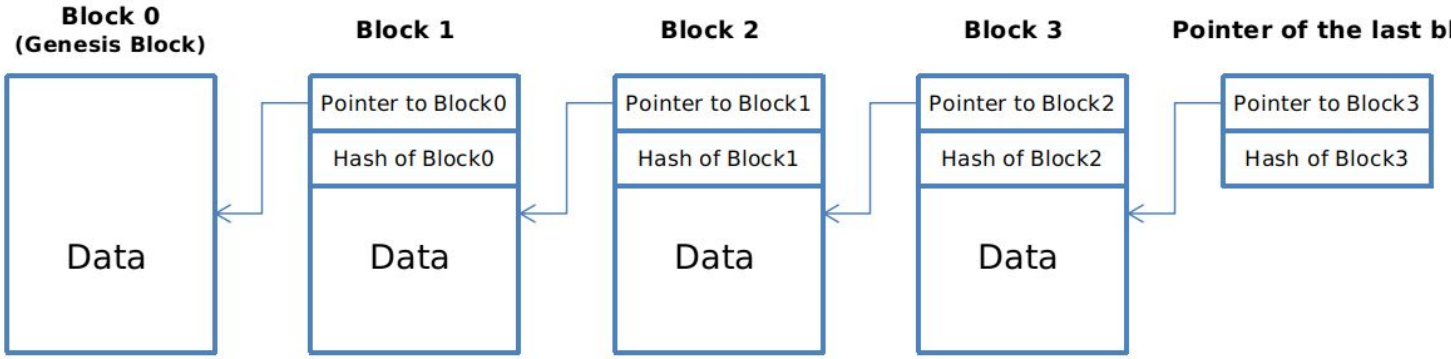
Transactions are secured by cryptography, i.e. they cannot be (easily) modified: **Immutability**

Transactions are visible by design: **Transparency**

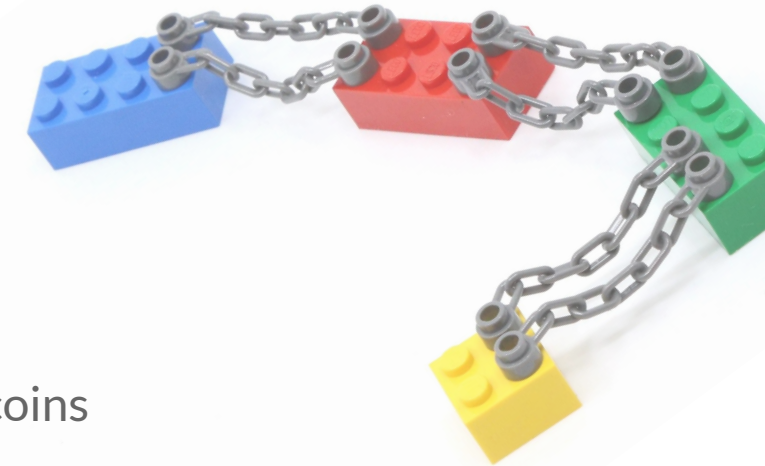
Transactions are **ordered**, i.e. it is possible to rebuild the current state of the ledger

User are **pseudo-anonym**

Bitcoin


Block 0
(Genesis Block)
Data
Block 1
Pointer to Block0
Hash of Block0
Data
Block 2
Pointer to Block1
Hash of Block1
Data
Block 3
Pointer to Block2
Hash of Block2
Data
Pointer of the last block
Pointer to Block3
Hash of Block3

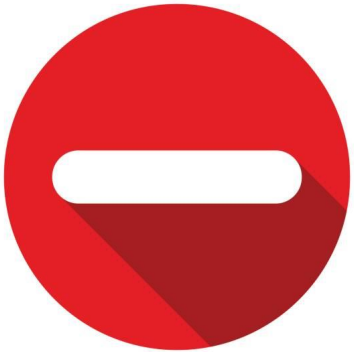
Bitcoin



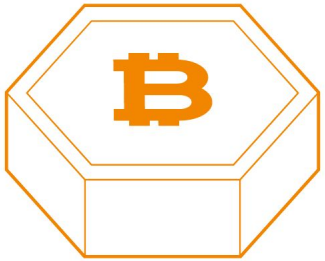
It is not intuitive for end users: it is easy to lose coins

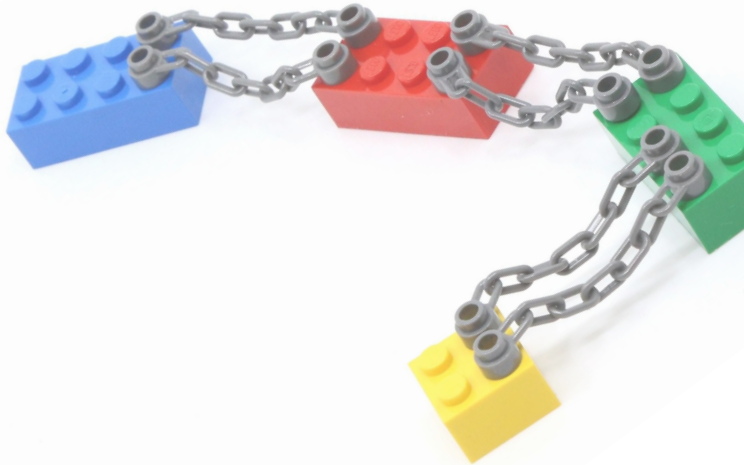
Slow processing power: around 7 Txs / s

Bitcoin is a good protocol as a decentralized payment system, but not much more



Bitcoin - Monolithic

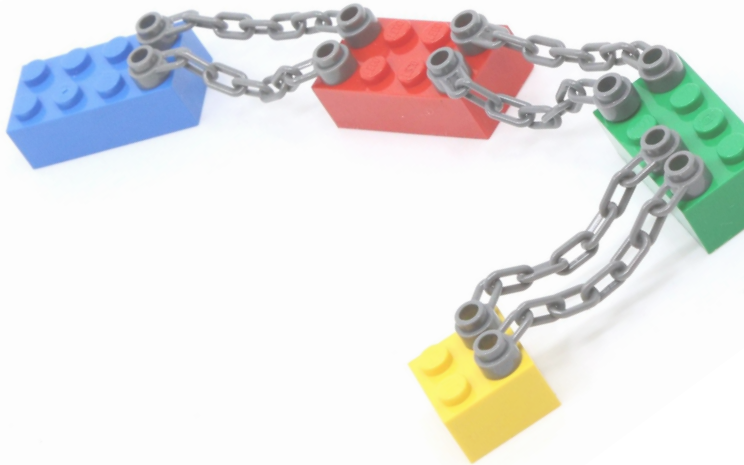




Images from:

https://cosmos.network/intro

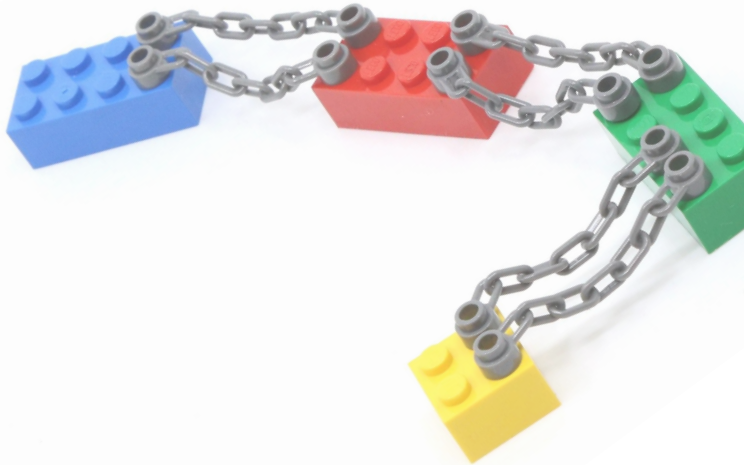
2015



PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11

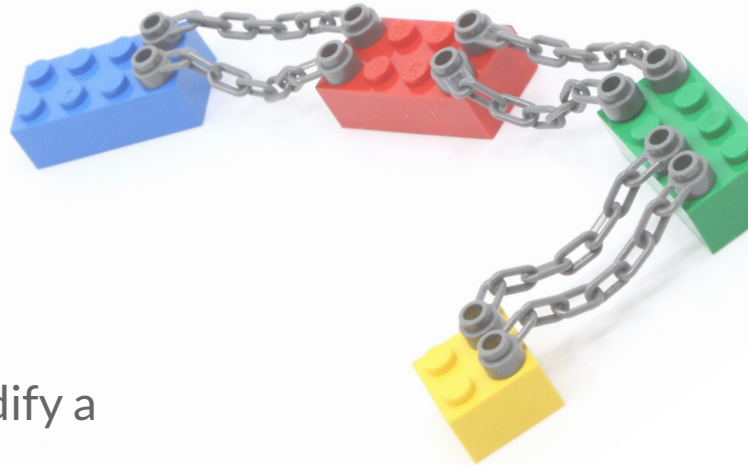
EXPO 2015
MILANO 2015

2015



Ethereum is a global, open-source platform for decentralized applications

Ethereum nodes run a virtual machine (EVM) that allows the execution of Turing-complete software called Smart Contracts

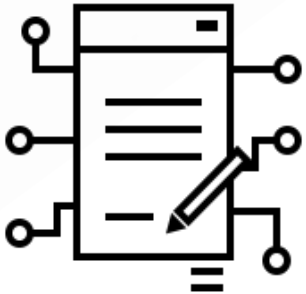


Ethereum

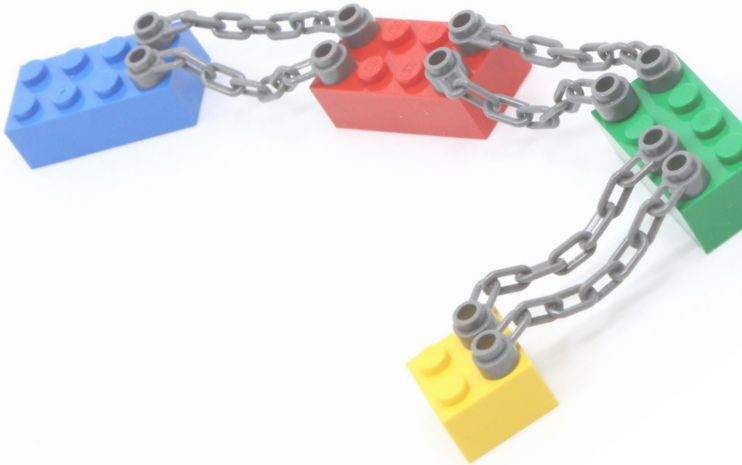
Smart contracts expose Functions which can modify a State stored in such contracts

With respect to Bitcoin, is possible to create more complex applications, also known as Decentralized Applications (DApp)

- Because Smart contracts are executed by the whole network



Ethereum

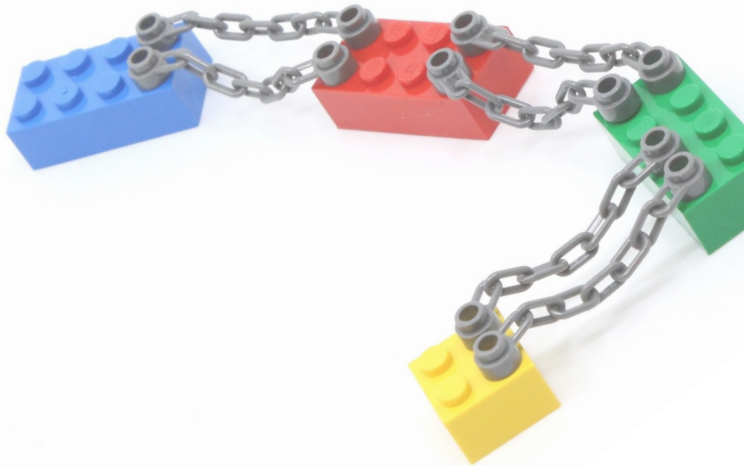


A very popular DApp is called Cryptokitties, a marketplace of digital cats with unique traits

- Its popularity caused a network slowdown in December 2017

Cryptokitties smart contract:
https://etherscan.io/token/0x06012c8cf97bead5deae237070f9587f8e7a266d

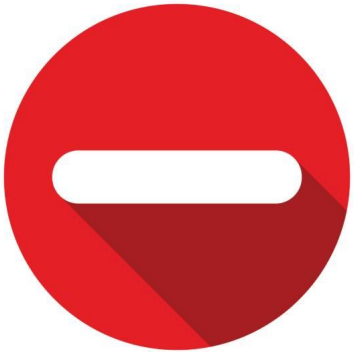
Ethereum



Slow processing power, around 15 Txs / s

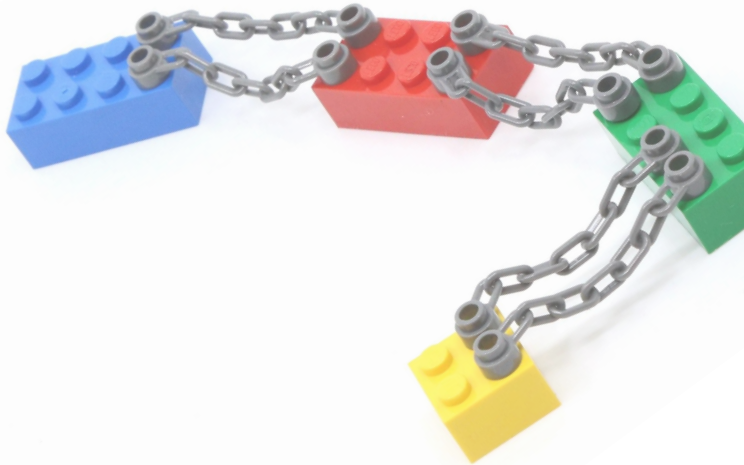
Smart contracts bugs cannot be fixed and can lead to big money loss

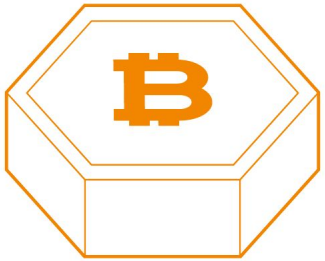
- In 2016 3.6M ETH were stolen, the equivalent of 70M $ (DAO attack)

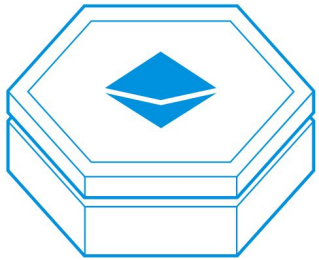


Less specialized than Bitcoin, but all DApps share the same resources

Ethereum - A top layer







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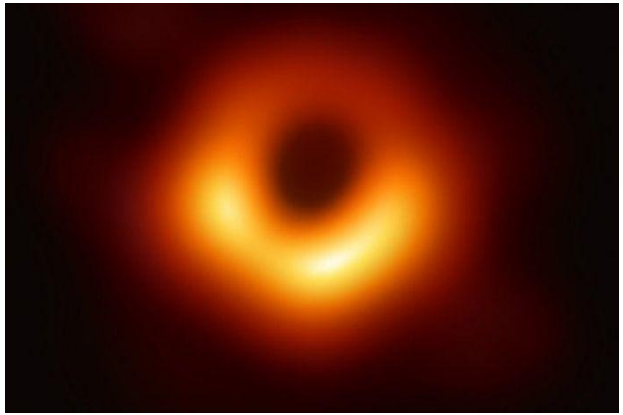
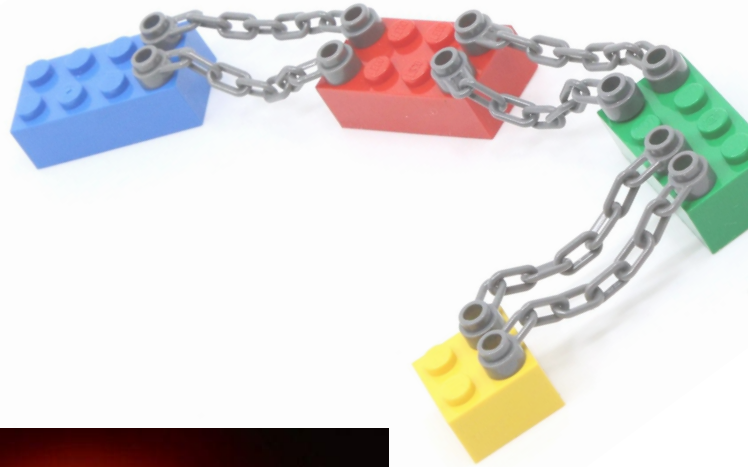
2019





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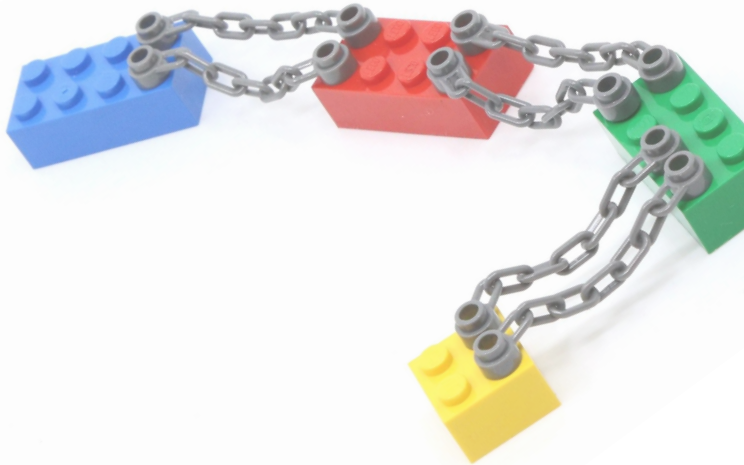
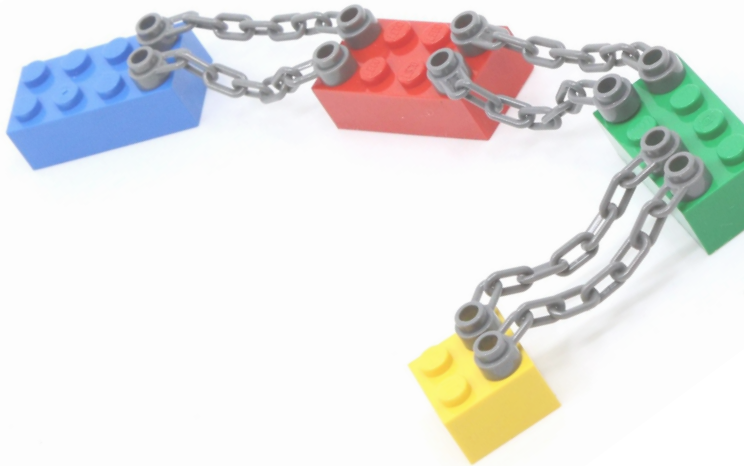


Blockchain applications are self-contained

- Bitcoin is specialized in digital payments
- Ethereum allows general DApps, but with shared resources
- And more...

Can they interact?

Use cases



Cross-chain asset exchange

- Without relying on trusted third parties

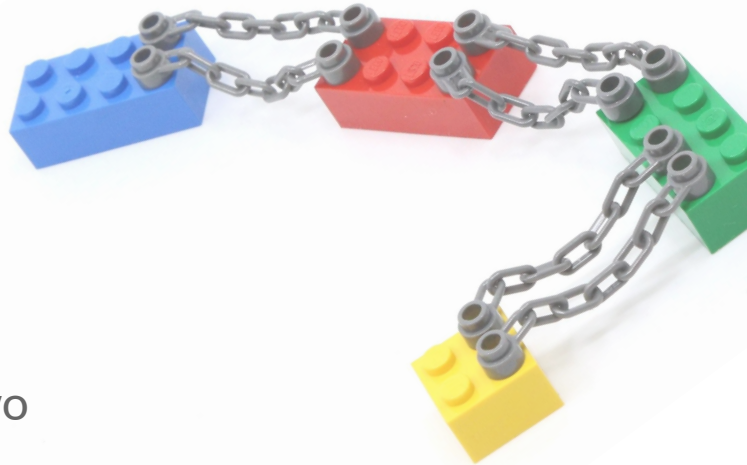
Cross-chain asset portability

- Move an asset between chains

Cross-chain smart contract interaction

- Smart contracts can trigger operations on other chains

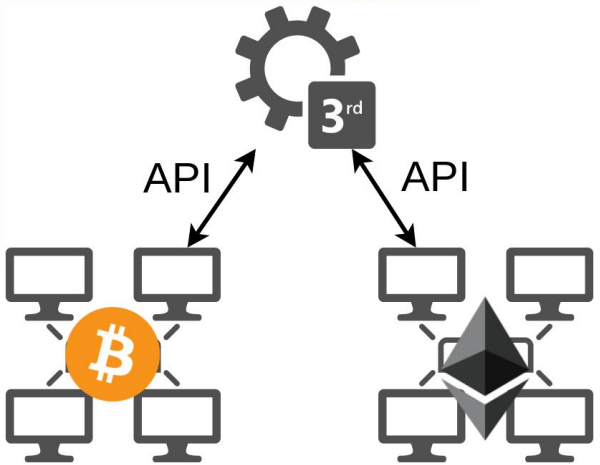
Notary schemes



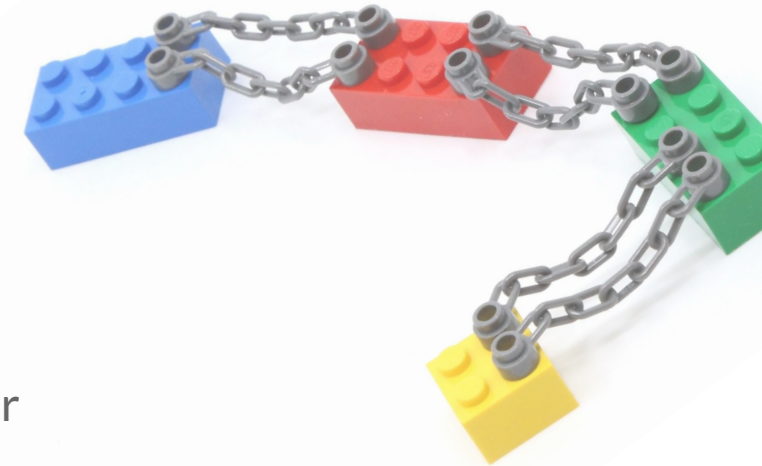
A trusted party, notary, is able to interact with two chains, X and Y

- Example: a listener fires a callback on X when detects a particular event on Y

Most intuitive approach, but introduces a single point of failure



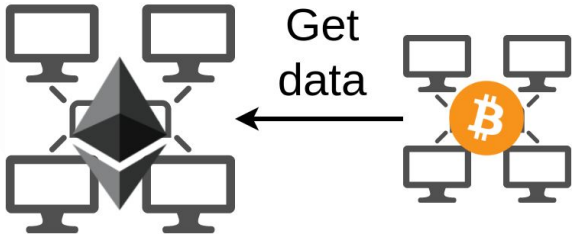
Side-chains



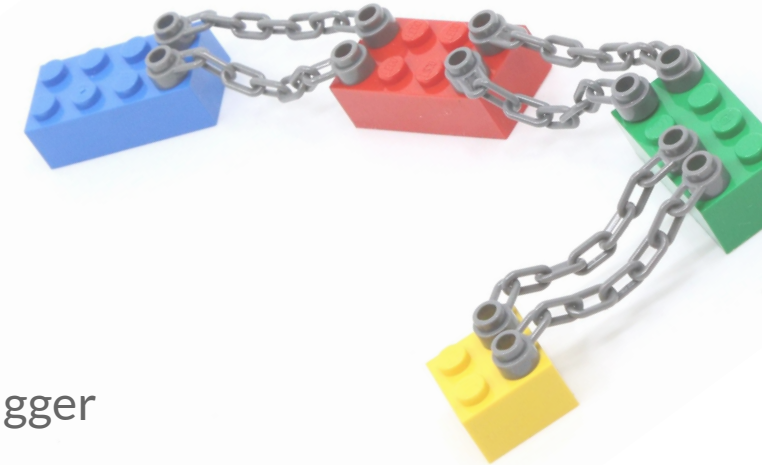
A chain can validate the state transitions of other chains

This approach is hard to achieve: it requires a blockchain, a self-contained system, to access to the outside world

- Otherwise, the input data must be provided by an external user



Hash locking

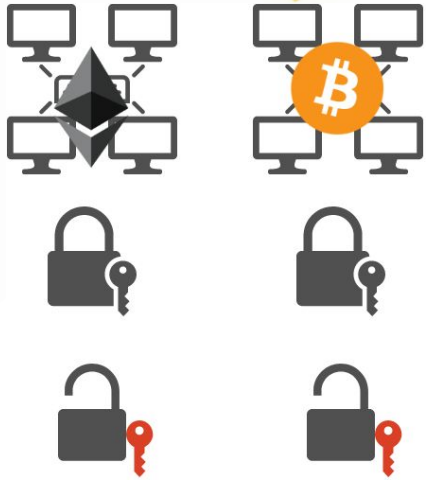


Operations on different chains have the same trigger

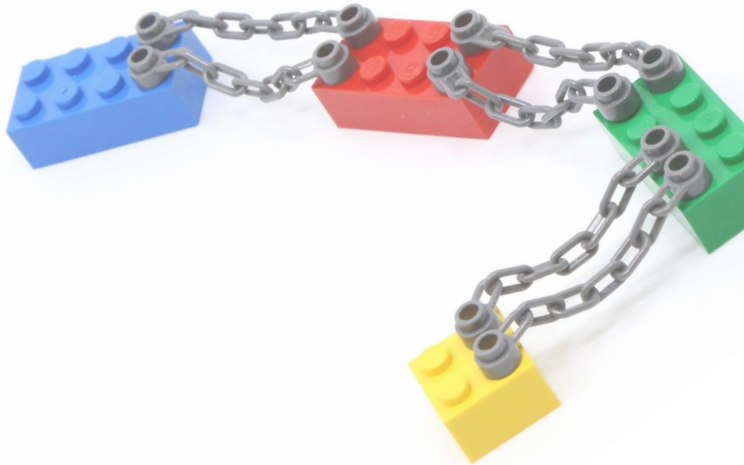
- Typically, the preimage of an hash value

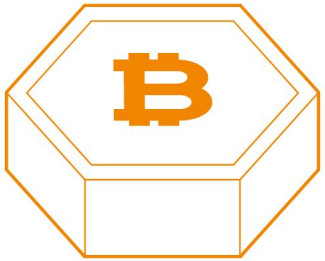
This approach is easy to implement and does not require external data

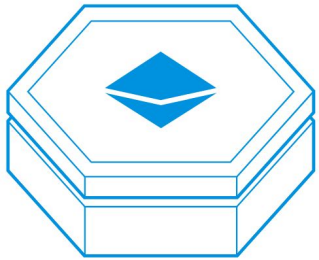
- But its applicability is limited with respect to the other approaches

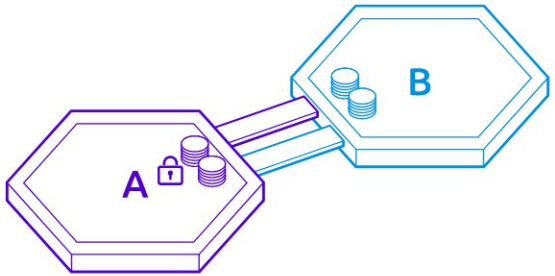


Connecting chains









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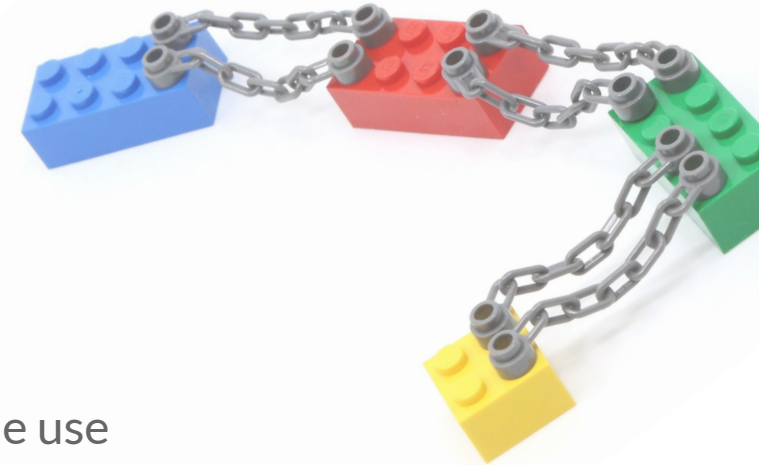


Future steps

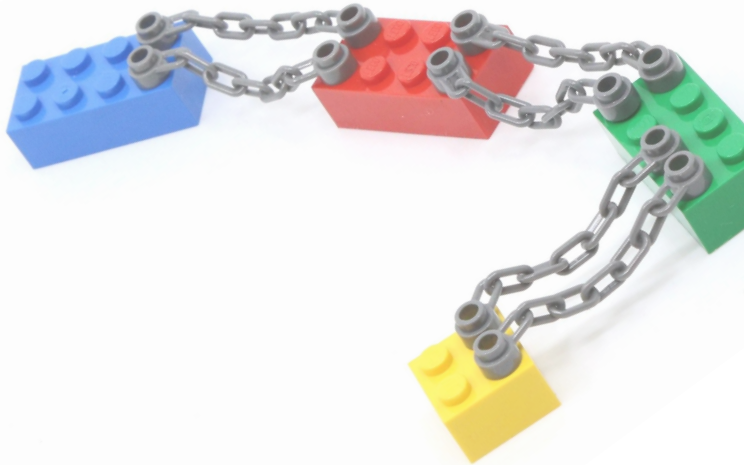
Investigate more in depth the approaches and the use cases

Propose an interoperability solution for a particular use case, either modifying an existing technology (if feasible) or provide an original proof of concept

- In the past I worked on a notary scheme solution

Thank you!

References - Bitcoin



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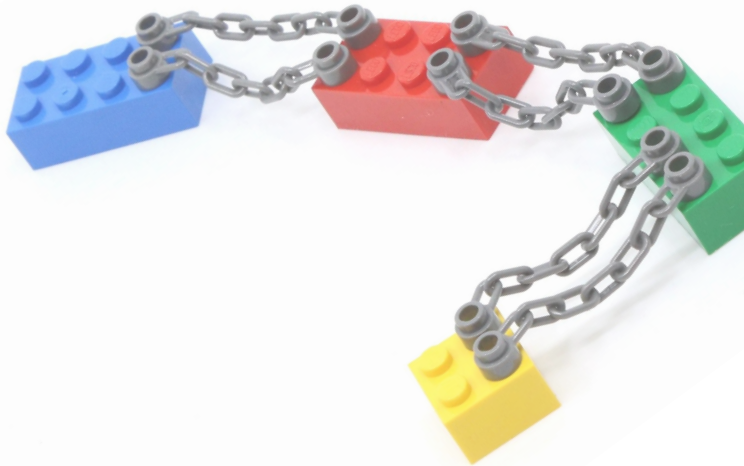

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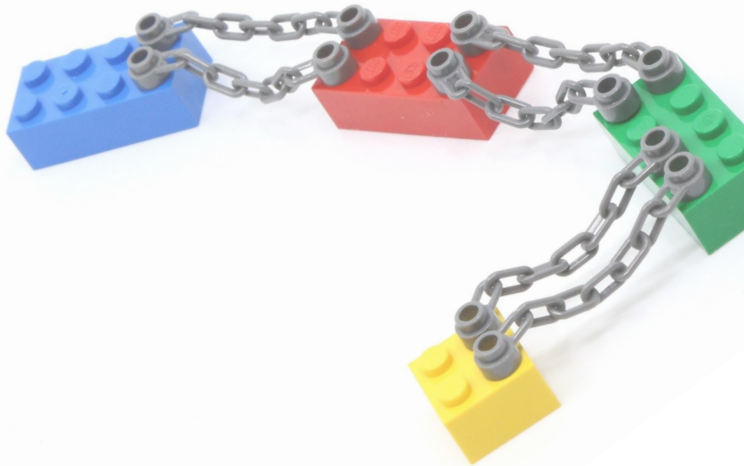

Bitcoin Lightning Network: https://lightning.network/

BTCRelay (deprecated): http://btcrelay.org/

Cosmos: https://cosmos.network/

Polkadot: https://polkadot.network/

Interledger: https://interledger.org/