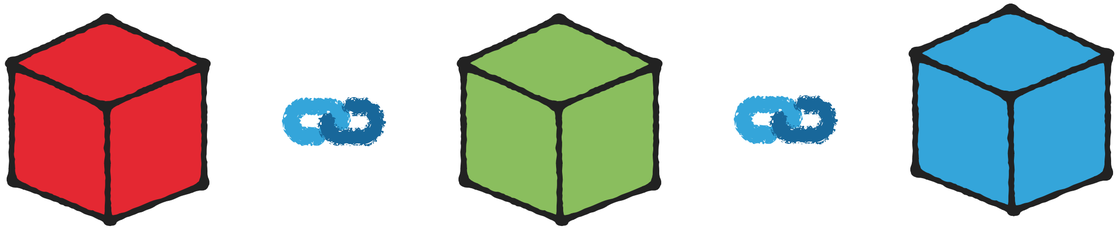


On Fairness Concerns in the Blockchain Ecosystem

Johnnatan Messias

@johnnatan_me

Thesis defense

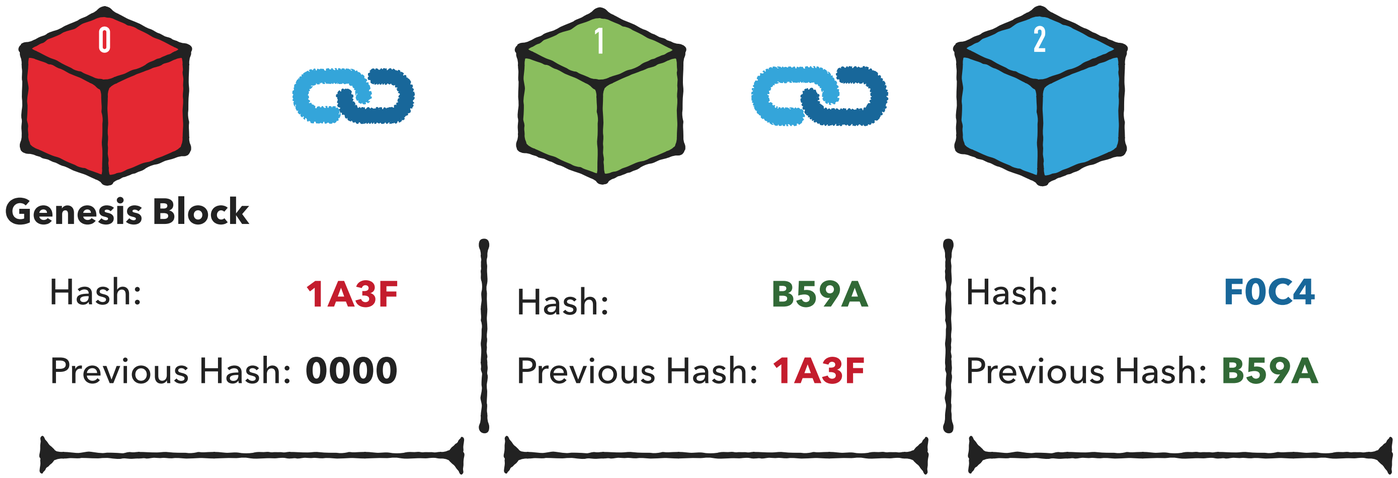
MAX PLANCK INSTITUTE
FOR SOFTWARE SYSTEMS

April 25, 2024 – Saarbrücken, Germany

UNIVERSITÄT
DES
SAARLANDES

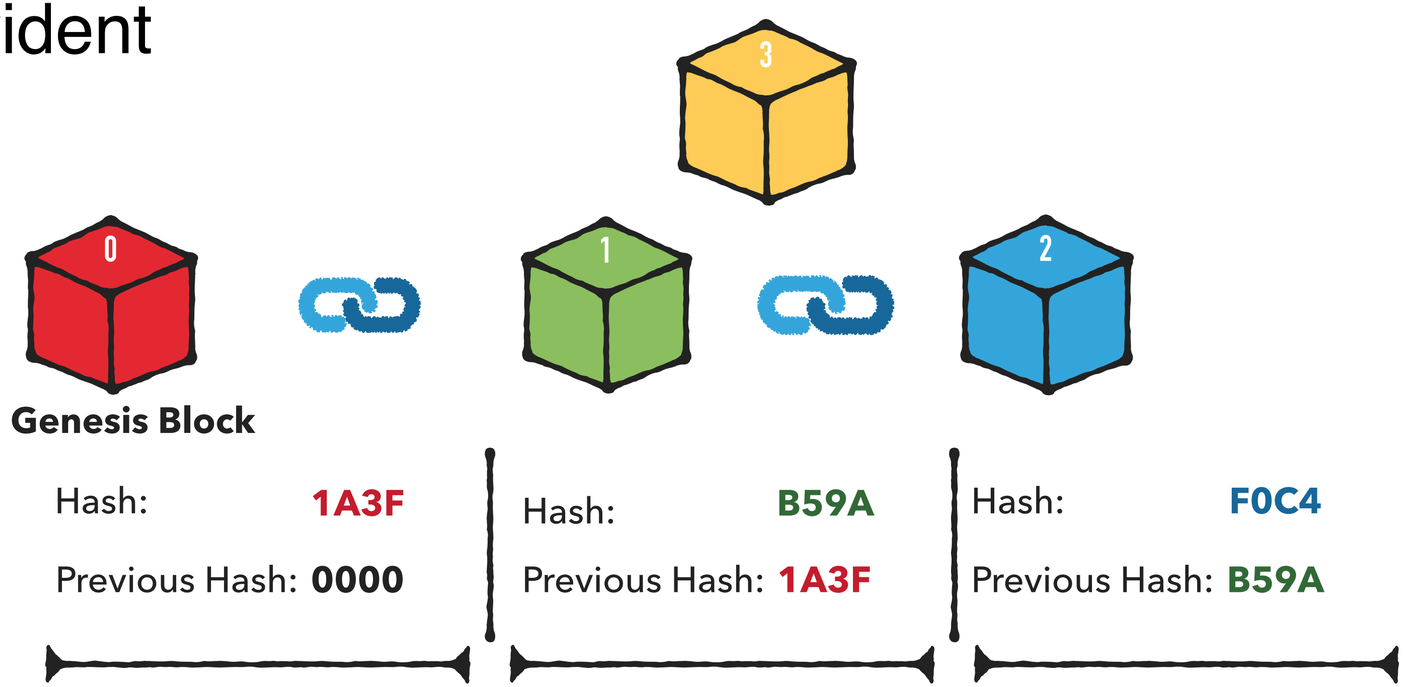
What's a Blockchain?

- Blockchain is a decentralized ledger to record **transactions** between any two or more users
  - An append-only list of cryptographically linked records of transactions called **blocks**
  - Tamper evident



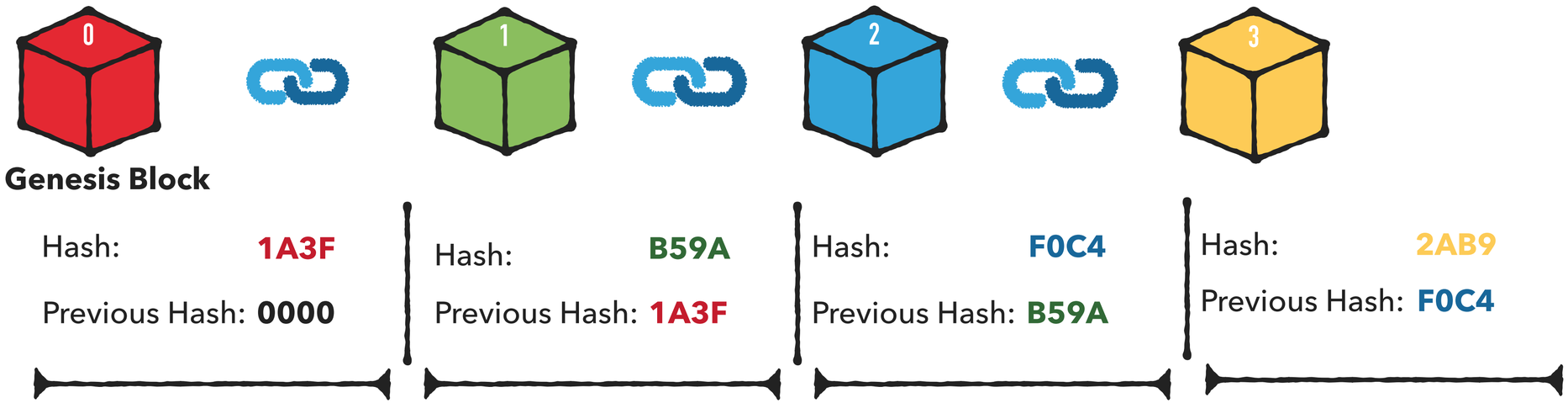
What's a Blockchain?

- Blockchain is a decentralized ledger to record **transactions** between any two or more users
  - An append-only list of cryptographically linked records of transactions called **blocks**
  - Tamper evident



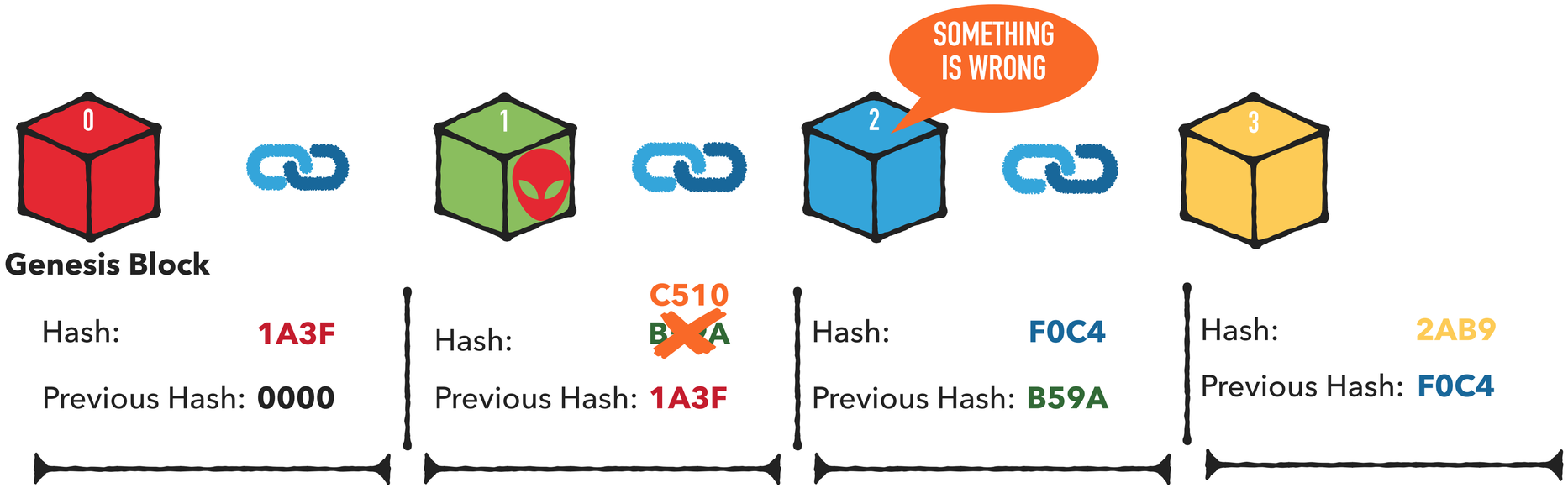
What's a Blockchain?

- Blockchain is a decentralized ledger to record **transactions** between any two or more users
  - An append-only list of cryptographically linked records of transactions called **blocks**
  - Tamper evident



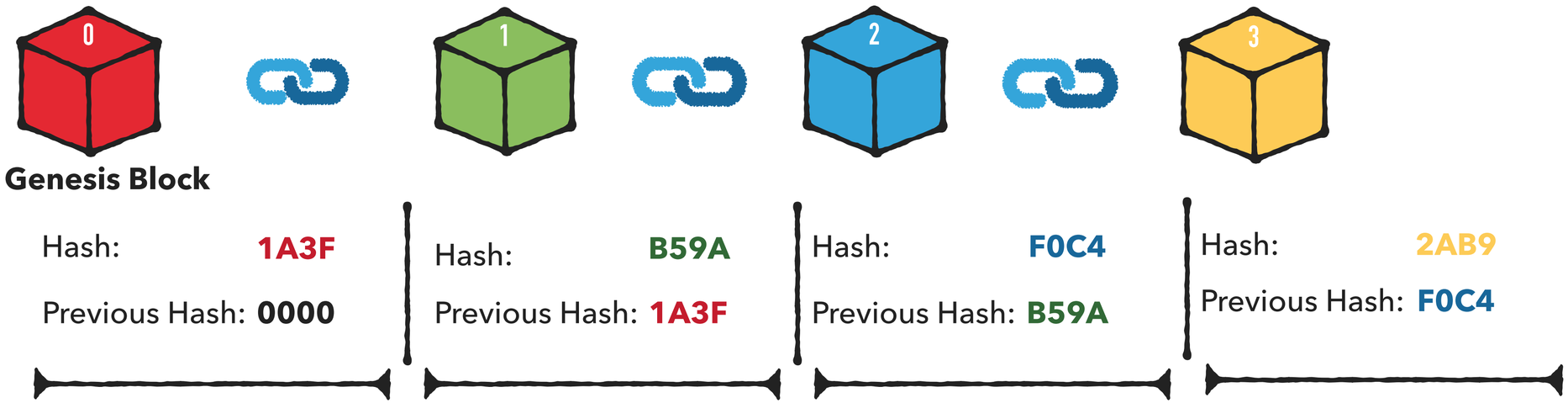
What's a Blockchain?

- Blockchain is a decentralized ledger to record **transactions** between any two or more users
  - An append-only list of cryptographically linked records of transactions called **blocks**
  - Tamper evident



What's a Blockchain?

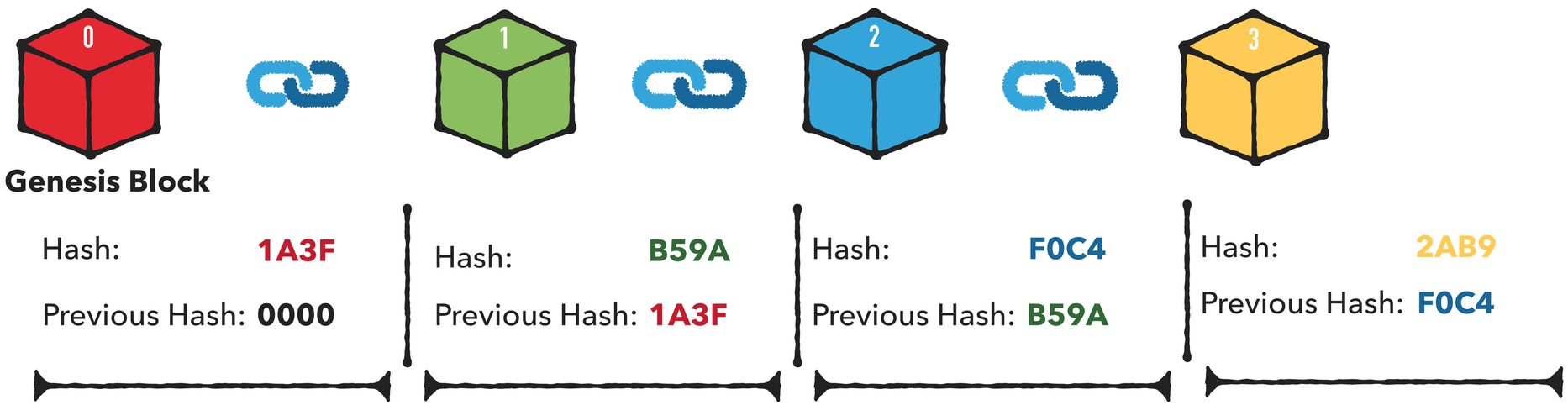
- Blockchain is a decentralized ledger to record **transactions** between any two or more users
  - An append-only list of cryptographically linked records of transactions called **blocks**
  - Tamper evident



What's a Blockchain?

- Blockchain is a decentralized ledger to record **transactions** between any two or more users
  - An append-only list of cryptographically linked records of transactions called **blocks**
  - Tamper

It's a chain of blocks!



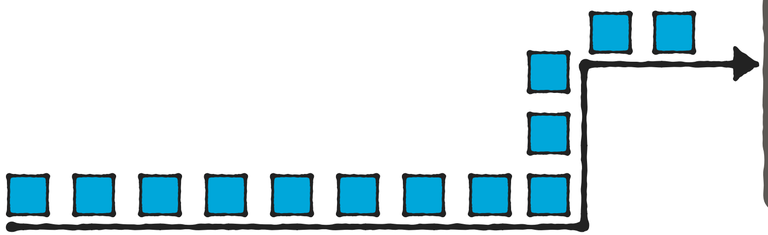
How Transactions Are Ordered?

Money transfer

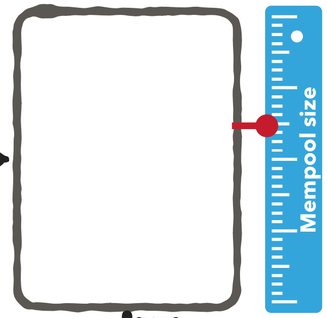
Smart contract interaction

1 - Transactions arrive through P2P

Every transaction includes a fee

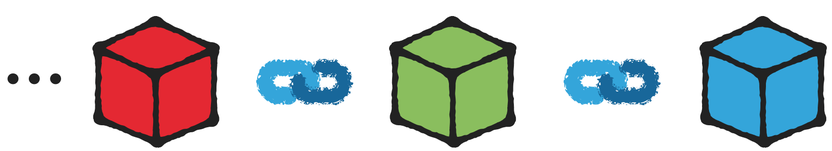


Mempool



2 - Transactions are included in the Mempool

3 - Miners select them to include in a block



4 - Miners/MPOs mine a block

5 - Miners relay the blocks to the P2P network

6 - Block and its transactions become part of the blockchain

Why This Is Good?

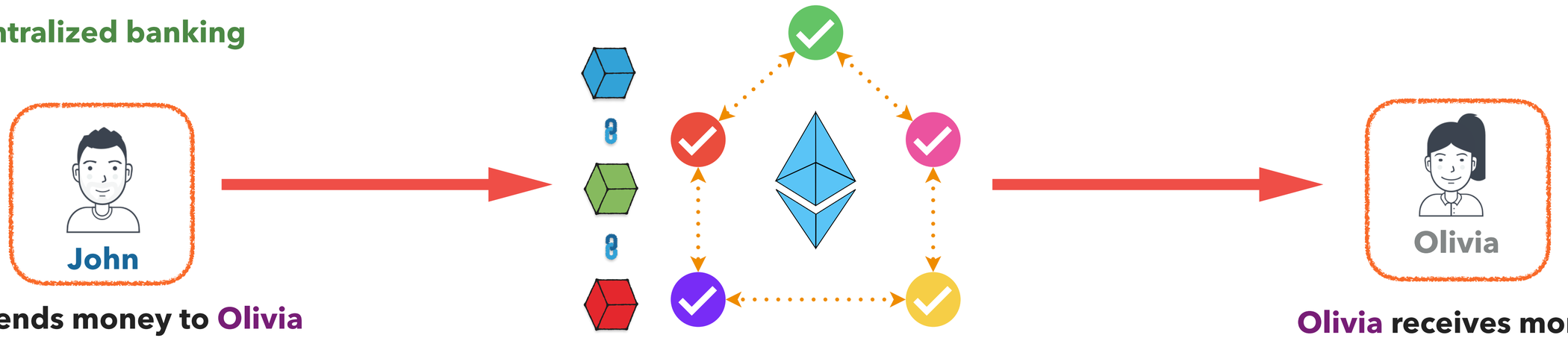
Centralized banking

John sends money to **Olivia** through his **bank** account

The **banks** take full custody of the funds and transfer the money between them

Olivia receives money in her account

Decentralized banking



John sends money to **Olivia** through the **blockchain**

The **blockchain** transfer money between accounts without a trusted party taking custody

Olivia receives money to her public address

50+ BLOCKCHAIN
REAL WORLD USES CASES

GOVERNMENT
Essentia develops world's first blockchain solution to manage international logistics hub together with Traffic Labs and the Finnish Government

essentia.one

IDENTIFICATION
Voter registration is being facilitated via a blockchain project in Switzerland spearheaded by **Uport**.

uport

MOBILE PAYMENTS
The blockchain ledger that **Ripple** uses has been latched onto by a group of Japanese banks, who will be using it for quick mobile payments.

ripple

INSURANCE
A smart contract-based blockchain is being used by Insurer **American International Group Inc** as a means of saving costs and increasing transparency.

AIG

ENDANGERED SPECIES PROTECTION
The protection of endangered species is being facilitated via a blockchain project that records the activities of these rare animals.

CARBON OFFSETS
IBM is using the Hyperledger Fabric blockchain in China to monitor carbon offset trading.

IBM HYPERLEDGER

ENTERPRISE
Ethereum's blockchain can be accessed as a cloud-based service courtesy of **Microsoft Azure.**

Microsoft Azure

BORDER CONTROL
Essentia has devised a border control system that would use blockchain to store passenger data in the Netherlands.

essentia.one

SUPPLY CHAINS
IBM and **Walmart** have partnered in China to create a blockchain project that will monitor food safety.

IBM Walmart

HEALTHCARE
A number of healthcare systems that store data on the blockchain have been pioneered including **MedRec.**

MEDREC

SHIPPING
Shipping is a natural fit for blockchain, and **Maersk** have been trialling a blockchainbased project within the maritime logistics industry.

MÆRSK

REAL ESTATE
Blockchain is now being used to complete real estate deals, the first of which was conducted in Kiev by **Propy**.

PROPY

ENERGY
Essentia is developing a test project that will help energy suppliers track the distribution of their resources in real time, whilst maintaining data confidentiality.

essentia.one

LAND REGISTRY
Land registry titles are now being stored on the blockchain in Georgia in a project developed by the **National Agency of Public Registry**.

NATIONAL AGENCY of PUBLIC REGISTRY

COMPUTATION
Digital Currency Group are helping Amazon Web Services examine ways in which the distributed ledger technology can help improve database security.

DIGITAL CURRENCY GROUP

ADVERTISING
New York Interactive Advertising Exchange has been experimen- ting with blockchain as a means of providing an ads marketplace for publishers.

NYIAX

BORDER CONTROL
Essentia is developing a blockchain project for border control that will allow customs agents to record passenger data from an array of inputs and safely store it.

essentia.one

JOURNALISM
Decentralized journalism, as enabled by blockchain technology, has the potential to prevent censorship and increase transparency, as **Civil** has shown.

CIVIL

WASTE MANAGEMENT
Waltonchain is using **RFID** technology to store waste management data on the blockchain in China.

ENERGY
Food importation is another industry where blockchain is proving its worth, with **Louis Dreyfus Co** trialling a soybean importation operation using this technology.

LDC. Louis Dreyfus Company

DIAMONDS
The **De Beers Group** is using blockchain to track the importation and sale of diamonds.

De Beers Group of Companies

FINE ART
By storing **certificates** of authenticity on the blockchain, it's possible to dramatically reduce art forgeries, as one blockchain project is proving.

NATIONAL SECURITY
For the past two years, the **US Department of Homeland Security** has been using blockchain to record and safely store data captured from its security cameras.

TOURISM
In a bid to boost its tourism economy, **Hawaii** is examining ways in which blockchain-based cryptocurrencies can be adopted throughout the US state.

TAXATION
In China, a tax-based initiative is using blockchain to store tax records and electronic invoices led by **Miaocai Network**.

ENERGY
Chile's National Energy Commission has started using blockchain technology as a way of certifying data pertaining to the country's energy usage as it seeks to update its electrical infrastructure.

CNE COMISIÓN NACIONAL DE ENERGÍA

RAILWAYS
Russian rail operator **Novotrans** is storing inventory data on a blockchain pertaining to repair requests and rolling stock

ДРУЗЬОВО КОМПАНИЯ HOBOTPAHC

ENTERPRISE
Google is building its own blockchain which will be integrated into its cloud-based services, enabling businesses to store data on it, and to request their own white label version developed by **Alphabet Inc**

Google Alphabet

MUSIC
Arbit is a blockchain-based project led by former Guns N Roses drummer Matt Sorum seeking a fairer way to reward musicians for their creative efforts.

arbit

FISHING
Blockchain technology has been used to provide a transparent record of where fish was caught, as a means of ensuring it was legally landed.

THE INTERNET OF BLOCKCHAIN FOUNDATION

Johnnatan Messias

50+ BLOCKCHAIN
REAL WORLD USES CASES

GOVERNMENT
Essentia develops world's first blockchain solution to manage international logistics hub together with Traffic Labs and the Finnish Government

essentia.one

IDENTIFICATION
Voter registration is being facilitated via a blockchain project in Switzerland spearheaded by **Uport**.

uport

MOBILE PAYMENTS
The blockchain ledger that **Ripple** uses has been latched onto by a group of Japanese banks, who will be using it for quick mobile payments.

ripple

INSURANCE
A s... contract-ba... blockchain is be... sed by In... an ...up ...a me... ...g cos... ...easin... ...span...

AIG

ENDANGERED SPECIES PROTECTION
The protection of endangered species is being facilitated via a blockchain project that records the activities of these rare animals.

CARBON OFFSETS
IBM is using the Hyperledger Fabric blockchain in China to monitor carbon offset trading.

IBM
HYPERLEDGER

ENTERPRISE
Ethereum's blockchain can be accessed as a cloud-based service courtesy of **Microsoft Azure.**

Microsoft Azure

BORDER CONTROL
Essentia has devised a border control system that would use blockchain to store passenger data in the Netherlands.

essentia.one

SUPPLY CHAINS
IBM and **Walmart** have ... in Ch... project th... monitor ... safety.

Walmart

...LTH
A number of healthcare systems that store data on the blockchain have been pioneered including **MedRec.**

MEDREC

SHIPPING
Shipping is a natural fit for blockchain, and **Maersk** have been trialling a blockchainbased project within the maritime logistics industry.

MÆRSK

REAL ESTATE
Blockchain is now being used to complete real estate deals, the first of which was conducted in Kiev by **Propy.**

PROPY

ENERGY
Essentia is developing a test project that will help energy suppliers track the distribution of their resources in real time, whilst maintaining data confidentiality.

essentia.one

...D REGISTRY
...d registry titles ... now being stored ... the blockchain in Georgia in a project developed by the **National Agency of Public Registry.**

NATIONAL AGENCY of PUBLIC REGISTRY

COMPUTATION
Digital Currency Group are helping Amazon Web Services examine ways in which the distributed ledger technology can help improve database security.

DIGITAL CURRENCY GROUP

ADVERTISING
New York Interactive Advertising Exchange has been experimen- ting with blockchain as a means of providing an ads marketplace for publishers.

NYIAX

BORDER CONTROL
Essentia is developing a blockchain project for border control that will allow customs agents to record passenger data from an array of inputs and safely store it.

essentia

JOURNALISM
Decentralized journalism, as enabled by blockchain technology, has the potential to prevent censorship and increase transparency, as **Civil** has shown.

CIVIL

WASTE MANAGEMENT
Waltonchain is using **RFID** technology to store waste management data on the blockchain in China.

ENERGY
Food importation is another industry where blockchain is proving its worth, with **Louis Dreyfus Co** trialling a soybean importation operation using this technology.

LDC Louis Dreyfus Company

DIAMONDS
The **De Beers Group** is using blockchain to track the importation and sale of diamonds.

De Beers

...E ART
...toring ...rtificates ...authenticity o... blockchain, it's possible to dramati- cally reduce art forgeries, as one blockchain project is proving.

NATIONAL SECURITY
For the past two years, the **US Department of Homeland Security** has been using blockchain to record and safely store data captured from its security cameras.

TOURISM
In a bid to boost its tourism economy, **Hawaii** is examining ways in which blockchain-based cryptocurrencies can be adopted throughout the US state.

TAXATION
In China, a tax-based initiative is using blockchain to store tax records and electronic invoices led by **Miaocai Network.**

ENERGY
Chile's National Energy Commission has started using blockchain technology as a way of certifying data pertaining to the country's energy usage as it seeks to update its electrical infrastructure.

CNE COMISIÓN NACIONAL DE ENERGÍA

RAILWAYS
Russian rail operator **Novotrans** is storing inventory data on a blockchain pertaining to repair requests and rolling stock

НОВОТРАНС

ENTERPRISE
...Google ...build... ...d... ...ain... ...which will be ...into cloud-based services, enabling businesses to store data on it, and to request their own white label version developed by **Alphabet Inc**

Google Alphabet

MUSIC
Arbit is a blockchain-based project led by former Guns N Roses drummer Matt Sorum seeking a fairer way to reward musicians for their creative efforts.

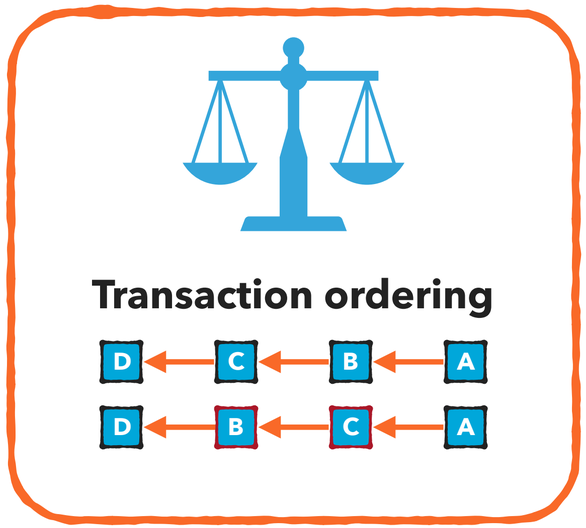
arbit

FISHING
Blockchain technology has been used to provide a transparent record of where fish was caught, as a means of ensuring it was legally landed.

What Can Go Wrong?

Anything that can go wrong will go wrong!

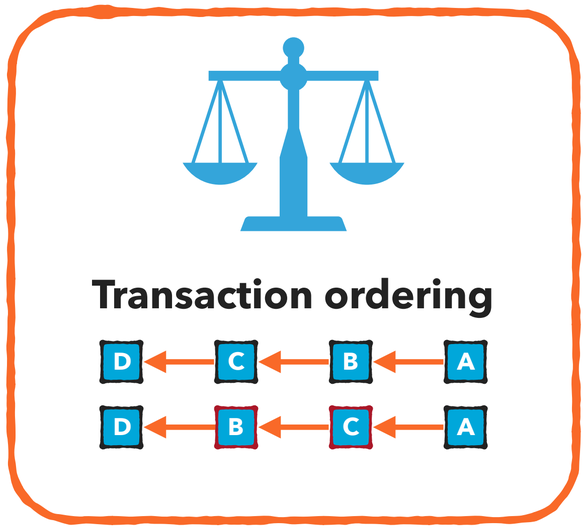
Fairness Concerns



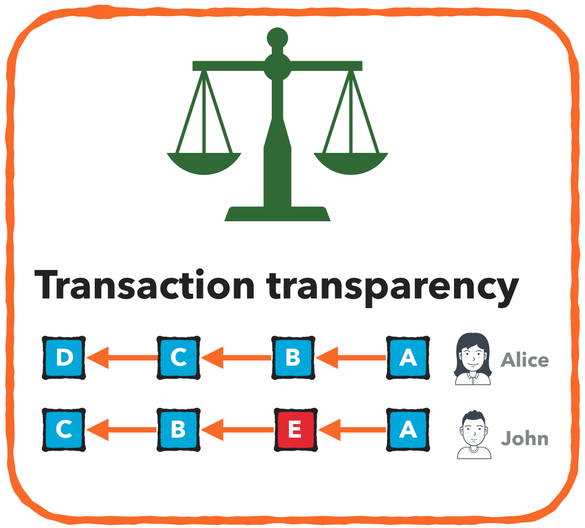
IMC 2021

- How do miners select transactions for inclusion in a block once they enter the miners' Mempool?
- In what order do miners include transactions within a block?
- Has there been collusion among miners to prioritize transaction inclusion?
- How do we know that the ordering is fair?

Fairness Concerns



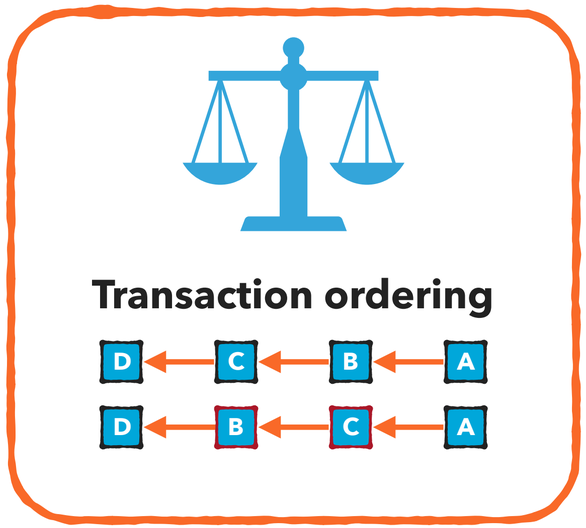
IMC 2021



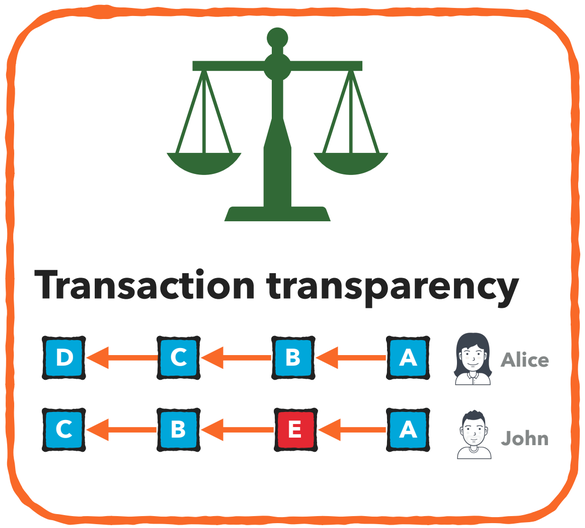
FC 2023

- Which transactions are allowed or transmitted over the public P2P network?
- Does everyone have the same view of available transactions?
- Are private transactions preferentially treated by miners?
- To what extent do transaction bundling practices occur using private relays?

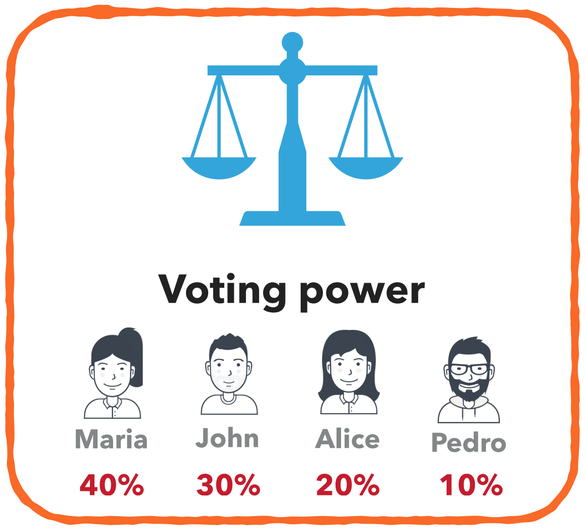
Fairness Concerns



IMC 2021



FC 2023



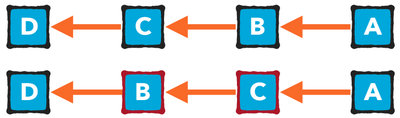
IMC 2024

Targeting

- What is the distribution of Compound tokens among its participants?
- How small or large is the set of voters who determine the outcomes for the amendments?
- What is the cost associated with casting a vote in the Compound protocol?

Fairness Concerns

Transaction ordering



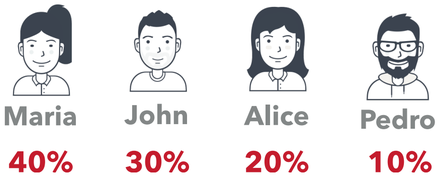
IMC 2021

For details, refer to our paper and thesis

Transaction transparency

FC 2023

Voting power



IMC 2024

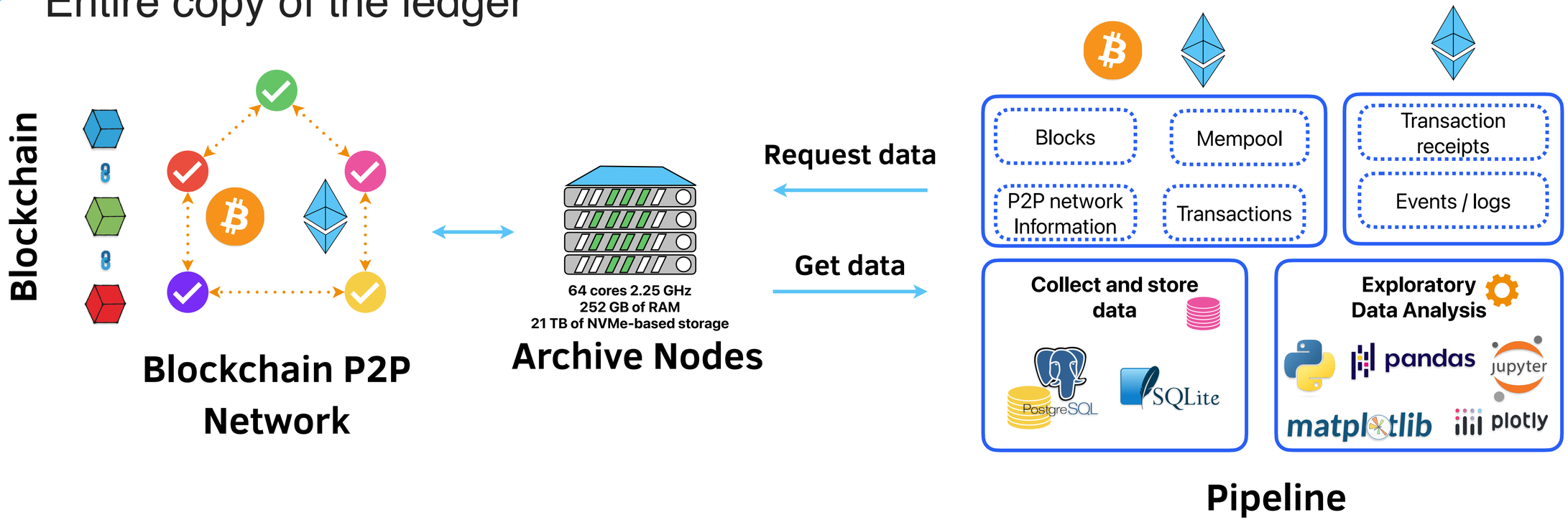
Targeting

Data Set

Publicly available does not mean easily accessible!

Data Publicly Available, but Accessible?

- We deployed Archive nodes
  - Bitcoin and Ethereum
  - Entire copy of the ledger



Data Collection: Blockchain

Category	Bitcoin	Ethereum
Time period	Jan. 1st 2018 to Dec. 31st 2020	Sep. 8th 2021 to Jun. 30th 2022
# of blocks	161,954	1,867,000
Block number	501,951 to 663,904	13,183,000 to 15,049,999
# of transactions	313,575,387	347,629,393

Mempool data

17,300,576 transactions in 7639 blocks

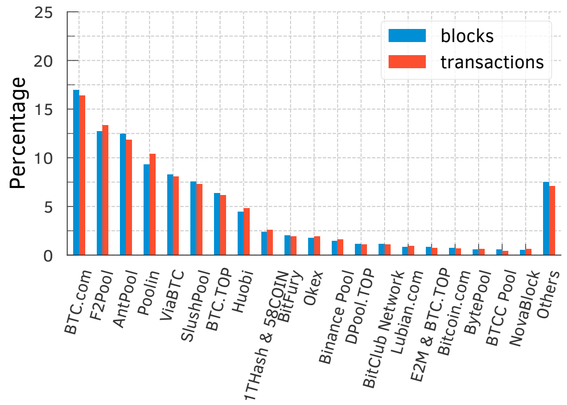
2 months of data

Flashbots data set

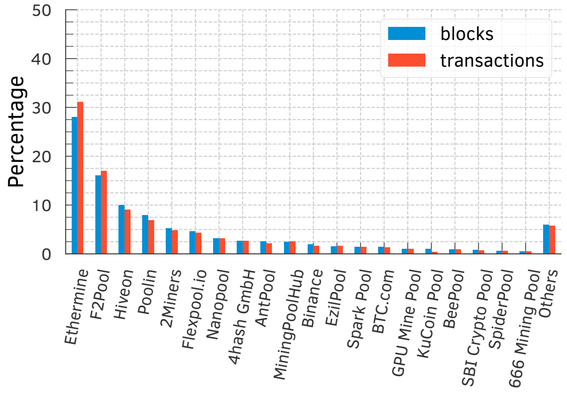
6,937,292 transactions

in **3,284,886 bundles**

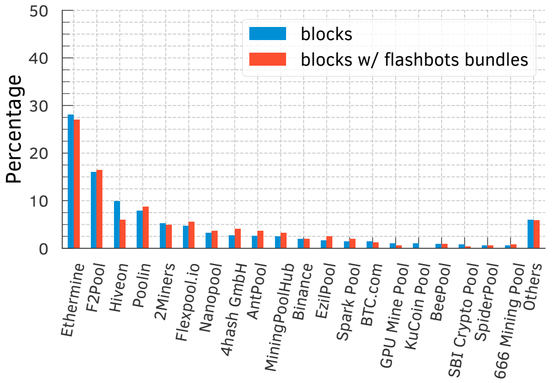
Bitcoin



Ethereum

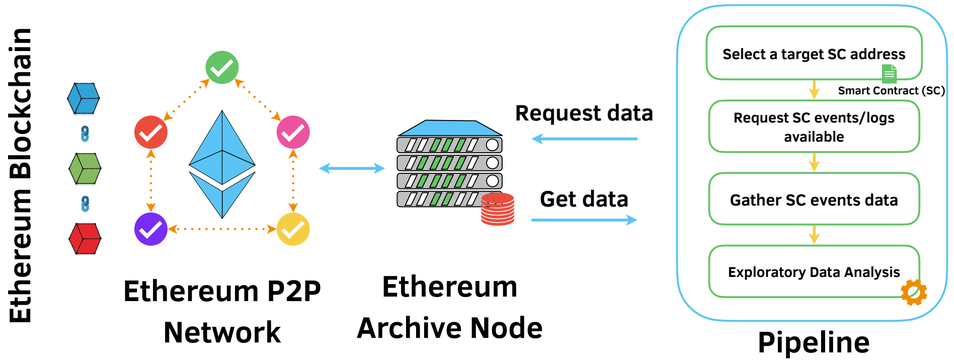


Flashbots bundles



Data Collection: Governance

Pipeline



Etherscan sybil Compound

- Gathered all Compound data up to Nov. 7, 2022
- Inferred wallet addresses ownership

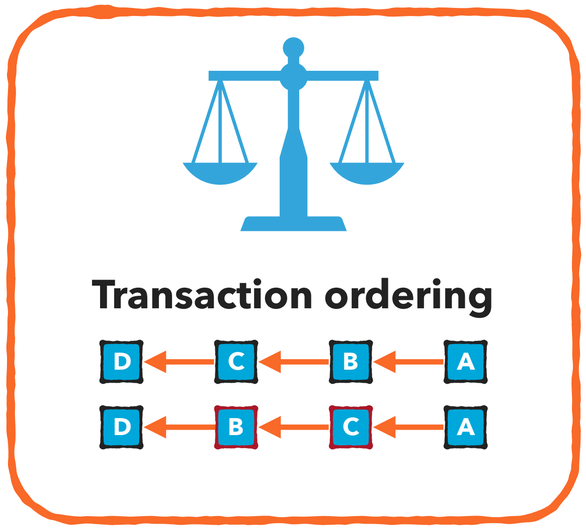
Compound (COMP) token events

Event name	# of events	Description
Approval	213,220	Standard ERC-20 approval event.
DelegateChanged	12,095	Emitted when an account changes its delegate.
DelegateVotesChanged	75,820	Emitted when a delegate account's vote balance changes.
Transfer	1,886,618	Emitted when users/holders transfer their tokens to another address.

Compound Governor events

Event name	# of events	Description
ProposalCanceled	17	Emitted when a proposal is canceled.
ProposalCreated	133	Emitted when a new proposal is created.
ProposalExecuted	101	Emitted when a proposal is executed in the TimeLock.
ProposalQueued	105	Emitted when a proposal is added to the queue in the TimeLock.
VoteCast	9500	Emitted when a vote is cast on a proposal: 0 for against, 1 for in-favor, and 2 for abstain.

Fairness Concerns



IMC 2021

FC 2023

IMC 2024

- How do miners select transactions for inclusion in a block once they enter the miners' Mempool?
- In what order do miners include transactions within a block?
- Has there been collusion among miners to prioritize transaction inclusion?
- How do we know that the ordering is fair?

There Are Three Social Conventions Everyone Assumes Are Followed

- Which transactions are allowed or transmitted over the P2P network?
  - **Social Convention 1:** Fee-rate threshold for excluding transactions

- Once they get into the Mempool, how are miners selecting them?
  - **Social Convention 2:** Fee-rate based selection when mining new blocks

- Once miners selected these transactions, in what order do they get included within a block?
  - **Social Convention 3:** Fee-rate based ordering within blocks

Analyzing Social Conventions Adherence

Analyzing Social Conventions Adherence

- **Social Convention 1:** Fee-rate threshold for excluding transactions
  - Bitcoin nodes filter out transactions with a fee-rate of less than 1 sat/byte.
    - But our node received in total 1084 low fee-rate transactions

- **Social Convention 2:** Fee-rate based selection when mining new blocks.
  - A non-trivial fraction of transactions pairs **violates** the social convention across all snapshots, clearly indicating that miners do not adhere to the social convention

- **Social Convention 3:** Fee-rate based ordering within blocks
  - Position Prediction Error (**PPE**): The mean PPE is **2.65%**. **20%** of all blocks have PPE higher than **4%**
  - Signed Position Prediction Error (**SPPE**) to measure acceleration and deceleration

Lower is better

Analyzing Social Conventions Adherence

- **Social Convention 1:** Fee-rate threshold for excluding transactions
  - Bitcoin nodes filter out transactions with a fee-rate of less than 1 sat/byte.
    - But our node received in total 1084 low fee-rate transactions

- **Social Conv**[illegible]cks.
  - A non-trivi[illegible]tion across all snapshots[illegible] convention

Some Social Conventions are largely followed, but sometimes are violated!

- **Social Convention 3:** Fee-rate based ordering within blocks
  - Position Prediction Error (**PPE**): The mean PPE is **2.65%**. **20%** of all blocks have PPE higher than **4%**
  - Signed Position Prediction Error (**SPPE**) to measure acceleration and deceleration

Lower is better

Investigating Social Convention Violations

Investigating Social Conventions Violations: Results

- Self-interest transactions
  - Identified MPOs wallets
  - MPOs **prioritize** their **own** transactions and **other** MPOs **transactions**

- Dark-fees transactions
  - We confirm that a large fraction have been **accelerated** via side-channel payments BTC.com | ACTIVE EXPERIMENT

SPPE ≥	*# transactions*	*# acc. transactions*	*% acc. transactions*
100 %	628	464	73.89
99 %	1108	720	**64.98**
90 %	5365	972	18.12
50 %	95,282	1007	1.06
1 %	657,423	1029	0.16

Investigating Social Conventions Violations: Results

- Self-interest transactions
  - Identified MPOs wallets
  - MPOs **prioritize** their **own** transactions and **other** MPOs **transactions**

- Dark-fees transactions
  - We confirm that a large fraction have been **accelerated** via side-channel payments

- Scam payment transactions
  - We did not observe any acceleration or deceleration

SPPE ≥	*# transactions*	*# acc. transactions*	*% acc. transactions*
100 %	628	464	73.89
99 %	1108	720	**64.98**
90 %	5365	972	18.12
50 %	95,282	1007	1.06
1 %	657,423	1029	0.16

BTC.com

Active Dark-Fee Experiment

- We took 10 snapshots of our Mempool during periods of high congestion
- We randomly selected only low-fee rate transactions with a size of 101 bytes for accelerating using ViaBTC transactions accelerator services
  - 212 in total transactions

- We paid ViaBTC 205 € to accelerate the 10 low fee rate transactions

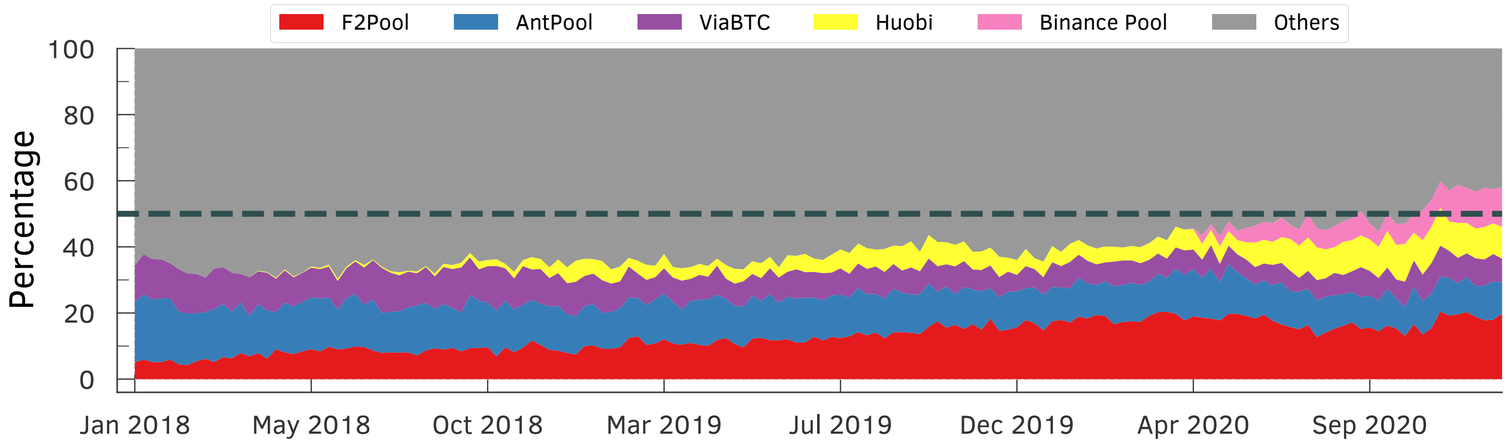
Metrics	Delay in # of blocks		Perc. Position in a block	
	Acc.	Non-acc.	Acc.	Non-acc.
Minimum	1	9	0.07	17.47
25-perc	1	148	0.08	75.88
Median	2	191	0.09	87.92
75-perc	2	247	0.20	95.00
Maximum	3	326	4.39	99.95
Average	1.8	198.5	0.79	84.46

Bitcoin Dark-Fees Transactions

- These transactions were accelerated by 5 MPOs

f2pool ANTPOOL BINANCE Huobi ViaBTC

Mining Pool	Hash-rate		
	Last 24h	Last week	Last month
F2Pool	19.9 %	18.7 %	19.9 %
AntPool	12.5 %	10.6 %	10.2 %
Binance	9.6 %	10.3 %	10.0 %
Huobi	8.1 %	9.3 %	9.8 %
ViaBTC	5.1 %	7.1 %	7.7 %
Total	55.2 %	56 %	57.6 %

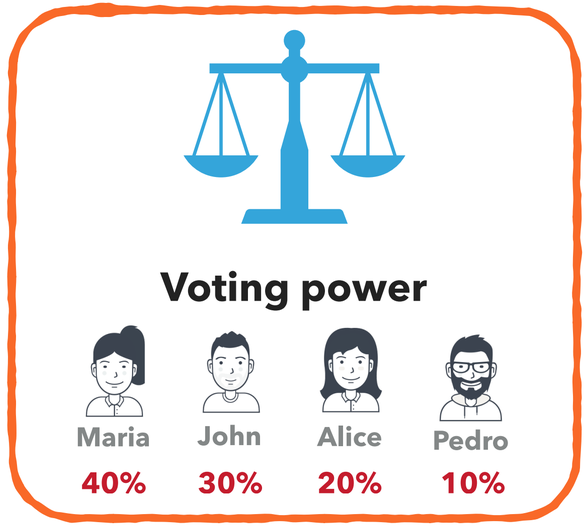


Mining pools with combined hash rates of over 50% were colluding to include these transactions!

Fairness Concerns

IMC 2021

FC 2023



IMC 2024

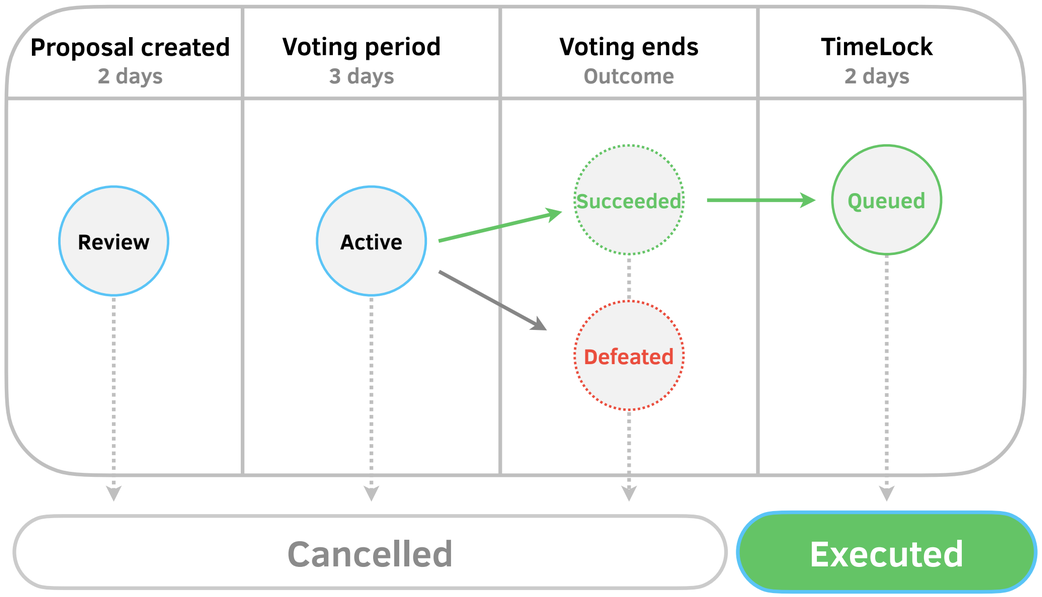
- What is the distribution of Compound tokens among its participants?
- How small or large is the set of voters who determine the outcomes for the amendments?
- What is the cost associated with casting a vote in the Compound protocol?

Decentralized Governance

- It is a smart contract that defines how to amend applications on the blockchain
- The security of the code is absolute paramount!
- What does a governance protocol do?
  - Defines a set of rules to amend smart contracts
  - Periodically people need to change these smart contracts
- Voting power is distributed to participants through tokens
  - Typically, one token equals one vote!
- On-chain voting mechanism!
  - **You pay transaction fees to vote!**

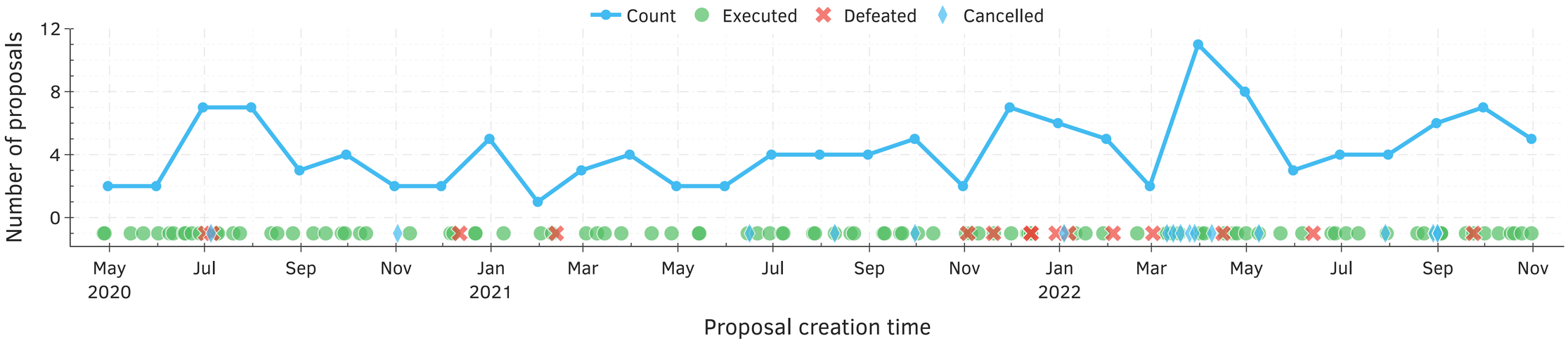
Compound Protocol

- Decentralized lending platform
- It uses the Compound Governor Bravo as their governance protocol
- Proposals lifecycle typically lasts for 7 days



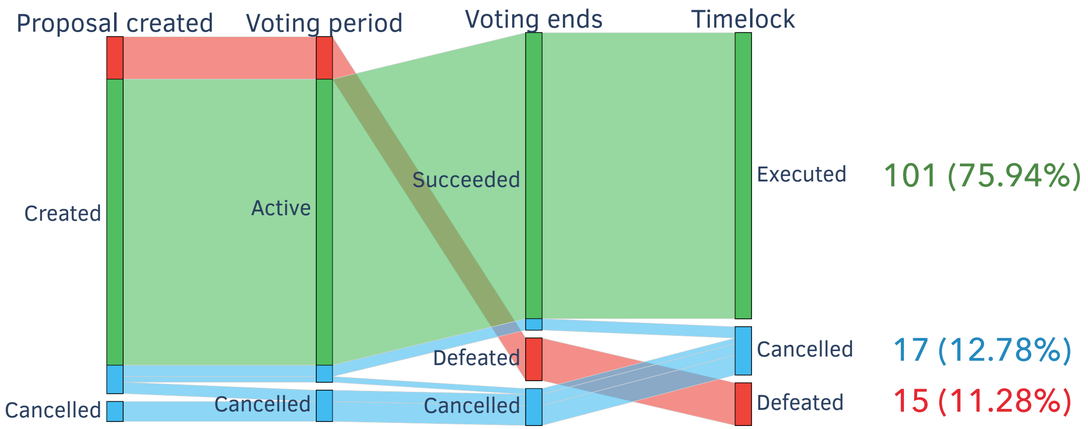
How Frequently Are Amendments Proposed and Voted?

- Compound contract is being actively amended. 1 proposal every 7 days on average



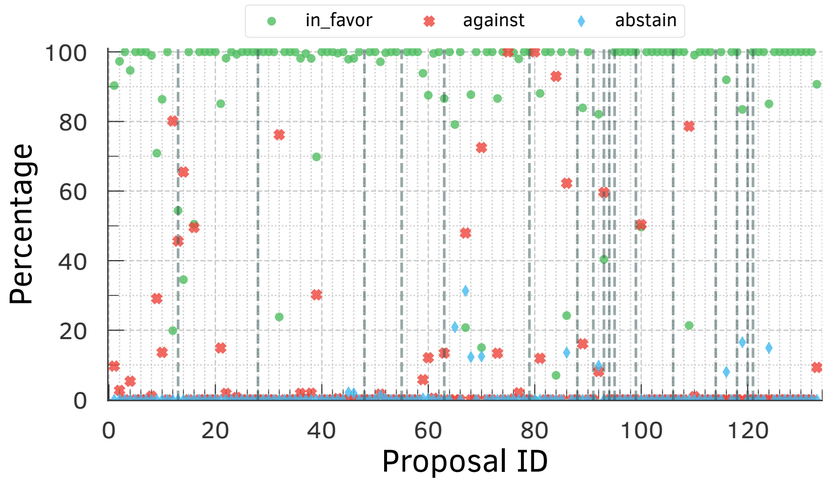
How Frequently Are Amendments Proposed and Voted?

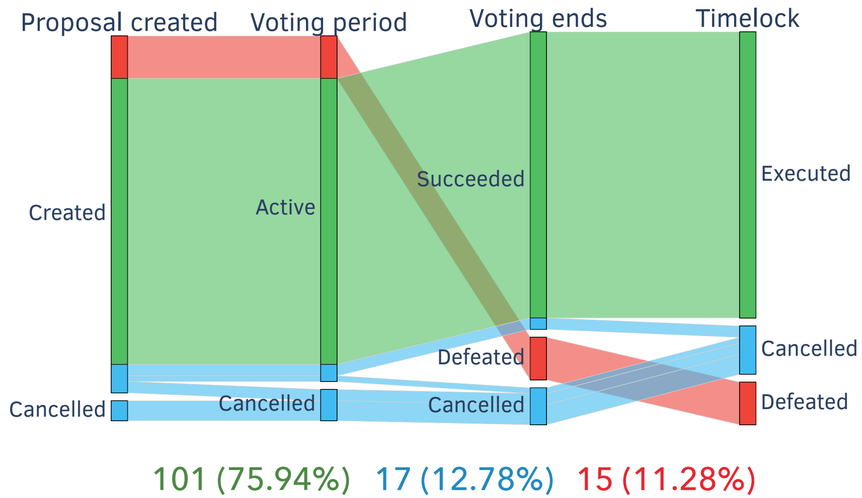
- Compound contract is being actively amended. 1 proposal every 7 days on average
- Most of the proposals are successfully executed



How Frequently Are Amendments Proposed and Voted?

- Compound contract is being actively amended. 1 proposal every 7 days on average
- Most of the proposals are successfully executed
- The majority of the proposals receive significant support
  - 89.39% of votes are in favor on average

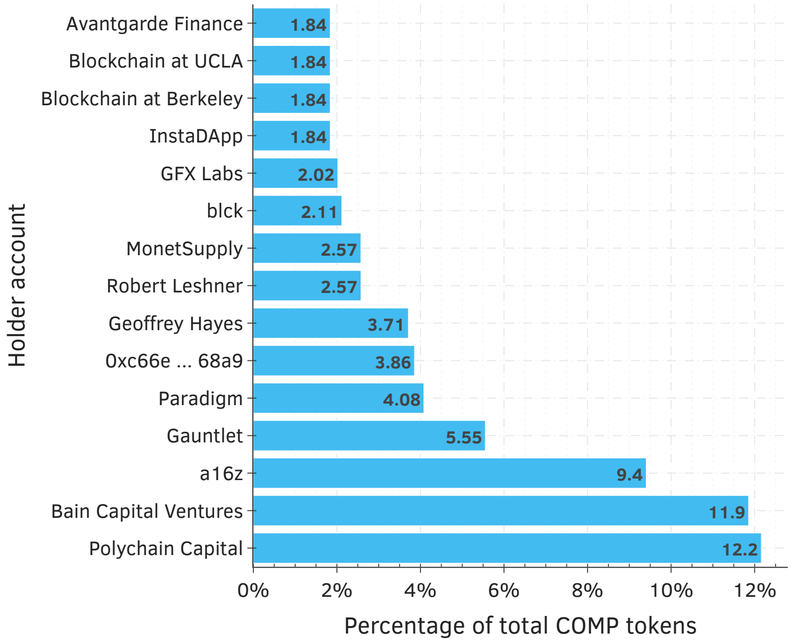




What Is the Distribution of Voting Power?

- The voting power is highly concentrated with 10 out of 4186 accounts controlling 57.86% of all voting power

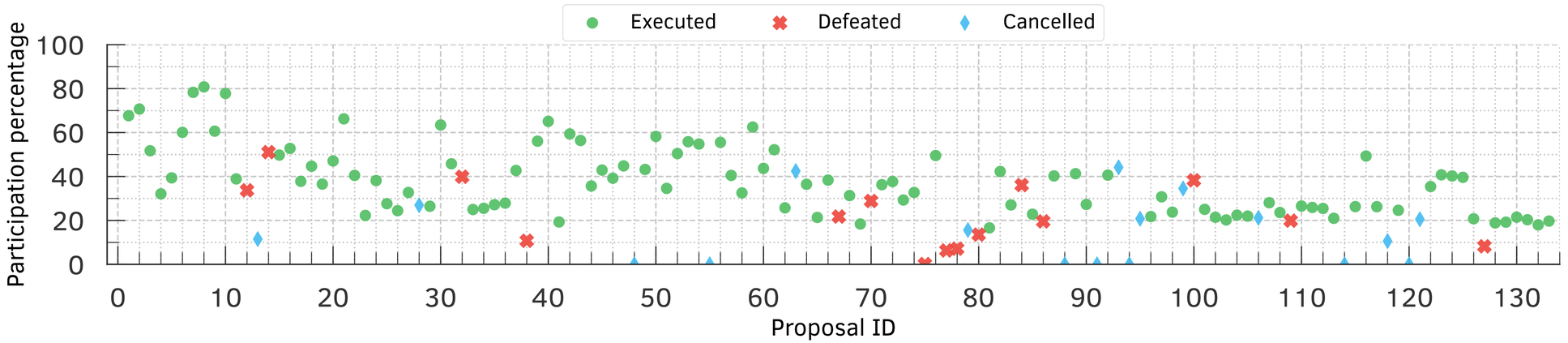
- On average **2.84 voters were needed to obtain at least 50% of the votes**



Top 15 accounts **control 63.56%** of the total voting power

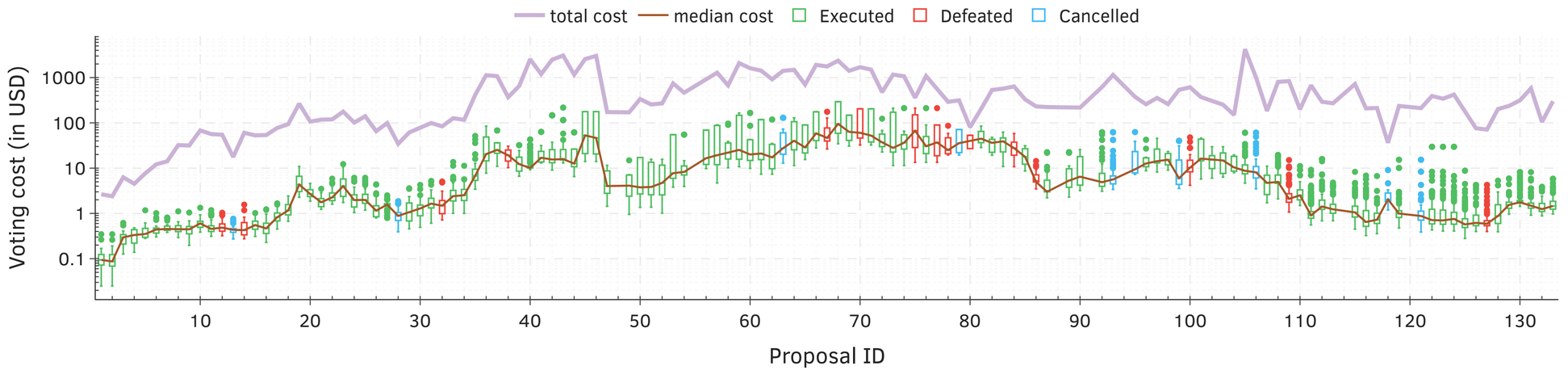
Voting Participation & Cost

- Voter turnout is, on average, 33.25%
- On average, proposals were voted by 71 voters



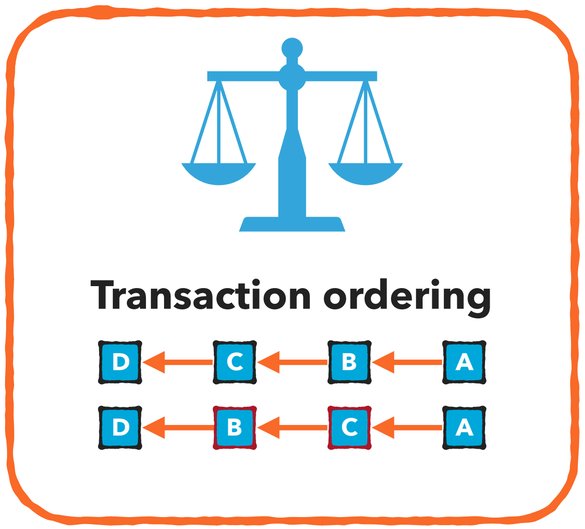
Voting Participation & Cost

- Voter turnout is, on average, 33.25%
- On average, proposals were voted by 71 voters
- Casting a vote can be highly costly! $0.03 to $294.02, with an average of $7.88
  - Cost per vote unit is on average $358.54



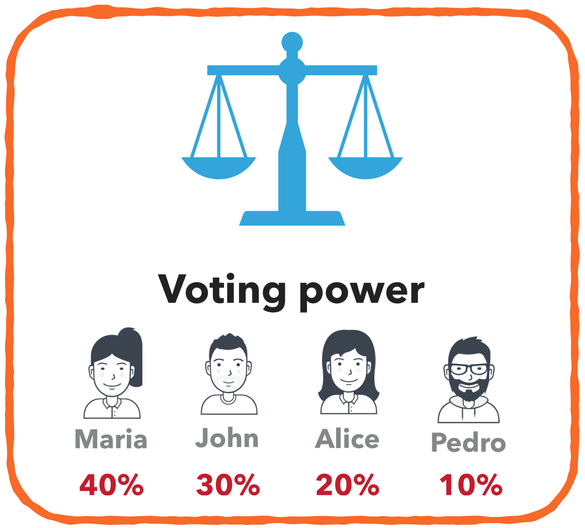
Conclusion

Conclusion



- **Transaction ordering is an important** topic to be considered!
- There are three social conventions that everyone assumes are followed
  - Our study shows **there are violations on all three**
- We expose some possible reasons behind them:
  - **Selfish prioritization**
  - **Non-transparent dark-fees payments**
- Through active experiments
  - **MPOs with over 50% of the hash rate collude** when accelerating transactions

Conclusion



IMC 2024

- **Users actively vote on proposals:** 89.39% in favor, on average
- **Voting costs vary significantly:** from $0.03 to $294.02, disadvantaging small token holders with an average cost of $7.88 per vote
  - Normalized costs per vote unit reveal an average of $358.54, posing fairness concerns
- **Voting power is concentrated**
  - 10 voters holding 57.86% and 44.72% of all tokens for Compound and Uniswap, respectively.
  - On average, proposals only required 2.84 voters to pass.
- **Powerful voters potentially form coalitions**
  - It raises concerns about voting concentration.

Papers

Publications Used in This Thesis 

- ArXiv (targeting IMC 2024) — Understanding Blockchain Governance: Analyzing Decentralized Voting to Amend DeFi Smart Contracts. **J. Messias**, V. Pahari, B. Chandrasekaran, K. P. Gummadi, and P. Loiseau.

- FC 2023 — Dissecting Bitcoin and Ethereum Transactions: On the Lack of Transaction Contention and Prioritization Transparency in Blockchains. **J. Messias**, V. Pahari, B. Chandrasekaran, K. P. Gummadi, and P. Loiseau.

- IMC 2021 — Selfish & Opaque Transaction Ordering in the Bitcoin Blockchain: The Case for Chain Neutrality. **J. Messias**, M. Alzayat, B. Chandrasekaran, K. P. Gummadi, P. Loiseau, and A. Mislove.

- Workshop (KDD-SDBD 2020) — On Blockchain Commit Times: An analysis of how miners choose Bitcoin transactions. **J. Messias**, M. Alzayat, B. Chandrasekaran, and K. P. Gummadi.

Ongoing Works on Blockchains

- ArXiv 2024 (targeting AFT 2024): Airdrops: Giving money away is harder than it seems. **J. Messias**, A. Yaish, B. Livshits.

- ArXiv 2024 (targeting AFT 2024): The Writing is on the Wall: Analyzing the Boom of Inscriptions and its Impact on Rollup Performance and Cost Efficiency. K. Gogol, **J. Messias**, M.I. Silva, and B. Livshits.

- ArXiv 2024 (targeting FC 2025)— Quantifying Arbitrage in Automated Market Makers: An Empirical Study of Ethereum ZK Rollups. K. Gogol, **J. Messias**, D. Miori, C. Tessone, and B. Livshits.

- Marble 2024 — Liquid Staking Tokens in Automated Market Makers. K. Gogol, R. Fritsch, **J. Messias**, M. Malte, B. Kraner, and C. Tessone.

- Marble 2024 — On the Determinants of Price Convergence between CEXs and Layer-2 Blockchain AMMs. K. Gogol, **J. Messias**, D. Miori, B. Livshits, and C. Tessone.

- CfC St. Moritz 2024 — Cross-border Exchange of CBDCs using Layer-2 Blockchain. K. Gogol, **J. Messias**, M. Schlosser, B. Kraner, and C. Tessone.

Additional Publications While at MPI-SWS

- ArXiv 2021— Modeling Coordinated vs. P2P Mining: An Analysis of Inefficiency and Inequality in Proof-of-Work Blockchains. M. Alzayat, **J. Messias**, B. Chandrasekaran, K. P. Gummadi, and P. Loiseau.

- WWW 2019 —(Mis)Information Dissemination in WhatsApp: Gathering, Analyzing and Countermeasures. G. Resende, P. Melo, H. Sousa, **J. Messias**, M. Vasconcelos, J. Almeida, and F. Benevenuto.

- Workshop ICWSM 2019 — WhatsApp Monitor: A Fact-Checking System for WhatsApp. P. Melo, **J. Messias**, G. Resende, K. Garimella, J. Almeida, and F. Benevenuto.

- Information Retrieval Journal 2019 — Search Bias Quantification: Investigating Political Bias in Social Media and Web Search. J. Kulshrestha, M. Eslami, **J. Messias**, M. B. Zafar, S. Ghosh, K. P. Gummadi, and K. Karahalios.

- FAT* 2019 — On Microtargeting Socially Divisive Ads: A Case Study of Russia-Linked Ad Campaigns on Facebook. F. N. Ribeiro, K. Saha, M. Babaei, L. Henrique, **J. Messias**, F. Benevenuto, O. Goga, K. P. Gummadi, and E. M. Redmiles.

Main Collaborators

Krishna P. Gummadi

Balakrishnan Chandrasekaran

Patrick Loiseau

Vabuk Pahari

Alan Mislove

Mohamed Alzayat

Fabrício Benevenuto

Jussara M. Almeida

Ben Livshits

Aviv Yashi

Krzysztof Gogol

Among others...

MAX PLANCK INSTITUTE FOR SOFTWARE SYSTEMS

UNIVERSITÄT DES SAARLANDES

VU VRIJE UNIVERSITEIT AMSTERDAM

Inria

UGA Université Grenoble Alpes

Northeastern University

University of Zurich[UZH]

UFMG

Matter Labs

האוניברסיטה העברית בירושלים
THE HEBREW UNIVERSITY OF JERUSALEM

Imperial College London

On Fairness Concerns in the Blockchain Ecosystem

Johnnatan Messias

@johnnatan_me

Thesis defense

April 25, 2024 – Saarbrücken, Germany

MAX PLANCK INSTITUTE
FOR SOFTWARE SYSTEMS

UNIVERSITÄT
DES
SAARLANDES