Project Liberty Institute // BlockchainGov

Interim Report on Blockchain Governance Practices

Multistakeholder Initiative:
Towards Best Practices for a Responsible Decentralized Technical Governance Ecosystem

BLOCKCHAINGOV

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Impressum

This report is jointly produced by Project Liberty Institute and BlockchainGov.

About Project Liberty Institute:

Project Liberty is an international impact organization mobilizing a global alliance of technologists, academics, policymakers and citizens to design a more responsible approach to technology development, including a more open internet infrastructure. Project Liberty Institute is an independent, non-partisan organization founded in 2021 with three academic partners Stanford University, Sciences Po and Georgetown University. Project Liberty Institute's mission is to enhance ethical governance by supporting timely, actionable research on digital technology and responsible innovation. The Institute serves as an international meeting ground for technologists, policymakers, academia, civil society, entrepreneurs and governance experts. Together, these interdisciplinary partners and leaders from the public and private sector create frameworks for how we design, invest in, deploy and govern new technologies.

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About BlockchainGov:

BlockchainGov is a 5-year project (2021-2026) funded by the European Research Council (ERC grant of €2M). The project is directed by Primavera De Filippi and hosted at the Centre National de Recherche Scientifique (France) and the European University Institute (Italy), with Principal Investigator and advisors from the Berkman Klein Center at Harvard University. As an interdisciplinary research team comprising legal scholars, social and political scientists, computer scientists, and blockchain engineers, BlockchainGov focuses on studying the impact of blockchain technology on governance and its consequences for legitimacy and trust.

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This report has been developed with the help of the Governance Multistakeholder Council (MSH Council).
The views expressed in this report do not reflect the views of the organizations with which Council members are affiliated.
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Executive summary

First devised as an innovative means to ledger transactions, blockchains and smart contracts running on them, have brought about a foundational shift in decision-making systems where central authorities are no longer needed to facilitate interactions. The adoption of public and permissionless blockchains, such as Bitcoin and Ethereum, has extended to domains including finance, trading, gaming, art, supply chain management, and identity verification, heralding an era where disintermediation, censorship resistance, transparency, and immutability are touted as essential features of a technological infrastructure. The evolution of blockchain technology and the novel applications built on it has been influenced by decisions made by individuals and organizations. Together, they form what we refer to as "blockchain systems," or techno-social constructs operating at multiple overlapping layers. If blockchain systems are to remain sustainable and resilient, understanding how they are governed and how their governance practices may impact perceptions of legitimacy, trust, and confidence is crucial.

This report represents a joint effort by the Project Liberty Institute and BlockchainGov to explore the governance dynamics of prominent blockchain networks using an interdisciplinary and comparative approach. It delves into 11 major blockchain networks, namely Avalanche, Bitcoin, Cardano, Cosmos, Ethereum, Filecoin, Optimism, Polygon, Polkadot, Tezos, and Zcash, examining them through a comprehensive governance framework. The findings of this analysis are presented across six interrelated domains, offering valuable insights into the governance dynamics of these blockchain systems.

Legal Entities

Except for Bitcoin, most of the blockchain networks we have studied have established legal entities such as non-profit foundations or private companies to manage off-chain interactions and support ecosystem growth. These entities generally hold large amounts of cryptocurrencies (i.e., digital currencies operating on blockchain networks), granting them significant influence and control over network governance. A key concern is the need for more open and transparent processes for appointing and holding the boards of these legal entities accountable for their actions. This opacity must be considered against the open and permissionless nature of public blockchain networks, raising issues about potential conflicts of interest and information asymmetries.

Power Distribution

Blockchain systems, though technically decentralized, involve multiple layers of governance. Understanding the power dynamics of these systems requires uncovering who truly influences governance decisions and how. This means examining the multiple types of governance areas or decisions that are being made, identifying the key stakeholders involved in making these decisions, and exploring the specific governance mechanisms utilized in each case. Such an examination is crucial for blockchain communities to implement more inclusive and representative governance structures aligned with their values and priorities.

Planned vs. Actual Decentralization

Many blockchain communities purport to maintain or increase decentralization over time in terms of the number of nodes maintaining the blockchain network (i.e., "technical decentralization") and/or the individuals and organizations making governance decisions (i.e., "political decentralization"). Yet, a precise definition of "decentralization," tailored to specific blockchain contexts, is essential for implementing these objectives. Maintaining or increasing decentralization is also challenged by on-chain and off-chain dynamics. At the on-chain level, these dynamics include the concentration of power in mining or validator pools and individuals with large amounts of tokens voting on-chain. At the off-chain level, the tacit need for technical knowledge, the complexity of existing governance documentation, and the persistent founders' influence can also stand in the way of effective decentralization. Recognizing and tackling these factors is crucial for achieving meaningful decentralization in blockchain networks.

Governance Formalization

Blockchain governance is defined through a combination of on-chain rules (i.e., blockchain protocols and smart contracts code) and off-chain practices (e.g., social norms and procedures adopted by the blockchain community members). Blockchain communities must recognize the intricate relationship between on-chain rules and off-chain practices, acknowledging that not everything can be fully codified on-chain. The formalization of off-chain practices creates an opportunity for blockchain communities to increase the transparency and accountability of off-chain governance, thereby enhancing the legitimacy of blockchain systems. Yet, while many blockchain communities have shared written documents outlining the rules and procedures for creating, amending, and repealing governance rules, there remains a significant gap between these formalized documents and the implicit, often undocumented practices of blockchain systems.

Governance Mechanisms

Blockchain governance relies on various mechanisms as key components of the governance process. "Rough consensus" and "signaling and voting" are two predominant mechanisms that can be used alone or combined to create a variety of diverse decision-making frameworks. Based on the context in which they are implemented, including the nature of the decisions made and the nature and scope of the decision-makers, these different frameworks present distinct trade-offs, which are crucial in shaping the community's perception of the legitimacy of the governance process.

Security Measures and Breaches

In many blockchain systems, handling security breaches often necessitates exceptional interventions. Contrarily to governance processes implemented in more "standard" governance areas, these interventions frequently involve sudden and less publicized courses of action with founders, security teams, and core developers assuming an important degree of decision-making power. The handling of unexpected security breaches has raised some controversies within members blockchain communities. For this reason, it is important to ensure that exceptional procedures for security maintenance are balanced and proportional and that they are not lenient to political manipulation.

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Methodology

This report was produced jointly by Project Liberty Institute and BlockchainGov. It aims to provide a rigorous and granular framework for understanding how governance decisions are made and adopted within the rapidly evolving Web3 ecosystem while helping foster a sustainable and responsible ecosystem for decentralized technologies, ensuring that the benefits of Web3 are accessible to all while minimizing potential risks and challenges.

This publication lays the foundation of a Manual on Best Governance Practices for Blockchain and Decentralized Technologies which will highlight recommendations to build a more responsible ecosystem. This manual will be published in April 2024.

The Project Liberty Institute and BlockchainGov teams express their gratitude to the fifteen experts forming the Governance Multistakeholder Council for their valuable contributions to our work. Their feedback during this iterative process has been instrumental in shaping the qualitative outcomes that can now be showcased publicly.

Introduction

Originally coined in 2014 by Ethereum co-founder and Polkadot creator Gavin Wood, 'Web3' refers to a novel iteration of the original World Wide Web. After Web 1.0, which has come to be regarded as the "read-only" web, and Web 2.0, which introduced a new layer of interactivity and participation with the possibility for users to both "read" and "write" on the web, came Web3, which introduced a new layer of "ownership" on the web. The main distinction between Web 2.0 and Web3 is that the latter is characterized by decentralized peer-to-peer infrastructures, which are owned and governed by their users, as opposed to centralized operators and/or trusted intermediaries, also leveraging novel technological systems enabling users to reclaim ownership over their data and digital assets.

One technology enabling users to reclaim ownership over their data and digital assets is blockchain. First devised as an innovative means to ledger transactions, blockchains, and smart contracts running on them as self-executing pieces of software, have brought about a foundational shift in decision-making systems where central authorities are no longer needed to facilitate interactions. The adoption of public and permissionless blockchains, such as Bitcoin and Ethereum, has extended to domains including finance, trading, gaming, art, supply chain management, and identity verification, heralding an era where disintermediation, censorship resistance, transparency, and immutability are touted as essential features of a technological infrastructure. The evolution of blockchain technology and the novel applications built on it has been influenced by decisions made by individuals and organizations. Together, they form what we refer to as "blockchain systems," or techno-social constructs operating at multiple overlapping layers. If blockchain systems are to remain sustainable and resilient, understanding how they are governed and how their governance practices may impact perceptions of legitimacy, trust, and confidence is crucial.

This report represents a joint effort by the Project Liberty's Institute and BlockchainGov to explore the governance dynamics of prominent blockchain networks using an interdisciplinary and comparative approach. The question that has guided our inquiry is: **What are the governance dynamics underpinning existing blockchain networks?** In pursuing this research effort, we understand "governance" as a process by which diverging—and sometimes conflicting—interests between multiple actors are accommodated, and collective action is taken based on shared principles and agreed-upon procedures. Our analysis of how these processes unfold in the governance of blockchain systems is based on our previous work,[3] as well as other relevant academic, scholarship, and practitioner literature that grasps the historical and ideological,[4] social and technical,[5] on-chain and off-chain dynamics of blockchain systems.[6] While "decentralization" has been frequently portrayed as the defining feature of this ecosystem, we aim to move beyond the claims that many blockchain communities seek to maximize 'decentralization' and 'consensus' by recognizing and embracing existing practices of 'governance as conflict.'[7] For this report, we adopt a descriptive ('as is') rather than prescriptive ('could be' or 'should be') approach to blockchain governance. However, the findings presented here intend to serve as a basis for future research efforts on best Web3 governance practices..

While acknowledging the plethora of previous empirical research on blockchain governance,[8] this report contributes to the state of the art by introducing a multidisciplinary comparative analysis of a selected set of prominent blockchain networks, including Avalanche, Bitcoin, Cardano, Cosmos, Ethereum, Filecoin, Optimism, Polygon, Polkadot, Tezos, Zcash. These networks have been carefully chosen based on their degree of technological innovation and adoption, the diversity of governance design and operative layers, and the various legal entities related to their associated communities. While many more blockchain networks could have been included in the analysis, we tried to select the most representative sample to illustrate the widest range of governance dynamics that are relevant in the Web3 ecosystem. Data for this report was collected through a combination of desk research of available online documentation and in-depth semi-structured interviews with key stakeholders within each network. This approach ensured a comprehensive understanding of documented procedures and undocumented practices that influence the governance of these blockchain networks.

Based on these data, we crafted a comprehensive governance taxonomy to organize our empirical data collection and analysis. The taxonomy comprises four dimensions that help understand how these systems operate and evolve over time.

/ Firstly, the organizational profile of blockchain systems, including their founding history, purpose, funding mechanisms, legal standing, and market dynamics influencing them. An important aspect refers to which layer of the technological "stack" each case study belongs to. Projects with components of layer 0 blockchains, such as Avalanche, Cosmos, and Polkadot, provide the foundational infrastructure for higher-level blockchains and their potential interoperability. Layer 1 blockchains, such as Bitcoin, Cardano, Ethereum, Filecoin, Tezos, Polygon PoS Chain, and Zcash, are the "main blockchain networks." They comprise the blockchain protocol—or the rules and procedures governing how data is exchanged, verified, and recorded on a blockchain network—and the actual "ledger" of recorded transactions. Finally, layer 2 blockchains offer scaling solutions to improve the efficiency and speed of transactions on layer 1 blockchains. Examples include Optimism and Polygon Rollups.

/ Secondly, governance areas, which comprise secondary rules or "rules on how to make rules," block production, monetary policy, software updates, treasury allocation, policies of rewards to contributors, standards and interoperability, and security measures and breaches.

/ Thirdly, governance frameworks, including rules on entry and exit for decision-makers, power distribution within decision-making groups, governance mechanisms, enforcement processes, participation incentives, internal dispute resolution systems, and "amendability," or the degree to which a governance area can be modified or eliminated.

/ Fourthly, governance surfaces or "the places" where these governance frameworks "exist" which can be split into on-chain or off-chain, written and unwritten.

/ Finally, governance trends, which specify how decision-making has evolved through time within each blockchain system in terms of power distribution (who makes decisions), governance scope (number of governance areas), governance complexation (scale and complexity of governance mechanisms), and governance formalization (the degree to which governance is described in off-chain written documents or embedded in on-chain code)

After conducting empirical data collection and taking stock of existing cross-disciplinary studies on governance, we have compiled six insights on governance dynamics in blockchain networks. While each finding primarily arises from one of the dimensions of the governance taxonomy described above, they should not be read as standalone pieces but rather as interconnected and influenced by one another. The content of the findings is illustrated with examples across all investigated case studies. At the end of each section, we offer a concise reflection on the impact of the findings on blockchain communities and the governance design of blockchain systems. The insights derived from this report will inform the elaboration of a set of best governance practices for blockchain systems, which will constitute the next step of our research.

1 Gavin Wood, "DApps: What Web 3.0 Looks Like," Gavin Wood, April 14, 2014, http://gavwood.com/dappsweb3.html.

2 'Web3' is not to be confused with the terms 'Web 3.0' or 'Semantic Web,' which refers to the enhancement of the World Wide Web via norms established by the World Wide Web Consortium, aimed at rendering internet data comprehensible to machines.

3 For example: Primavera De Filippi et al., "Blockchain Technology, Trust & Confidence: Reinterpreting Trust in a Trustless System?," SSRN Scholarly Paper 4300486, (2022), https://doi.org/10.2139/ssrn.4300486. Primavera De Filippi et al., "Report on Blockchain Technology & Legitimacy," SSRN Scholarly Paper 4300502, (2022), https://doi.org/10.2139/ssrn.4300502. Primavera De Filippi et al., "Blockchain Constitutionalism: The Role of Legitimacy in Polycentric Systems," (2023), https://blockchaingov.eu/wp-content/uploads/2023/11/EUI-Conference-June-2023-FINAL.pdf.

4 Kelsie Nabben, "Cryptoeconomics as governance: an intellectual history from 'Crypto Anarchy' to 'Cryptoeconomics'," Internet Histories 7, no. 3 (2023): 254–276, https://doi.org/10.1080/24701475.2023.2183643.

5 Michael Zargham and Kelsie Nabben, "Aligning 'Decentralized Autonomous Organization' to Precedents in Cybernetics," SSRN Scholarly Paper 4077358, (2022), https://doi.org/10.2139/ssrn.4077358.

6 Primavera De Filippi and Benjamin Loveluck, "The Invisible Politics of Bitcoin: Governance Crisis of a Decentralised Infrastructure," Internet Policy Review 5, no. 3 (2016), https://hal.science/hal-01382007.

7 Jaya Klara Brekke, Kate Beecroft, and Francesca Pick, "The Dissensus Protocol: Governing Differences in Online Peer Communities," Frontiers in Human Dynamics 3 (2021), https://www.frontiersin.org/articles/10.3389/fhumd.2021.641731. Eric Alston, "Governance as Conflict: Constitution of Shared Values Defining Future Margins of Disagreement," MIT Computational Law Report (2022), https://law.mit.edu/pub/governanceasconflict/release/1.

8 See: Rafael Ziolkowski et al., "Examining Gentle Rivalry: Decision-Making in Blockchain Systems," in Proceedings of the 52nd Hawaii International Conference on System Sciences, HICSS 52, edited by Tung Bui, Hawaii, USA, (2019), https://doi.org/10.5167/uzh-160377. Lukas Schädler, Michael Lustenberger, and Florian Spychiger, "Analyzing decision-making in blockchain governance," Frontiers in Blockchain 6 (2023), https://doi.org/10.3389/fbloc.2023.1256651. Rowan van Pelt, Slinger Jansen, Djuri Baars and Sietse Overbeek, "Defining Blockchain Governance: A Framework for Analysis and Comparison," Information Systems Management 38, no. 1 (2020): 21–41, https://doi.org/10.1080/10580530.2020.172004. Kevin Werbach, "The Siren Song: Algorithmic Governance by Blockchain," in After the Digital Tornado: Networks, Algorithms, Humanity, ed. Kevin Werbach (Cambridge: Cambridge University Press, 2020), 215-40.

I. Legal Entities

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“The existence of legal entities does not, in itself, mean that a network is ‘centralized,’ as that legal entity cannot force decisions upon a public, permissionless blockchain network.”

Finding

Most blockchain networks have established legal entities, such as non-profit foundations or corporations, to manage various aspects of their activities and operations. The reasons for establishing such legal entities are to benefit from legal personality when entering into contracts with parties off-chain, navigating regulatory uncertainty, enhancing governance sustainability, and supporting the growth of blockchain ecosystems through, for example, the issuance of grants. In some cases, multiple entities have been formed to perform some of these activities individually. At the same time, Bitcoin is an outlier compared to the other blockchain networks under review as it doesn’t use legal entities to pursue these objectives.

Purpose

Several blockchain networks that were part of this study were initially developed and launched by a small team of founders through a private company (Ava Labs Inc. [Avalanche]; IOHK and EMURGO Group Pte Ltd. [Cardano]; Protocol Labs [Filecoin]; OP Labs [Optimism]; Polygon Labs; Dynamic Ledger Solutions [Tezos]; Electric Coin Company [Zcash]) and/or a foundation (Ethereum Foundation; Interchain Foundation [Cosmos]; Web3 Foundation [Polkadot]; Polygon Foundation; Tezos Foundation; Bootstrap and Zcash Foundation [Zcash]). In conjunction with a private R&D firm, the promotion and growth of blockchain network ecosystems, such as through the management of community treasuries, developing scaling solutions, funding research, community initiatives, grants, and educational efforts, are typically undertaken by non-profit entities (Avalanche Foundation; Cardano Foundation; Ethereum Foundation; Filecoin Foundation; Optimism Foundation; Web3 Foundation [Polkadot]; Polygon Foundation; Tezos Foundation; and Zcash Foundation) and less commonly by a for-profit corporation (Interchain GmbH and All in Bits, Inc. and New Tendermint Inc. [Cosmos]; Parity Technologies Limited [Polkadot]). While the decisions or operations of several of these foundations are ostensibly shaped by community input, ultimate control over these foundations rests in the hands of a board of directors. Bitcoin is an exception in this regard,[9] as its founding and eventual growth were driven by a diffuse community of volunteers and donors, before attracting the support of corporate sponsors, research institutions, and non-governmental organizations for further development and growth.

Location

Many of the foundations are registered in Switzerland because of legal certainty, tax exemptions for foundations that serve philanthropic or public purposes, pragmatic business licensing, and a supportive crypto-startup ecosystem. However, the operations of the blockchain networks are more dispersed, with founders, (core) developers, miners/validators, and other affiliated persons and corporate entities being spread across the globe.

Governance Dynamics

As indicated above, most of the analyzed blockchain networks are supported by both a for-profit corporate entity and a non-profit foundation. In the case of the Polygon network, the relationship between these entities is clearly defined, with the non-profit foundation wholly owning the corporate entity. In other cases, such as the Tezos network, this relationship may be contested, with the founders of Dynamic Ledger Solutions entering into a dispute with a board member of the independent Tezos Foundation.[11] The relationship between these two entities may also become relevant if a fork occurs in the network and a decision has to be made on which chain is authoritative, as in the case of Zcash. This also impacts the trademark that the chain can legally use. In such circumstances, the Electric Coin Company and the Zcash Foundation use a 2-of-2 multi-signature method, whereby the two entities together decide whether to modify/update the protocol or introduce new features before a chain can use the Zcash trademarks. In other words, the trademark agreement acts as a coordinating mechanism in a low-trust environment between two entities.

The existence of legal entities does not, in itself, mean that a network is "centralized," as that legal entity cannot force decisions upon a public, permissionless blockchain network. For example, the Ethereum Foundation may propose a roadmap for transitioning from Proof-of-Work to Proof-of-Stake. However, its effective implementation depends on multiple other stakeholders. Even then, the influence of these legal entities on the blockchain network has been a key concern in blockchain communities as it impacts the qualification of network tokens as (unregistered) securities under US federal securities law. The existence of "a central third party" that undertakes efforts for the benefit of others is a key component of US regulators' and courts' analyses about whether a digital asset represents an investment contract and potentially falls foul of federal securities laws. This has led some regulators to opine that the degree of decentralization in a blockchain network is an important condition for determining whether a digital asset is an investment contract, as decentralization reduces "information asymmetries" between actors in the network and makes it more difficult and meaningful to identify an "issuer" or "promoter" of a purported investment contract. However, it is necessary to stress that the existence of legal entities that support the activities of a blockchain network does not in and of itself imply the existence of a central third party, issue, or promoter. In 2018, Bitcoin and Ether were deemed as not being securities as the Bitcoin and Ethereum networks were considered to be sufficiently decentralized (even with the existence of, for instance, the Ethereum Foundation). This concern about network tokens being classified as (unregistered) securities has considerably shaped the governance and strategies of the networks. While it has been acknowledged that it is possible that blockchain networks beyond Bitcoin and Ethereum can also be sufficiently decentralized (with Polkadot, among others, claiming that their native token has achieved this), Cardano's ADA token, Cosmos' ATOM token, Filecoin's FIL token, and Polygon's MATIC token have been alleged to be securities. Following a class action lawsuit that claimed that Tezos had illegally sold securities with its XTZ token, it settled to the tune of $25 million without admitting guilt.

Token Distribution

In some cases, these foundations hold and manage a percentage of the governance tokens issued by these networks, which gives them a significant minority stake in the governance of the network, even if no single actor can unilaterally change a public, permissionless system. In some cases, these tokens were 'pre-mined' as the tokens were created and, at times, distributed before the blockchain network was publicly launched. For instance, the Web3 Foundation behind the launch of Polkadot was initially allocated 30% of the total supply of its native DOT token at the time of initial distribution. Similarly, the founders and team/contributors of Avalanche, Cardano, Ethereum, Filecoin, Optimism, Polygon, and Tezos received between 9.9-20% of the network tokens issued at the time of initial distribution. In the case of Zcash, the 10% token supply to founders as a reward will take place over four years. Such a token distribution clearly does not remain static, with vesting rules and distribution agreements diluting the initial concentration of crypto-assets or governance tokens over time. The Ethereum Foundation, for instance, reports that as of 31 March 2022, they held 0.297% of the total ETH supply.

Impact

Legal entities are formed to generate greater legal certainty for blockchain networks, yet some examples above show that creating such entities does not always result in greater legal certainty. These entities, including founder-led for-profit corporations and non-profit foundations, hold a sizable number of network tokens giving them a significant minority stake in the governance of these blockchain networks. However, this does not automatically translate into any single actor being able to control these networks unilaterally. Instead, as discussed in the subsequent section, these legal entities and associated individuals exert power over blockchain networks in other ways. Nevertheless, as the legal entities supporting these networks do not—by and large—have open, transparent, and inclusive appointment and accountability mechanisms for their board of directors, there are concerns about the discrepancies between the public and permissionless nature of the networks and the opacity of the legal entities that support them. These concerns can include potential conflicts of interest and non-disclosure of material information to their communities.

9 Please note that Bitcoin foundation was founded several years after the launch of Bitcoin and it is of a different nature than the legal entities we are talking about.
10 There is no unanimous definition of what a "core dev" (core software developer) is. The matter is also subject to contentious debate across different blockchain communities. However, "client devs" are usually considered "core devs." Client devs tend to have a degree of privilege in managing the source code repository of the blockchain system, which translates into being the blockchain systems' client GitHub repository maintainers. However, this does not grant "client devs" discretionary power over the code. See: Lopp, J. (2019, July 14). Who Controls Bitcoin Core? Medium. https://medium.com/@lopp/who-controls-bitcoin-core-c55c0af91b8a; Jameson, H. (2020, June 22). What is an Ethereum core developer? Hudson Jameson. http://souptacular.github.io/2020-06-22-what-is-an-ethereum-core-developer/
11 MacDonald v. Dynamic Ledger Sols., Inc., Case No. 17-cv-07095-RS (N.D. Cal., 2017).
12 William Hinman, "Digital Asset Transactions: When Howey Met Gary (Plastic)," U.S. Securities and Exchange Commission, June 14, 2018, https://www.sec.gov/news/speech/speech-hinman-061418. Also see, the recent case of SEC v. Ripple for such an analysis where it was held that Ripple's sale of XRP on digital asset exchanges using trading algorithms (i.e., "Programmatic Sales") did not constitute an unlawful sale of investment contracts to the public. This was because, among other things, these sales were "blind bid/ask transactions, and Programmatic Buyers could not have known if their payments of money went to Ripple, or any other seller of XRP" (p. 23). As a consequence, they could not have relied on the efforts of Ripple for a profitable return. Securities and Exchange Commission v. Ripple Labs, Inc., Case 1:20-cv-10832-AT-SN Document 874, (USDC SDNY, July 2023), https://www.nysd.uscourts.gov/sites/default/files/2023-07/SEC%20vs%20Ripple%207-13-23.pdf.
13 ibid.
14 It is worth noting that the current SEC Chairman Gary Gensler has created some ambiguity by not confirming or denying that he agreed with Hinman's position on Ether. See: Nikhilesh De, "SEC Chair Gensler Declines to Say if Ether Is a Security in Contentious Congressional Hearing," CoinDesk, April 19, 2023, https://www.coindesk.com/policy/2023/04/19/sec-chair-gensler-declines-to-say-if-ether-is-a-security-in-contentious-congressional-hearing/.
15 Securities and Exchange Commission v. Binance Holdings Limited, BAM Trading Services Inc., BAM Management US Holdings Inc., and Changpeng Zhao, Civil Action Case 1:23-cv-01599 Document 1, (D.D.C., 2023), https://www.sec.gov/files/litigation/complaints/2023/comp-pr2023-101.pdf. Nikhilesh De and Danny Nelson, "Filecoin Price Drops After SEC Asks Grayscale to Withdraw Application to Make Trust Reporting," CoinDesk, May 18, 2023, https://www.coindesk.com/policy/2023/05/17/filecoin-price-drops-after-sec-asks-grayscale-to-withdraw-fil-trust-application/.

II. Power Distribution

II. Power Distribution

Finding

Blockchain systems can be regarded as more or less centralized based on the distribution of decision-making power. Despite their decentralized technical structure, where transaction ledgers are distributed across numerous network nodes, these systems are complex techno-social constructs operating across multiple overlapping layers. Thus, a thorough analysis is essential to genuinely comprehend the nuances of power distribution within a blockchain ecosystem. Such an analysis entails scrutinizing the nature of decisions being made, pinpointing the various stakeholders involved in the decision-making process, and comprehending the specific mechanisms utilized in arriving at these decisions.

Governance areas

Governance in a blockchain system can involve many types of decision areas, which can be summarized as follows:

/ Like most complex systems, blockchains have rules to govern different areas and rules on how to make, amend, and repeal governance rules themselves. These can be referred to as "process rules" or, in analogy to the constitution of nation-states', "secondary rules." The making of secondary rules involves different actors and power dynamics depending on whether the process of making, amending, or repealing governance rules is discussed to take place on-chain or off-chain. Virtually every blockchain system stakeholder has an interest in participating in this process. However, as we will see afterward in the "governance formalization" insight, founders, founding teams, wealthy token holders or investors, and high-reputation software developers and community members may play a crucial role.

/ In layer 1 blockchains, rules about block production or how new "blocks" of transactions are created and added to the ledger, are often predefined on-chain by the blockchain protocol. "Consensus algorithms" or "consensus protocols" define the criteria and processes used to achieve agreement among the network's participants about the current state of the blockchain. Some examples are the Avalanche Consensus [Avalanche's Primary Network subnet], Equihash Proof-of-Work [Zcash], Expected Consensus [Filecoin], Liquid Proof-of-Stake [Tezos], Nominated Proof-of-Stake [Polkadot], Ouroboros [Cardano], Proof-of-Stake [Cosmos Hub, Ethereum, Polygon PoS Chain (originally Matic Network)], and Proof-of-Work [Bitcoin]. Founders, founding teams and early software developers contributing to the blockchain system usually design these rules. Still, consensus protocols are executed by miners or validators, with nodes also playing an essential role in maintaining a single, consistent ledger across the network.

/ Rules on monetary policy across layer 1 blockchains are also generally predefined on-chain by the blockchain protocol. These rules are frequently referred to as "tokenomics," [16] a portmanteau of "token" and "economics," comprising the principles and characteristics that govern the issuance, distribution, and overall management of a cryptocurrency or digital token within a blockchain ecosystem. Tokenomics encompasses decisions about supply mechanics, such as total supply (e.g., fixed or infinite supply), initial token distribution (e.g., an Initial Coin Offering or an Airdrop, where tokens are disbursed to the wallets of the selected recipients, often without needing them to take any proactive steps), and the creation and release of new tokens over time (e.g., through rewards and fees involved in the process of mining or validating new blocks). It also includes mechanisms like "token burning," where tokens are permanently removed from circulation, affecting the total supply. While founders and developers are very involved in the design of tokenomics, token holders and investors also have an avid interest in voicing their preferences.

/ Other decisions involve software upgrades or parameter changes to a blockchain protocol, including "soft forks" and "hard forks." [17] These decisions tend to be among the most contentious ones because of their implications for the functioning of the entire blockchain ecosystem. Since parameter changes require substantial technical expertise, software developers are naturally given a lot of voice. Still, these decisions need miners or validators and nodes to agree to enforce them. The Tezos network is an exception to this rule, with its blockchain famously popularized as "self-amending" given its built-in mechanism for automatically implementing changes to its own protocol.

/ Decisions on treasury allocation vary across case studies. This area refers to how to spend pooled funds usually set aside for the development of the network and the growth of the ecosystem vary across case studies.

- In some cases, founding teams make decisions about treasury allocation before the project fundraising event and launch, with non-profit entities generally receiving a certain amount of funds they are supposed to distribute progressively to the ecosystem at large (e.g., Avalanche, Ethereum, Filecoin, and Tezos).
- In other cases, blockchain systems devise mechanisms for collecting funds after the project launch based on, for example, block production rewards or transaction fees. Token holders can have a relatively greater (e.g., Polkadot) or lesser (e.g., Zcash) influence in treasury allocation than the founding teams and their legal entities.
- Finally, some blockchain systems have already implemented collectively-managed treasuries, such as Optimism's funds that are overseen by the Optimism Collective, and the Cosmos Hub's Community Pool Fund where proposals are voted on-chain by ATOM token holders. Other blockchains systems plan to do something similar in the future. Examples include Polygon's Community Treasury or Cardano's CIP-1694 which describes a way for ADA holders to vote on treasury withdrawals offering a more encompassing model than the Cardano's Project Catalyst fund.

/ Policies on rewards to contributors or non-hired volunteers who work on aspects other than block production can overlap with decisions on treasury allocation. The difference is that these rewards need not come from pooled funds.

- Occasionally, rewards are funneled more bottom-up through individual community donations (e.g., donations made by individual Bitcoin community members to engaged software developers or popular public speakers), decisions made by groups of token holders (e.g., Optimism's grants managed by the Token House, or the Polygon's Village Community Grants), or decisions made by representative bodies

“In blockchain governance, the absence of a centralized coercive authority makes the design of stakeholder incentives crucial to influence the behavior of each stakeholder group within the ecosystem.”

elected by community members (the Zcash Community Grants managed by the Zcash Grants Committee, or Optimism's Retroactive Grants managed by the Citizens' House).

- In other cases, rewards can be distributed more top-down through direct grants or investments issued by non-profit entities (e.g., Avalanche Foundation, Ethereum Foundation, Filecoin Foundation, Interchain Foundation, Optimism Foundation, Web3 Foundation, Polygon Foundation, Tezos Foundation, and Zcash Foundation) or through employment offers from broader ecosystem organizations (e.g., Blockstream and BitPay have hired software developers to continue working on the development of the Bitcoin ecosystem).

/ Decisions on standards and interoperability lead to integrations of the blockchain network with third-party applications. These integrations are usually “permissionless,” since they don't require official approval from a central entity such as in Web2 platforms like Google or Apple. However, for integrations to happen, projects must follow specified technical standards that software developers usually draft with more or less input from the founders or founding teams and the third-party organizations themselves, frequently also considering the users' preferences.

/ Finally, the handling of security measures and breaches. These areas usually involve exceptional governance processes or mechanisms that do not apply to more “regular” governance areas, where stakeholders with technical expertise play a significant role.

Stakeholders

As seen above, blockchain systems are techno-socio structures in that they encompass the underlying blockchain technology and also the human input required to develop and maintain the ledger and other integrated software. Accordingly, many individuals and organizations play different roles in each governance area. [18] The stakeholder groups found across the case studies can be summarized in the following way:

/ Founders or founding teams, who are credited for developing the idea and that, except for Bitcoin's Satoshi Nakamoto, usually remain involved in developing the project and may create and integrate legal entities for this purpose. Some publicly known and active (co)founders include Emin Gün Sirer, Kevin Sekniqi, and Maofan Yin [Avalanche], Charles Hoskinson [Cardano], Jae Kwon and Ethan Buchman [Cosmos], Vitalik Buterin [Ethereum], Juan Benet [Protocol Labs/ Filecoin], Jinglan Wang, Karl Floersch, and Kevin Ho [Optimism], Robert Habermeier, Gavin Wood, Peter Czaban [Polkadot], Jaynti Kanani, Sandeep Nailwal, and Anurag Arjun [Polygon], Arthur Breitman and Kathleen Breitman [Tezos], and Zooko Wilcox [Zcash].

/ Software developers, both hired by legal entities related to the blockchain system and volunteers, who propose new software rules that affect the blockchain protocol or the applications running on the network.

/ There are groups of stakeholders that are involved in block production:

- In the studied layer 1 blockchains, miners and validators produce new blocks of transactions added to the blockchain.
- In layer 2 blockchains, such as Polygon Rollups and Optimism Rollups, sequencer nodes are responsible for ordering transactions before they are finalized on the Ethereum blockchain. In the case of Polygon Rollups, aggregator

nodes produce proofs attesting to the integrity of the sequencer's proposed state change.

/ Non-validator or non-mining nodes which are not involved in producing new blocks of transactions but that independently verify all transactions according to the network's consensus rules.

/ Broader ecosystem organizations, such as wallets, cryptocurrency exchanges, decentralized applications (dApps), and decentralized autonomous organizations (DAOs) [19]."

- This includes applications running on layers interconnected to the blockchain networks of reference. For example, governance decisions on technical standards on a layer 1 blockchain (e.g., Ethereum) affect applications running on a layer 2 blockchain (e.g., Optimism), giving them an interest in participating in the governance area. [20]
- Albeit not necessarily through direct intervention in decision-making, the governance decisions on blockchain systems perceived as "competitors" (e.g., Avalanche versus Ethereum, Optimism Rollups versus Polygon Rollups) may influence decisions made in the blockchain system of reference to maintain a competitive advantage and attract users. [21]

/ There are groups of stakeholders that emanate from the funding mechanism and token distribution policy of the blockchain system:

- Some blockchain systems, including Cardano in 2015-2017, Cosmos in 2017, Ethereum in 2014, Filecoin in 2017, and Tezos in 2017, have launched their projects through novel funding mechanisms known as Initial Coin Offerings (ICOs), which, similarly to Initial Public Offerings (IPOs), allow to raise funds by issuing tokens to purchasers. Others, such as Polygon/Matic Network in 2019, have resorted to an Initial Exchange Offering (IEO), where centralized cryptocurrency exchanges have facilitated the sale of tokens.
- There are blockchain systems that have been funded through traditional investment mechanisms, such as public and private sales, including Avalanche in 2020, Optimism/Plasma Group in 2019-2022, Polkadot in 2017, and Zcash in 2016.
- Additionally, blockchain systems can choose to distribute tokens through Airdrops, where tokens are disbursed to the wallets of the selected recipients, often without needing them to take any proactive steps.

Consequently, blockchain systems may have:

- Investors, meaning individuals or entities that allocate capital in a blockchain system expecting a future financial return. Investors can participate in the space through ICOs, by purchasing stocks of private companies related to the blockchain system, or by providing seed or venture capital funding for blockchain startups.
- Token holders, meaning individuals or entities that hold cryptocurrencies or tokens issued by the blockchain system, which they can hold as investments or use for their utility in accessing services related to the blockchain system, or staking and on-chain voting in Proof-of-Stake (PoS) blockchain networks.

/ Users, including those trading the native cryptocurrency or token and using platforms and applications of the broader ecosystem.

/ Finally, policymakers, lawmakers, and regulators in international organizations or in state jurisdictions where the blockchain systems operate or are incorporated. They create and attempt to enforce frameworks to govern the operation of cryptocurrencies, tokens, and related blockchain projects.

In the governance of blockchain systems,, the absence of a centralized coercive authority makes the design of stakeholder incentives crucial [22] to influence the behavior of each stakeholder group within the ecosystem. While it is important to recognize the inherent complexities and individual variations, we outline some of the incentives that drive different categories of stakeholders. The examples below presume stakeholders are acting as 'rational agents,' aiming to positively contribute to and derive value from the blockchain system without any intent of wrongdoing. However, we acknowledge that real-world scenarios may exhibit broader behaviors and objectives.

/ Founders or founding teams can be motivated by non-financial incentives such as the project's long-term success, the pursuit of innovation, and reputation gain in the ecosystem. Financial incentives can include potential profits from the project's success.

/ Software developers can be motivated by non-financial incentives like a commitment to technological excellence, gaining the community's esteem, and ideologically pursuing decentralized solutions. Financial incentives can also play a role, mainly through developer grants or employment.

/ Miners, validators, sequencers, and aggregators are predominantly motivated by financial incentives, including earning transaction fees and block rewards. Their behavior focuses on operational efficiency and network security to maximize earnings.

/ Non-validator or non-mining nodes are usually motivated by non-financial factors centered around maintaining network integrity and supporting a system they rely on, potentially for ideological or intellectual reasons.

/ Broader ecosystem organizations are motivated by financial incentives linked to user adoption, transaction volume, and ecosystem activity. These entities focus on enhancing user experience and network effects for business growth.

/ Investors are strongly motivated by financial returns through capital appreciation or trading. Market dynamics, project potential, and the health of the broader ecosystem influence their decisions.

/ Token holders can have financial incentives through the potential appreciation of their holdings. Non-financial incentives include participation in governance processes, especially if tokens confer voting or decision-making rights.

/ Users can be driven by functional incentives, such as seeking efficient, secure, and useful blockchain-related services, and ideological ones, motivated by a desire to support value systems behind the development of decentralized technologies.

/ Policymakers, lawmakers, and regulators can be incentivized by non-financial goals such as balancing innovation, risk management, and consumer protection while ensuring legal compliance and maintaining traditional financial market stability.

Beyond their incentives, it is important to also look at who holds more power within these stakeholder groups and why. Indeed, the power to make decisions is not always evenly distributed.

/ Founding teams can act or be perceived by the blockchain community of reference as “benevolent dictatorships” [23] or “spiritual leaders,” [24] with individuals—usually, founders—being considered “traditional” or “charismatic” types of authority, having more decision-making influence than the rest of stakeholders.

/ Software developers are generally more prone to behaving like a “perceived reputation-based meritocratic group.” The ones who may have more voice tend to be the ones the community perceives as more technically knowledgeable or to have made important contributions to developing the blockchain protocol, smart contract, or decentralized applications.

/ Non-validator or mining nodes, at least in traditional Proof-of-Work and Proof-of-Stake systems, tend to act as “sovereign entities” with equal decision-making power to individually engage and stop engaging in relaying transactions across the network, store the ledger information, and accept or reject validated transactions that don't follow the consensus rules. There have been occasions where non-validator or non-mining nodes have also engaged in seemingly democratic governance practices. A notable example is the case of Bitcoin Improvement Proposal 148 (BIP 148). This proposal introduced a User Activated Soft Fork (UASF) inviting full nodes to run software supporting the activation of SegWit. This approach chooses to give more decision-making power to the full nodes, who can express their preferences independently of miners, with the threat that if miners do not comply with their choices, they will simply ignore blocks that do not respect the soft-fork upgrade.

/ Miners and validators usually behave like “plutocratic groups,” where more “wealth” in the form of computing power or, especially, [25] staked tokens tends to lead to more decision-making power.

/ Token holders and investors, broader ecosystem organizations, and users affected by supply and demand market forces can also behave in a plutocratic manner, where more economic power leads to more influence.

/ Policymakers, lawmakers, and regulators are elected or appointed based on the governance rules of the corresponding international organization or the political system of the relevant jurisdiction. Across the world, the most influential figures in regulating the blockchain space usually work in international organizations such as the International Monetary Fund (IMF), the Financial Action Task Force (FATF), and the World Bank (WB). There are also agencies and representatives of powerful nations such as the United States, the European Union, European countries such as France and Germany, and China.

Additionally, given the polycentric nature of public blockchain networks, the extent to which a specific stakeholder group has the ability to sway decision-making in a particular governance area is also worth analyzing:

/ Based on the design of blockchain technology, blockchain systems are characterized by relatively lower costs to “exit” than other complex, more centralized traditional systems such as nation-states or private companies.[26] In terms of governance, this means that whenever a stakeholder group (e.g., founding teams or software developers) can exert influence in a governance area (e.g., drafting secondary rules, deciding on contribution rewards policies, or technical standards for interdependencies) the parties that disagree or feel disadvantaged are not obliged by a coercive authority to stay—they can “leave” the system (e.g., non-validator nodes can cease participating in a network, token holders can sell their tokens, and broader ecosystem organizations and users can move to another network). These parties can even propose and encourage a "hard fork" or split of the chain. However, because of network effects (where the value or utility of a product or service increases as more people use it), even if the exit is relatively straightforward, the economic (and political) costs of stakeholders "exiting" a network must also be factored in the governance decisions.

/ More importantly, in contentious governance areas such as software updates—particularly changes to block production and monetary policy—some stakeholders have a credible capacity to counteract controversial decisions of another stakeholder. For example, miners and validators can reject changes to a blockchain protocol proposed by software developers or founding teams by simply not updating their software. This power creates a check against unwanted or controversial changes. If a significant portion of miners or validators do not adopt a proposed update, it can lead to a hard fork or chain split.

Finally, the same individual or entity can participate in a blockchain system through different stakeholder roles. For instance, it is not uncommon to see active contributors, software developers also be validators, or broad ecosystem organizations also run full nodes.

Governance mechanisms

Besides what decisions are being made and who is involved in making them, there is the question of how decision-making happens. Governance mechanisms can be categorized according to multiple criteria. We distinguish here between two important modalities:

/ On-chain governance mechanisms (also referred to as "governance by the infrastructure") [27] refer to those enshrined into the blockchain code and, therefore, transparent and highly resistant to change. These include:

- Ex-ante rules and processes that come "baked" into the blockchain protocol, such as consensus algorithms specifying how to produce and add new blocks of transactions.
- Ex-post rules and processes to amend existing governance dynamics and create new ones, such as on-chain signaling and on-chain voting, which record the expressed preferences on the blockchain itself.

In traditional Proof-of-Work and Proof-of-Stake blockchain systems, on-chain mechanisms frequently give rise to relatively oligarchic power distributions, where decision-making tends to accumulate in the hands of technical experts (software developers) who design ex-ante rules or wealthy stakeholders (miners/validators, token holders) who express their preferences through on-chain signaling or voting.

/ Off-chain governance mechanisms (also referred to as "governance of the infrastructure")[28] include any decision-making process that is not automatically recorded into the blockchain and, thus, is less transparent (or less publicly visible) but more flexible. These include

- Mechanisms developed by the blockchain community of reference, such as
  - -In-person mechanisms, from private stakeholder meetings to public conferences.
  - -Online mechanisms, like community debates on social media, dedicated online platforms (e.g., governance forums or GitHub repositories), and off-chain signaling and off-chain voting where the preferences are not recorded directly on the blockchain.
- Mechanisms developed by public and private third parties that affect the blockchain community, such as national laws and regulations, contractual agreements, or technology standards.

Since off-chain mechanisms are less transparent, the power distribution they favor is, by definition, harder to measure. While they can be more democratic by encouraging broader community participation in governance through conferences or debates, behind-the-scenes conversations among influential figures (e.g., founders or investors) can have the opposite effect. We will explore governance mechanisms in greater depth later on.

Impact

To more precisely determine who influences various governance decisions and through what mechanisms, it is essential to unravel the complex and multi-layered nature of blockchain systems. Undertaking this analysis allows blockchain communities to identify practices that may not align with their interests or values. Recognizing these misalignments is crucial for proposing rules, processes, and mechanisms that more accurately reflect their preferences and priorities.

16 Ralf Wandmacher, "Tokenomics," in Cryptofinance and Mechanisms of Exchange: The Making of Virtual Currency, ed. Stéphane Goutte, Khaled Guesmi and Samir Saadi (Springer International Publishing, 2019), 113-123, https://doi.org/10.1007/978-3-030-30738-7_7

17 A "soft fork" is a backward-compatible update to the blockchain protocol. It introduces changes that are not in conflict with the existing rules. Nodes (computers) that do not upgrade to the new protocol can still participate in validating and verifying transactions, although they might not be able to utilize new features. A "hard fork" is a significant change to the blockchain protocol that is not backward-compatible. It creates a permanent divergence from the previous version of the blockchain; nodes running the old version will not accept blocks created by the new version, and vice versa. This often results in a split of the blockchain into two separate paths, each following its own distinct protocol.

18 Shermin Voshmgir and Michael Zargham, "Foundations of Cryptoeconomic Systems," Research Institute for Cryptoeconomics, Vienna, Working Paper Series 1 (2019), https://assets.pubpub.org/sy02t720/31581340240758.pdf. Primavera De Filippi et al., "Report on Blockchain Technology and Polycentricity," (forthcoming).

19 While they are connected to blockchain networks, DAOs are governed following special dynamics and, therefore, are out of the scope of this report.

20 The VP of Galaxy Digital spoke at Pragma New York 2023 on the Ethereum Governance Process highlighting the role played by developers of layer 2 rollups in the drafting and passing of EIP-7516. See: Christine Kim, "The Ethereum Governance Process," ETHGlobal Youtube, September 29, 2023 https://www.youtube.com/watch?v=2T4h-r9wu44

21 Eric Alston, "Constitutions and Blockchains: Competitive Governance of Fundamental Rule Sets," Case Western Reserve Journal of Law, Technology & the Internet 11, no. 1 (2020), https://scholarlycommons.law.case.edu/jolti/vol11/iss1/6

22 Rong Han et al., "How can incentive mechanisms and blockchain benefit each other? A survey," ACM Computing Surveys 55, no. 7 (2022): 1-38, https://doi.org/10.1145/3539604

23 De Filippi, P. & Loveluck, B. (2016). The invisible politics of Bitcoin: governance crisis of a decentralized infrastructure. Internet Policy Review. https://hal.science/hal-01382007

24 Sandra Faustino, Inês Faria and Rafael Marques, "The myths and legends of king Satoshi and the knights of blockchain", Journal of Cultural Economy 15, no. 1 (2021): 67-80, https://doi.org/10.1080/17530350.2021.1921830

25 Arguments have been made that because computing power does not guarantee a Return On Investment (ROI) in mining, whereas, in the absence of slashing, staking does, staking tends to accentuate plutocratic dynamics at a greater extent than mining. See: Alberto Leporati, "Studying the Compounding Effect: The Role of Proof-of-Stake Parameters on Wealth Distribution," in Proceedings of the Fifth Distributed Ledger Technology Workshop (DLT 2023), ed. Paolo Mori, Ivan Visconti and Stefano Bistarelli, (2023), https://ceur-ws.org/Vol-3460/papers/DLT_2023_paper_2.pdf. Md Sadek Ferdous et al., "Blockchain Consensus Algorithms: A Survey," arXiv, (2020), https://doi.org/10.48550/arXiv.2001.07091

26 Alston, "Constitutions and Blockchains." De Filippi et al., "Report on Blockchain Technology & Legitimacy."

27 Primavera De Filippi and Greg McMullen, "Governance of blockchain systems: Governance of and by Distributed Infrastructure," Blockchain Research Institute and COALA, (2018), https://hal.science/hal-02046787/document

28 ibid.

III. Planned vs. Actual Decentralization

VI. Planned vs. Actual Decentralization

"Decentralization across blockchain projects faces a pivotal obstacle: the absence of a universally accepted definition."

Finding

Many blockchain communities aspire to maintain or increase decentralization over time, although many lack a clear and operationalized definition of "decentralization." Many factors can affect power distribution in blockchain systems, including of both on-chain dynamics, such as consolidation of power in mining and validators pools, and plutocratic token-weighted voting, and off-chain dynamics, such as growing governance complexity, early entrenchment of power, and external regulatory pressure).

Lack of Clear Definition of Decentralization

Several blockchain systems' founders, founding teams, and legal entities have publicly expressed their ambition to "progressively decentralize" their governance. In fact, "decentralization enjoys almost a mythical status in the ecosystem,"[29] even though it can be hard to observe and evaluate. The first barrier is the lack of a clear definition of what "decentralization" actually means, both generally for blockchain systems and specifically for each blockchain network.

Several scholars have made an effort to lay the conceptual foundations of "decentralization" in the context of government institutions [30], geographic political units[31], or in the process of governance itself[32]. However, regarding blockchain systems, the first publicly known attempt at addressing decentralization came from Ethereum co-founder Vitalik Buterin in February 2017[33]. Buterin distinguished between "architectural (de)centralization"—i.e., the number of nodes that make up the system—, "political (de) centralization"—i.e., the number of individuals and organizations that ultimately control these nodes—, and "logical (de)centralization"—i.e. the interfaces and data structures presented and maintained by the system. For Vitalik, "blockchains are politically decentralized (no one controls them) and architecturally decentralized (no infrastructural central point of failure), but they are logically centralized (there is one commonly agreed state, and the system behaves like a single computer)."[34]

A couple of months later, technologist and entrepreneur Balaji Srinivasan introduced the Nakamoto Coefficient,[35] another attempt at concretely measuring decentralization in blockchain systems. Contrary to Buterin's article, Balaji posited that decentralization was not a binary, but a spectrum. He contended that understanding the level of decentralization in a blockchain system involved examining the minimum number of entities that, if they were to collude, could effectively control the system (typically by reaching more than 50% of the network's resources or decision-making capacity). The blockchain networks included in the original article authored by Srinivasan are Bitcoin and Ethereum, which he subdivided into several subsystems, each with their own measures of decentralization: the "mining" operations on the network (back then, both were Proof-of-Work networks), calculated through the number of computational resources invested into the network; the variety of "clients" available to access the network, measured based on unique "codebases" or bodies of source code for a given software program; the influence of "core" developers, depending on their respective number of "commits" or recorded changes to the main client Github repository; the various "exchanges" on the market for their native tokens, whose power is based on their 24 hours trading volume; the number of "nodes" on the network independently verifying all transactions according to the consensus rules and distributed across multiple countries; and, finally, the "owners" of their native token in amounts larger than the equivalent to 500,000 USD. Balaji found that, for Bitcoin, the most centralized areas were that of software clients, cryptocurrency exchanges, and network nodes, whereas, for Ethereum, the influence of core developers was quite more centralized than in Bitcoin.

While the Nakamoto Coefficient was an interesting first attempt at measuring decentralization in blockchain systems at different layers, it failed to reflect the full complexity of their power distribution and governance frameworks. Since then, various researchers have worked on more comprehensive and stratified taxonomies. One of these taxonomies identified six architectural layers (i.e., governance, network, consensus, incentive, operational, and application) and thirteen "aspects of centralization" within them, which were exemplified with Bitcoin and Ethereum as case studies.[36] A newer taxonomy looks into additional blockchain networks such as Avalanche, Cosmos, Cardano, Polkadot, and Zcash. It proposes to look into eight layers (i.e., hardware, software, network, consensus, tokenomics, API, governance, and geography). For each system layer, it identifies one or more "resources" (the layer's basic "unit") and the relevant "parties" that control the resource, directly or indirectly. When control of a resource within a specific layer is rather centralized, the taxonomy highlights the impact of centralization on one or more "key properties" of blockchain systems, including safety, liveness, stability, and privacy.[37] Other research has focused on forces that tend to propel (re)centralization in blockchain systems through time. For example, the ideological pursuit of "maximal decentralization" can conflict with other values like technical efficiency or governability. Founding teams and core developers tend to retain substantial control over governance when relying on rough consensus as a decision-making mechanism. The need for external recognition or for connecting blockchain systems with the "outer world" while ensuring legal compliance also tends to lead to recentralization. Finally, the impact of incentive mechanisms built into blockchain systems and affecting stakeholders' behaviors can also lead to (re)centralization of power. Interestingly, the aftermath of "existential threats" like bugs, hacks, and other security breaches can encourage decentralization as a pragmatic means to remove single points of failure.[38]

The examples above reveal a lack of a universally accepted definition of "decentralized governance" across different systems. The lack of a standardized method for implementing decentralization further complicates comparing it across various projects. This also makes it challenging to discern whether a project merely professes its commitment to decentralization or genuinely enforces and upholds it.

Announcements of "Progressive Decentralization"

Still, many blockchain communities have discussed and, in some cases, publicly committed themselves to decentralizing decision-making power across different governance areas in a process that is usually referred to as "progressive decentralization."[39]

Sometimes, progressive decentralization is driven by stakeholder groups other than the original founders and founding teams. For example, the Stratum protocol, which is widely used in Bitcoin mining, was developed as a collaborative effort between a few mining pools and other relevant mining enterprises. Due to concerns over power centralization in the hands of mining pools, Stratum V2 introduced several improvements, including "job negotiation" for individual miners to select their own transaction sets for new blocks, rather than relying solely on the mining pool's choices, thereby increasing the

"Technical advancements have sparked a re-centralization trend in blockchain, fueled by professionalized mining pools and token-based governance, offsetting the decentralized ideals within decision-making areas beyond block production."

decentralization of transaction selection in the mining process.[40]

In other cases, greater decentralization has been discussed by the blockchain community at large. For instance, in the context of Zcash, the community launched the Zcash developer fund in 2016 (initially known as the Founder's Reward), which allocated 20 percent of Zcash's block rewards to the founders, investors, and development support. Four years later, in 2020, a Zcash Improvement Proposal (ZIP) 1014 was approved, continuing the allocation of 20 percent of mining rewards for community funding, but with a revised distribution structure aimed to enhance product decentralization: 35 percent to the Electric Coin Company (ECC), 25 percent to the Zcash Foundation, and 40 percent for third-party development.

Most of the time, however, progressive decentralization is driven by founders and founding teams. For instance, after the execution of the "Ethereum Merge" in September 2022, which completed the transition of the Ethereum network from Proof-of-Work to Proof-of-Stake, most of the block production on Ethereum is done through centralized operators. During Korea Blockchain Week 2023,[41] Ethereum founder Vitalik Buterin identified the centralization of block production as a major issue confronting the Ethereum network. He suggested that this challenge should be tackled by reducing the costs and simplifying the process of operating validator nodes. Vitalik noted that removing the reliance on centralized service providers was part of the Ethereum roadmap but that, in practical terms, it would probably take decades to implement.

Similarly, with the introduction of the Optimism (OP) Collective in April 2022, the Optimism Foundation committed to ensuring "digital democratic governance" for the "rapid and sustainable growth of a decentralized ecosystem." The plan introduced a dual-house system including the Token House (composed of token holders who had received OP tokens via Airdrop) responsible for voting on a series of governance areas, such as software updates, and the Citizen House (comprising individuals and entities elected based on reputation measured through a series of attestations) in charge of governing the distribution of retroactive public goods funding. In 2023, OP Labs announced a plan for "technical decentralization" of the OP Stack codebase that forms the backbone of Optimism. Among the "milestones" of that plan, OP Labs proposes the creation of a Security Council that will help manage software updates.[42]

In June 2023, Polkadot announced the launch of a new governance framework called OpenGov (or Governance V2), catalyzed by a desire to "further decentralize Polkadot." This involves dissolving two centralized governance bodies: "the Council," whose responsibilities, including the governance of treasury allocation, will be transferred to "the public", (i.e., the DOT token holders). and the "Technical Committee," in charge of submitting "emergency proposals," which will be replaced by the "Polkadot Technical Fellowship" with the power to whitelist proposals based on their urgency.

One month later, Polygon presented the Governance 2.0 framework for "decentralized ownership and decision-making over all Polygon protocols and the ecosystem." The framework consists of three pillars: (1) *protocol governance*, expanding the scope of the Polygon Improvement Proposal (PIP) framework to eventually cover the entirety of the Polygon permissionless stack, giving the community a formal way to research and propose upgrades that may eventually become part of protocols; (2) *system smart contracts governance*, creating the "Ecosystem Council" to take care of the additional governance steps involved in upgrading smart contracts; (3) *community treasury governance*, with the introduction of a funding source for public goods, supporting projects and initiatives in the Polygon ecosystem, governed by an independent Community Treasury Board which community members will eventually elect.

Finally, Cardano initially set up a Roadmap with three phases of decentralization. The initial "Byron phase," during which the Cardano network was federated, was followed by the "Shelley phase," progressively shifting control to the Cardano community by enabling community-run nodes and introducing a delegation and incentives scheme to encourage stake pool participation within Cardano's Proof-of-Stake framework. In 2023, Cardano launched the last phase of its roadmap, called "Voltaire".[43] Voltaire introduces an on-chain voting mechanism for ADA holders to present "governance actions," which are not to be confused with Cardano Improvement Proposals. Governance actions can be submitted by paying a transaction fee. Voltaire also allows ADA holders to vote on-chain for treasury allocations.[44] The Cardano Improvement Proposal (CIP)-1694 instigated a significant change to governance by introducing two new governance bodies with specific functions in addition to the already-existing body of stake pool operators (SPOs). Firstly, a constitutional committee or group of persons and organizations that collectively guarantee the Cardano Constitution is respected by voting on the constitutionality of governance actions. Secondly, a group of delegated representatives (DReps) to which ADA holders will generally delegate their voting rights. ADA holders can also register themselves as DReps and delegate voting power to themselves.

On-Chain Dynamics

The attempts at defining and measuring decentralization, as well as steps taken by some blockchain systems, show that there are at least two types of on-chain forces that tend towards (re)centralization.

/ One relates to consensus algorithms over block production (i.e, how way in which consensus over an updated ledger state is achieved). To be decentralized, consensus algorithms require that the probability of producing the next block is evenly distributed across a large network of independent nodes. In Proof-of-Work (PoW) consensus, this probability can be skewed if miners or mining pools have outsized computational resources which increase their chances of mining the next block.

In many Proof-of-Stake (PoS) consensus algorithms, probabilities become similarly skewed when validators control an outsized stake in the network. Today, as mining and validating have become professionalized industries over time, relying on specific pieces of hardware and often organized in validator or mining pools, PoW, and especially PoS[45] and Delegated PoS blockchain networks, face important re-centralization tendencies.

/ Another area relates to governance via token-weighted on-chain voting. In many blockchain systems, token holders play a role in several governance areas, such as treasury management or protocol upgrades through different on-chain voting mechanisms. This often results in a plutocratic governance system ("rule by wealth") where more tokens ultimately lead to more "voice". This can be problematic especially if initial token distribution was geared towards a few powerful actors. For example, both Polkadot and Optimism allocated significant governance tokens to early investors and team members. While the projects are making deliberate efforts to distribute token holdings over time, governance in these blockchain systems has been found to exhibit plutocratic tendencies.[46]

Off-chain Dynamics

Certain off-chain forces may also impact decentralization within a blockchain community.

/ As blockchain projects grow and develop over time, their complexity increase significantly. This can be observed both in the amount of governance documentation produced by various projects and the vast tacit knowledge that interviewees reported is, at times, necessary to participate in decision-making processes effectively. This can entrench decision-making power in early members with a better understanding of the context and history of the blockchain system, thus inhibiting new members or those with less time to participate in decision-making from participating effectively.

/ Except for Bitcoin, whose founder remains anonymous and inactive, project founders typically assume an important governance role, sometimes as a "spiritual leader" or "benevolent dictator." This dynamic has been observed across many online communities predating Web3.[47] Yet, for blockchain networks that aspire to pursue a progressive decentralization strategy, it might be necessary to explore founder exit and succession strategies in more detail.

/ External actors, like policymakers, lawmakers, and regulators, may also impact progressive decentralization. For example, the United States Securities and Exchange Commission (SEC), when applying securities laws, accounts for the decentralization of cryptocurrency projects in order to assess whether the issuance thereof might qualify as security issuance. Under U.S. law, the Howey Test (from the Supreme Court's decision in SEC v. W.J. Howey Co.) stipulates that an investment contract is considered a security if it involves: (a) an investment of money, (b) in a common enterprise, (c) with an expectation of profit, (d) derived primarily from the efforts of others. Many cryptocurrencies and ICOs that are issued and promoted by centralized profit centers could fall under this definition, subjecting them to securities regulations.

Impact

Decentralization is a common goal across blockchain networks. Yet, achieving decentralization may require more precise and operationalized definitions of what decentralization means in different contexts. Moreover, decentralized governance requires acknowledging and overcoming oligopolistic tendencies occurring on-chain (at the level of consensus algorithms and token-weighted on-chain voting) and off-chain (due to tacit knowledge, complex documentation, and the perceived influence of founders).

29 Balazs Bodo and Alexandra Giannopoulou, "The logics of technology decentralization – the case of distributed ledger technologies," in Blockchain and Web 3.0 1st Edition, (Routledge, 2019): 114-129, DOI:10.4324/9780429029530-8
30 Aaron Schneider, "Decentralization: Conceptualization and measurement," Studies in Comparative International Development, 38, no. 3 (2003): 32–56, https://doi.org/10.1007/BF02686198
31 Daniel Treisman, "Defining and Measuring Decentralization: A Global Perspective," SSCNet UCLA Social Sciences, (2002), https://www.sscnet.ucla.edu/polisci/faculty/treisman/Papers/defin.pdf.
32 Jean-Paul Faguet "Decentralization and Governance," World Development 53, (2014): 2–13 https://doi.org/10.1016/j.worlddev.2013.01.002
33 Vitalik Buterin, "The Meaning of Decentralization," Medium, February 6, 2017, https://medium.com/@VitalikButerin/the-meaning-of-decentralization-a0c92b76a274
34 ibid.
35 Balaki S. Sirinivasan, "Quantifying Decentralization," Medium/news.earn.com, July 12, 2017, https://news.earn.com/quantifying-decentralization-e39db233c28e
36 Ashish Rajendra Sai et al., "Taxonomy of centralization in public blockchain systems: A systematic literature review," Information Processing & Management 58, no. 4, (2021), https://doi.org/10.1016/j.ipm.2021.102584.
37 Dimitris Karakostas, Aggelos Kiayias and Christina Ovezik, "SoK: A Stratified Approach to Blockchain Decentralization," arXiv, (2022), https://doi.org/10.48550/arXiv.2211.01291.
38 Bodo and Giannopoulou, "The logics of technology decentralization."
39 Jad Esber and Scott Duke Kominers, "Progressive decentralization: a high-level framework," A16z Crypto, Jan 12, 2023, https://a16zcrypto.com/posts/article/progressive-decentralization-a-high-level-framework/
40 Braiins, "Bitcoin's Decentralization with Stratum V2," Braiins, June 29, 2020, https://braiins.com/blog/stratum-v2-bitcoin-decentralization
41 Tom Mitchelhill, "Vitalik Buterin on fix for Ethereum centralization: Make running nodes easier," Cointelegraph, September 5, 2023, https://cointelegraph.com/news/vitalik-buterin-ethereum-centralization-issues-running-nodes-easier
42 We will explore further the role of this governance body in the insight "Security Measures and Breaches"
43 Godfrey Benjamin, "Cardano (ADA) Voltaire era to be launched following three major steps: Details," U.Today, March 2, 2023, https://u.today/cardano-ada-voltaire-era-to-be-launched-following-three-major-steps-details
44 For more information on Cardano's Monetary Policy, see: Cardaniansio, "Understanding Cardano Monetary Policy," Cexplorer.io, Sep 11, 2023, https://cexplorer.io/article/understanding-cardano-monetary-policy
45 See footnote 29.
46 Tom Barbereau et al., "Decentralised Finance's timocratic governance: The distribution and exercise of tokenised voting rights," Technology in Society 73, (2023), https://doi.org/10.1016/j.techsoc.2023.102251. Rainer Feichtinger et al., "The Hidden Shortcomings of (D)AOs -- An Empirical Study of On-Chain Governance," arXiv, (2023), https://doi.org/10.48550/arXiv.2302.12125
47 Nathan Schneider, "Admins, mods, and benevolent dictators for life: The implicit feudalism of online communities," New Media & Society 24, no. 9 (2021): 1965-1985, https://doi.org/10.1177/1461444820986553

IV. Governance Formalization

IV. Governance Formalization

"Maintaining a careful balance of on-chain and off-chain governance practices makes it possible to benefit from a mix of predictability and flexibility."

Finding

In the past few years, blockchain communities have witnessed a surge in the adoption of online written documents that articulate blockchain rules and procedures. These documents play a crucial role in establishing the framework for off-chain and on-chain decision-making, introducing what can be termed secondary rules or "rules on how to make rules." Yet, the blockchain governance landscape remains characterized by a significant gap between these written rules and the implicit, often undocumented, practices that shape the governance of many blockchain systems.

Blockchain Constitutionalism 2.0

Secondary rules refer to rules on how to make, amend, and repeal governance rules. They can be expressed on-chain or off-chain. The blockchain protocol or smart contract rules are part of the "on-chain constitution," In contrast, the implicit and often unwritten off-chain governance practices are part of the "off-chain material constitution." We refer to the process of formally describing these implicit off-chain rules in written, formalized documents that are part of the "off-chain formal constitution" as Blockchain Constitutionalism 2.0.[48]

Since their inception, all interviewed blockchain communities, have been formalizing how governance decisions are (or should be) made. These written documents can appear in GitHub repositories, in Discord channels, and on websites (co)managed by stakeholder groups like founders and founding teams, or pseudonymous individuals such as "Cobra" on the famous Bitcoin.org website[49]. Some of these documents can be accessed on the Avalanche Foundation's GitHub, the Cardano website, the Cosmos Hub website, the Ethereum website, the Filecoin Foundation website, the Optimism Collective website and the OPerating Manual on GitHub, the Polkadot website, the Polygon blog, the Tezos website, and Zcash website. Notably, as of the time of writing, one blockchain community has (the Optimism Collective) and another one is in the process of (Cardano) adopting a "constitution" as a single unified document laying out important governance rules and processes.

An interesting outlier is Bitcoin. Without an active founder, the formalization of governance has not been planned, but it has organically emerged over time. This process was very prolific in the early days and stagnated in recent years, as seen by the declining number of Process Bitcoin Improvement Proposals (BIPs) adopted over time. Some of the interviewed community members felt that Bitcoin adopted "dark governance by design" because of the exponential growth in scrutiny from policymakers, lawmakers, and regulators. There seems to be a conscious decision from community members to keep some governance practices unwritten to avoid making "any one person" responsible (and accountable) for how decisions are made.

Persisting Informal Practices and Information Asymmetry

Despite many public blockchain networks qualifying as a "transparent record of transactions," this feature does not necessarily translate into the governance of these networks. Firstly, formalizing governance can never completely eliminate unofficial and undocumented governance practices. In many cases, multiple stakeholders hold significant decision-making power over the operations of a blockchain network, some exercising it behind the scenes without informing the rest of the community or being held accountable for their actions. A particular area where informal practices tend to occur more frequently is in the context of security breaches or bugs, as we will explore further in the report. Secondly, written documentation is not always easy to access (e.g., Avalanche) or to understand (e.g., Polkadot) by the blockchain community at large. This creates information asymmetries between newcomers and oldtimers, including founding teams and core developers.

Legitimacy, Flexibility, and Predictability

As a general rule, people may perceive a blockchain system as "legitimate" if they believe governance is conducted in a "morally acceptable" way and/or in a way that serves the interests of the blockchain community.[50] Writing down tacit and implicit norms into a formalized constitution can help build trust and garner support from community members by fostering a sense of accountability for all the actors involved in the governance processes. Yet, formalizing governance rules requires lengthy and careful consideration of the various governance mechanisms at play within a particular blockchain community. When crafting a formal constitution, a balance must be struck between how flexible and predictable the governance system should be. When governance happens on-chain, it is more predictable but also more rigid and inflexible. Examples of on-chain governance are making decisions by token-weighted on-chain voting mechanisms where preferences are expressed through transactions permanently recorded on the blockchain or using "slashing" as a punitive measure in Proof-of-Stake networks, where a portion of a participant's stake (i.e., the cryptocurrency they have locked up as collateral) is removed or "slashed" due to various forms of misconduct or failure to meet their responsibilities. Conversely, off-chain governance mechanisms, such as debates on governance forums, preserve flexibility but lead to more unpredictability or arbitrary change. Maintaining a careful balance of on-chain and off-chain governance practices makes it possible to benefit from a mix of predictability and flexibility.

Impact

Governance formalization can become an important opportunity for strengthening the legitimacy of blockchain systems in the eyes of the blockchain community, and beyond. Yet, blockchain communities should remain aware of the delicate interplay between on-chain rules, which are formalized into code, and off-chain practices, which can never be completely and fully codified on-chain. Implementing a hybrid of on-chain and off-chain rules makes blockchain governance more flexible and adaptable to the community's evolving needs while preserving the reliability and accountability of code-based mechanisms.

48 Morshed Mannan, Primavera De Filippi and Wessel Reijers, "Blockchain Constitutionalism," in Oxford Handbook of Digital Constitutionalism, ed. Giovanni de Gregorio, Oreste Pollicino and Peggy Valcke, (forthcoming). Another piece that defines "constitutions" in blockchain systems through a functional perspective is Michael Zargham et al., "What Constitutes a Constitution?," BlockScience Medium, April 7, 2023, https://medium.com/block-science/what-constitutes-a-constitution-2034d3550df4.
49 Daniel Phillips, "The Bitcoin.org website is getting a new owner," Decrypt, May 21, 2020, https://decrypt.co/29517/the-bitcoin-org-website-is-getting-a-new-owner
50 De Filippi et al., "Report on Blockchain Technology & Legitimacy"

V. Governance Mechanisms

V. Governance Mechanisms

"The dilemma between 'rough consensus' and 'signaling' or 'voting' shapes how blockchain communities make amendable governance decisions."

Finding

In blockchain systems, the governance landscape is often shaped by the contributions and inputs from the community. Within this domain, various governance mechanisms are utilized, each serving as a fundamental component in the governance process. Two prevalent mechanisms in this arena are "rough consensus" and "signaling and voting." These mechanisms can be employed either in isolation or in tandem, giving rise to diverse decision-making frameworks. In each blockchain system, the uniqueness of these mechanisms, combined with contextual factors such as the nature of the decision at hand and the nature and scope of the participants, introduce distinct governance trade-offs. These trade-offs play a critical role in determining the perceived legitimacy of the decision-making process within the blockchain community.

Terminology

In the previous sections, we distinguished governance mechanisms as "on-chain" versus "off-chain" based on where and how the decision-making is recorded and executed. In this section, we distinguish between governance mechanisms based on their underlying ethos and structural processes[51]:

/ Rough consensus is a qualitative and informal mechanism of gauging agreement in a group which often involves extensive discussions, debates, and deliberation until there is a lack of strong or significant opposition to a proposal.[52] Rough consensus doesn't rely on a strict count of votes but rather on a general sense of the group's opinion. Its ethos emphasizes collective agreement and collaborative problem-solving. This mechanism is not unique to blockchain systems. In fact, it was popularized in Internet governance by the Internet Engineering Task Force[53] and extended to other open-source projects, such as the Linux Kernel community[54] and the Phyton community, which famously passed the Python Enhancement Proposals (PEP) 0 and PEP 1 that served as inspiration for early blockchain communities.

/ Signaling and voting are more formalized and quantitative governance mechanisms where participants explicitly indicate their preferences or choices regarding a proposal or issue within a specified time frame. Proposals are passed if a pre-established quorum and majority thresholds are met. The inherent ethos of signaling and voting is not necessarily to encourage opposing parties to jointly agree on a desirable outcome, but rather to unambiguously measure how much support there is for a particular proposal. While these mechanisms are a staple in traditional governance structures, ranging from corporate boardrooms to national elections, blockchain technology and blockchain systems have paved the way for novel and more intricate signaling and voting designs. Although the terms are frequently used interchangeably, in this report, we choose to distinguish "signaling" and "voting" based on the blockchain community's perception of the anticipated outcomes as binding (the result ought to be enforced) or non-binding (the result does not need to be enforced).

- In signaling, the outcomes are not considered binding, but rather

indicative.[55] Signaling can happen on-chain, but it mostly occurs off-chain through third-party platforms. The reason is that in blockchain networks with high transaction fees, signaling acts as a filtering mechanism to streamline governance processes, ensuring that primarily those proposals with broad support advance to the formal voting stage, thereby optimizing governance costs.
• In contrast, voting outcomes are typically regarded as binding. While off-chain voting is technically possible, in practice, it frequently occurs on-chain.

In this report, "enforceability" in a blockchain system is understood as implementing a governance decision determined through a given governance mechanism. Considering the complex and multi-layered nature of blockchain systems, enforceability can—but not always is, or needs to be—automatically executed by a blockchain protocol or smart contract. For example, in Tezos, on-chain voting is not only aggregates preferences but also allows for outcomes to be self-executing by automatically integrating the results into the blockchain protocol code. However, merging code changes into the Bitcoin Core's GitHub repository in line with a Standards Track BIP adopted by off-chain rough consensus is also considered, in and of itself, an act of "enforcement."

Comparative Analysis of Governance Mechanisms Across Blockchain Networks

As previously noted, blockchain systems may employ these two mechanisms—either in isolation or combined—across different governance areas, experimenting with various configurations depending on specific needs.

The Bitcoin community adopts many decisions are adopted through Bitcoin Improvement Proposals (BIP). The process for how BIPs work was laid out in 2011 through BIP 0001, amended by BIP 0002, which is technically the first "secondary rule" or "rule on how to make rules" to govern a blockchain network. There are three types of BIPs: Process BIPs, which describe or propose changes to the BIP process itself, or other processes within the Bitcoin community. Informational BIPs are designed for general guidelines or information sharing and do not necessarily propose any changes to the Bitcoin protocol. Finally, Standards Track BIPs, which propose changes to the Bitcoin protocol, blockchain, or transaction validation method.Technically anyone can be a BIP author and share it in the Bitcoin Core GitHub repository. If the BIP editor—usually a well-known Bitcoin core dev—deems it meets the content and formatting criteria, it gets published. For a BIP to pass from "drafted" to "accepted," it has to meet a rough consensus. In other words, it should meet "no stark opposition" from community members. As time passed, BIP authors began to propose ad-hoc on-chain signaling mechanisms for miners to express their support or rejection by using, for example, the version field in the blocks they mine. Even if signaling was never deemed binding, it has played a crucial role in Standards Track BIPs, such as the ones that propelled the Segregated Witness (BIP 0141) and Taproot (BIP 0341 and BIP 0342) soft forks. .

Ethereum got inspiration from Bitcoin and adopted a similar framework. In 2015, community members presented their own "rule on how to make rules" through the Ethereum Improvement Proposal (EIP) 1, which had a similar rationale and review process. Like in Bitcoin, there are Informational EIPs, Meta (or Process) EIPs, and Standards Track EIPs. Several editors were originally assigned to oversee the quality and clarity of the proposals, including Ethereum co-founder Vitalik Buterin. Over time, as needs have evolved, this team's composition has grown and changed. To date, EIPs pass from "review" to "last call" to "final" stages through rough consensus where, in the case of Core EIPs—a type of Standards Track EIP—, protocol core developers play a crucial role in reviewing and issuing feedback. While no EIP standardized signaling or voting mechanisms exist, some have been proposed and utilized to help resolve contentious debates. For example, following the 2016 The DAO hack, the Ethereum community conducted a form of on-chain voting [56] to decide whether to implement a hard fork to reverse the DAO hack transactions. The voting was conducted through Carbonvote, a platform that allowed token holders to express their preference by sending a zero-value transaction from their Ethereum address to a YES or NO address and paying a transaction fee. A supra-majority of approximately 85% of the Ethereum addresses participating said YES to a hard fork, which effectively occurred on 20th July 2016.

The Zcash community has relied on rough consensus and, for some Zcash Improvement Proposals (ZIPs), ad-hoc signaling mechanisms. The Zcash's trademark agreement, one of the community's key governance documents, gives the Zcash Foundation and the ECC the exclusive right to legally determine what chain is called Zcash. Still, it stipulates that they agree to "not make or withhold any approval, consents, or other decision (...) if such approval, consent, or other decision is contrary to the Clear Consensus of the Zcash community." Proposals by the community follow the process established in ZIP 0—which, interestingly, gives credit to Luke Dashjr, a famous Bitcoin core developer—and can be rejected if, among other reasons, "they manifestly violate common expectations of a significant portion of the Zcash community." Throughout time, the community also incorporated "community sentiment collection polls." For example, in 2019, to decide on 13 ZIPs related to development funding, the Zcash Foundation requested input from the representative community body known as the Zcash Community Advisory Panel (ZCAP) through the off-chain signaling platform Helios Voting Booth and from the Zcash miners through an on-chain signaling mechanism.

Similarly, Filecoin stakeholders can submit a Filecoin Improvement Proposal (FIP) by following the guidelines outlined in FIP-0001. FIP-0001 advises FIP authors to first vet their proposals within the community, utilizing platforms like the Filecoin GitHub Repository's Issues section, the Filecoin Discourse Forum, and the Filecoin Community Chat. After drafting an FIP, authors are tasked with building community consensus. This process can involve noting opposing views, responding to technical concerns, and making necessary adjustments to ensure the FIP's acceptance. In August 2023, the Filecoin Foundation introduced the FIP0001v2 Initiative #799. This initiative aims to revise FIP-0001, deploy improved tools to facilitate the FIP process, and ensure greater alignment with community values.

Other blockchain systems also resort to rough consensus and propose native or third-party signaling mechanisms. In October 2023, the Avalanche Foundation proposed an Avalanche Community Proposal (ACP) process, also inspired by Bitcon's and Ethereum's "secondary rules" and aimed at "building consensus." Contrarily to BIPs and EIPS, however, the ACP process includes an off-chain signaling mechanism that ACP authors can—but are not obliged—to use. It also gives the Avalanche Foundation a role in issuing "non-binding recommendations" on ACPs.

The Polygon ecosystem presents similar aspects. Currently evolving in the framework of Polygon's Governance 2.0, the community relies on Polygon Improvement Proposals (PIPs) for providing information or describing a new feature for Polygon or its processes or environment following the framework put forward in PIP-1 and PIP-8. The main discussion space among community members for all PIPs is the Polygon Community Forum. Feedback from the forum is incorporated into the documented PIPs housed in the Github repository. Additionally, members of Polygon Labs and other stakeholders with technical knowledge gather in online calls such as "Polygon Governance Calls," which serve as instances for addressing questions and suggestions about potential or in-review governance proposals. The governance of the PoS Chain has also relied on off-chain signaling mechanisms. Traditionally, validators would conduct polls to signal support or rejection of ideas in a dedicated Discord channel. In 2022, Polygon Labs announced they would use Snapshot as a tool for consensus gathering in areas such as offboarding offline validators. Snapshot was used to conduct a poll on PIP-4: Validator Performance Management.

Notably, some blockchain communities have developed sophisticated combinations of different governance mechanisms. For example, in Cosmos Hub, token holders can propose how to spend funds from the community pool, changes to a core on-chain parameter, upgrades to the chain version, or updates to an IBC client. Proposals go through an off-chain process of peer review by community members. For pushing proposals lives on testnet and mainnet, members are recommended to host the detailed documentation on a separate censorship-resistant data-hosting platform like IPFS. Once the proposal is live before it is up to an on-chain vote, 250 ATOM tokens need to be deposited within a period of a maximum of 14 days. If a quorum of 40% of the network's total voting power (staked ATOM) is reached, participants may select a vote of either 'Yes,' 'No,' 'Abstain,' or 'NoWithVeto.' Proposals pass by a simple majority of 50% 'Yes.' However, if 33% votes 'NoWithVeto', the proposal will fail and the proposer will lose their proposal deposit. Results of proposals on funds from the community pool and parameter changes cause direct changes to the Hub. Cosmos Hub also has an on-chain signaling mechanism called "Text Proposals," which are used to record sentiment on-chain but are considered non-binding and are not automatically enforceable.

Cardano's governance model is undergoing a series of changes. The community relies on two main processes. On the one hand, there are Cardano Improvement Proposals (CIP), which, as specified in CIP-1, present information or changes to the Cardano ecosystem, processes, or environment in the Cardano Foundation's GitHub Repository. The CIP workflow goes from "proposed," to "active" or "inactive" through rough consensus. Interestingly, every CIP is required to include a clear "path to active" with a measurable metric used to gauge when CIPs related to projects or technologies are "implemented and released," when changes to the Cardano protocol go live on the Cardano mainnet, and when ecosystem standards achieve "noticeable adoption within the community." These "activation criteria" should be accompanied by a detailed "implementation plan." Essentially, CIPs must provide a specific reference or benchmark to indicate their successful enforcement. CIP Editors hold meetings that are public, recorded, and published on YouTube. On the other hand, there are Funding Proposals (FP), which are selected through on-chain voting. FPs refer to proposals put forward by community members to improve the ecosystem. Examples of such proposals might involve allocating funds for future platform development or creating new features or integrations. FPs undergo a voting process through an application called Project Catalyst. When a proposal is presented, any ADA holder can cast a vote on it. Votes are weighted based on token holdings. The proposals that garner the most support are will be awarded funds from the treasury, as outlined in their respective proposals. CIP-1694, pivotal in shaping the evolution of Cardano's governance, introduces two new governance bodies to existing Stake Pool Operators. Together, these entities play a role in the ratification of "governance actions", not to be confused with CIPs, and introduced by ADA holders through a mechanism of on-chain voting. These changes are part of the "Voltaire" stage of Cardano's governance development.

The Polkadot community is in the process of shifting from Governance V1 to Governance V2, also known as OpenGov. Until now, the primary mechanism for the community to make decisions has been through "referenda" whose content is discussed off-chain and decided on-chain through a platform called Polkassembly. As of November 2023, with the advent of OpenGov, any DOT holder can draft a proposal, which is categorized based on implementation complexity and potential impact. This categorization helps determine the appropriate governance process for each proposal. After a referendum is created, it enters a "decision period" during which votes can be cast and counted. Voters can cast an 'aye,' 'nay,' or 'abstain' vote, or, alternatively, split votes among these categories. For a proposal to be approved, votes must satisfy the "approval and support criteria" during the "confirmation period," otherwise, the proposal is automatically rejected. Approved proposals enter the "enactment period," where proposed changes are being executed. Approval is calculated as the proportion of affirmative (aye) votes, adjusted for conviction, concerning to the overall vote weight. Support is measured by the sum of affirmative and abstained votes (without any adjustment for conviction) as a percentage of the total potential votes within the system. "Conviction" refers to "conviction voting," a way for token holders to boost their voting power by committing their tokens to a decision (or keeping their tokens staked) for a longer period. The Polkadot community also relies on a Technical Fellowship, functioning as a self-governing expert body and primarily engaged in managing its membership, approving Request for Comments (RFCs), and whitelisting proposals for Polkadot OpenGov. The collective decision of the members, with votes weighted according to their respective ranks, forms the considered opinion of the Fellowship.

In April 2022, the launch of the Optimism Collective, comprising "communities, companies, and citizens," was announced and stewarded by the Optimism Foundation. Governance is bi-cameral. On the one hand, the Token House which is governed by holders of the OP token, who can vote directly or delegate their voting power to an OP delegate. Currently, they vote on matters such as governance fund grants, protocol upgrades, inflation adjustment, director removal, treasury appropriations, and rights protection. On the other hand, the Citizens' House, is "an experiment in non-plutocratic governance" using a one-person, one-vote system and responsible for retroactive public goods funding (RPGF) generated by the revenue collected by the network. Its responsibilities are expected to increase with time. Citizens are supposed to be elected based on a series of attestations relevant to the eligibility process. Following an announcement in July 2023, the Citizens' House will determine Citizenship Eligibility, and the Token House will have the power to veto. To date, Citizenship expansion has been administered by the Optimism Foundation. In December 2022, the Optimism Foundation proposed transitioning from Snapshot into on-chain voting through Agora, where OP Delegates, the stewards of the Optimism Token House, make governance decisions on their behalf. The Optimism Collective is undergoing a process "governance reflection period." As of December 2023, the Optimism Collective is undergoing a "governance reflection period. According to the OPerating Manual, both Houses should make governance decisions through governance proposals. Most proposal types are posted in the Governance Forum for feedback, following a Standard Proposal Template. After a governance administrator creates a Voting Cycle Roundup, stakeholders responsible for deciding on each type of proposal (either OP Delegates or Citizens) are invited to vote. Proposals shall pass depending on the quorum, approval, and—for the Citizens' House—veto thresholds.

Finally, governance in Tezos is a multi-phase process that relies on on-chain voting over proposals for amending the economic protocol that, if approved, have their outcomes automatically enforced. The amendment process in Tezos involves a structured sequence of five periods spanning approximately two and a half months, with voting power tied to the number of XTZ tokens held by delegates. The process begins with the "proposal period," where delegates submit or upvote proposals. The most supported proposal that meets the quorum advances to the "exploration period," where delegates vote Yea, Nay, or Pass. If a super-majority approves and quorum is met, it moves to the "cooldown period" for further off-chain scrutiny. Next is the "promotion period," with another round of voting. If this also achieves a quorum and a super-majority of affirmative votes, the proposal enters the "adoption period." While the quorum threshold during the first voting was close to 80% of the stake, it has since been adjusted to ensure that the amendment process can continue even if some delegates stop participating. The supra-majority is reached if the cumulated stake of Yea ballots is greater than 8/10 of the cumulated stake of Yea and Nay ballots. During the final "adoption" phase, developers release tools supporting the new protocol, and various stakeholders update their systems. The proposal is activated at the end of this period, with the new economic protocol taking effect from the first block following this period.

Legitimacy, Contextual Factors, and Trade-offs

As mentioned in the "Governance Formalization" insight, whether the community will consider the governance of the blockchain system legitimate is usually contingent on the moral alignment or the perceived benefit to the interest of its members.[57] Thus, contemplating the potential consequences of using one of several governance mechanisms is pivotal. However, the comparative examination of blockchain systems shows that discerning the trade-offs inherent to mechanisms like "rough consensus" and "signaling and voting" is a nuanced task, often eluding broad generalizations. Contextual factors, such as the nature of the governance decision and the diversity and scope of the participating stakeholders, deeply influence these trade-offs. For instance, employing rough consensus among a small group of developers discussing technical standards significantly differs from using it for wider community deliberations on contentious software upgrades. Similarly, the dynamics of token-weighted on-chain voting among aligned token holders may contrast sharply with using this mechanism for decisions that seem to benefit more directly token-holders with high stakes. However, with these gradients in mind, the explored governance mechanisms can lead to some distinct scenarios. Rough consensus, while ostensibly more "democratic" in allowing participation of non-token holders, faces challenges in determining when consensus is truly reached, potentially leading to protracted, unresolved discussions or manipulation of public opinion by influential entities. On the other hand, signaling and voting tend to offer more measurable, time-bound decision-making processes but are not without issues. When happening on-chain through token-weighted systems, they inherently lean towards plutocracy. The pseudonymity of public blockchains might also compromise anonymity, deterring honest expression among participants wary of backlash and facilitating the proliferation of "automated bribery protocols."[58]

Impact

Blockchain communities must carefully consider the implications of these governance mechanisms. Whether these are used individually or in combination, in their simpler or more sophisticated forms, "rough consensus" and "signaling and voting" encourage behaviors that can be either constructive or detrimental to the network's sustainability and resilience, ultimately influencing stakeholders' perceptions of the legitimacy of the blockchain system.

51 It is important to remember that this section dwells on governance mechanisms that amend or develop new rules, as opposed to on-chain and ex-ante governance mechanisms that are already "baked" into the blockchain code, such as consensus algorithms.
52 Rough consensus does not require unanimous decision approval. Still, it is not considered "achieved" if a bit less than half of the decision-makers clearly express disagreement. See: Jones, B. (1994). A comparison of consensus and voting in public decision making. Negotiation Journal, 10(2), 161–171. https://doi.org/10.1007/BF02184175
53 Pete Resnick, "On Consensus and Humming in the IETF," Internet Engineering Task Force, June, 2014, https://datatracker.ietf.org/doc/rfc7282/
54 Greg Kroah-Hartman, "9 lessons from 25 years of Linux kernel development," Opensource.com, December 14, 2016, https://opensource.com/article/16/12/yearbook-9-lessons-25-years-linux-kernel-development
55 For examples on why we define signaling as non-binding, even when on-chain, see: Bitcoin Magazine, "Bitcoin Miners Are Signaling Support for the New York Agreement: Here's What that Means," Bitcoin Magazine, June 20, 2017, https://www.nasdaq.com/articles/bitcoin-miners-are-signaling-support-for-the-new-york-agreement:-heres-what-that-means
56 There is an ongoing discussion on what "on-chain voting" is supposed to encompass. See, for example, ZeusLawyer, "For decentralized governance on Ethereum, why is Snapshot considered "off-chain" but Tally considered "on-chain"?" [Forum post], Ethereum Stack Exchange, May 2, 2022, https://ethereum.stackexchange.com/q/127331. In this report, on-chain voting involves issuing preferences through transactions in the blockchain, usually paying transaction fees, even if the final vote count and tally is done, off-chain and the results were deployed on a traditionally hosted website such as in the case of Carbonvote back in 2016.
57 Phillips, "The Bitcoin.org website is getting a new owner."
58 For more information about automated bribery protocols, particularly in the Decentralized Finance (DeFi) space, see: Liam J. Kelly, "DEFI bribes are on the rise," Decrypt, Jan 13, 2022, https://decrypt.co/90276/defi-bribes-are-on-the-rise

VI. Security Measures and Breaches

VI. Security Measures and Breaches

"Core developers and security teams remain among blockchain governance's most trusted stakeholders."

Finding

In the context of many blockchain systems, the adoption of preventive security measures and, in particular, the handling of security breaches usually involve exceptional governance processes or mechanisms that extend beyond "regular" governance areas. These emergencies or "states of exception" sometimes entail the centralization of decision-making power by founders, founding teams, and software developers in ways that some community members may perceive as controversial.

Preventive Security Measures

Preventive security measures comprise a variety of practices and technologies used to protect blockchain networks from specific threats and vulnerabilities. These include safeguarding the network from external attacks aimed at disrupting its operations, such as Distributed Denial of Service (DDoS) attacks[60], evaluating the robustness of consensus algorithms against potential take-overs, such as through 51% attacks, or ensuring that smart contracts execute as intended without any room for exploits. The design and implementation of preventive security measures require input from tech-savvy individuals, either in-house security teams, third-party service providers, or external contributors submitting bugs or vulnerabilities for fun or with an expectation of rewards.

Often, in-house security teams are set up and employed by the legal entities associated with a particular blockchain network (e.g., the security team hired by the Ethereum Foundation). These are usually responsible for designing, implementing, and overseeing security measures, following responsible disclosure, response, and reporting processes. Bitcoin represents an interesting case of a blockchain community with no in-house (i.e., "hired") security team. However, the Bitcoin community has delineated a process for responsible disclosure of security bugs. Reports can be submitted through encrypted emails to Bitcoin core developers or through the Bitcoin Core GitHub repository. They are handled by Bitcoin core developers, who usually disclose and report patches on the Bitcoin core website.

Blockchain communities occasionally rely on bug bounty programs to incentivize people with technical expertise to identify potential threats and vulnerabilities before they become known to the world at large. For instance, the Ethereum Foundation uses a bug bounty platform that rewards bug reporters with up to 250,000 USD, depending on the severity of the issue. Avalanche also implemented a bug bounty program deployed on HackenProof, a "Web3 bug bounty platform for crypto projects," with potential rewards of up to 100,000 USD. Similarly, the Tezos Foundation has set up a bug bounty program where anyone—except for Tezos core developers or contractors—can report a bug by submitting an encrypted email to the Foundation's security team, which rewards the author of valuable submission with a particular amount of XTZ.

“Exceptional governance processes in blockchain, particularly during critical bug reports and security breaches, often necessitate a ‘state of exception,’ leading to centralized authority.”

Another common practice in the ecosystem is for blockchain systems to undergo third-party security audits. Avalanche recently announced the auditing of its main architectural components in the footsteps of Cardano’s IOHK, Cosmos, Filecoin, Optimism, Polkadot, Polygon, Tezos, and Zcash. Blockchain communities have also established processes or developed products and services for auditing projects built on their network, such as Cardano’s CIP-52.

Processes and Mechanisms for Unanticipated Events

Even when blockchain communities invest a lot of effort and resources in preventive security measures, unanticipated events can still occur. Some blockchain communities have established specific governance processes that only become effective in the contingency of security breaches, such as hacks and attacks. These processes tend to increase the transparency of how unanticipated events are handled and may give the blockchain community a way to hold decision-makers to account. Still, the individuals directly involved in the decision-making processes during these emergencies retain considerable discretion.

In September 2023, the Optimism Collective voted to introduce a Security Council, whose role and responsibilities are described in the OPerating Manual. During normal operations, the Security Council would implement protocol updates and designate the roles of actors involved in block production, such as sequencers, proposers, and challengers. During “emergencies,” it would be in charge of ensuring the safety of the network by “proactively addressing issues” such as bugs, defects, unplanned maintenance, or any concerns impacting the security, stability, integrity, and availability of the OP Stack or any OP Chain. To safeguard the Security Council from legal liability, each member can “undertake actions deemed necessary for legal compliance,” as advised by themselves or the Optimism Foundation. These emergency measures can be implemented without “formal Governance approval.” However, in cases where the Security Council exercises this discretion, it is expected to promptly deliver a “detailed and transparent retrospective to the community,” explaining the actions taken and their reasons while respecting any “legal or security obligations for confidentiality.” The Optimism Collective shall elect the Security Council and hold it to account, with the Token House having the power to remove Security Council members at any time for severe violations of the Code of Conduct. As of this report, this governance body has not been elected, and we expect its governance mandate to continue to be shaped.

In the context of Polkadot, as discussed earlier, the new OpenGov framework introduced a Technical Fellowship to replace the Technical Committee and Council of its previous governance framework. In cases of emergency, the Technical Fellowship can whitelist proposals to have shorter lead-in, confirmation, and on-chain voting periods. PIP-29 also introduced a “Protocol Council” (previously referred to as “Ecosystem Council” in Polygon’s Governance 2.0 documentation), a 13-member governance body responsible for performing regular and emergency upgrades to the system’s smart contracts. For “regular” changes, decisions require a 7-of-13 majority vote, with a 10-day timelock delay to allow the community to exit before any change occurs. For “emergency” changes, it requires a 10-of-13 majority vote, and changes are automatically implemented.

At Filecoin, some stakeholder groups proposed the idea of enacting a process for “states of exception” or emergencies. This idea started after Storage Providers heavily debated certain FIPs which, ultimately, did not pass. The proposed idea never gained traction due to the lack of due process. As seen in the "Governance Mechanisms" insight, various other approaches have been taken in controversial proposals, including core developers' rough consensus.

Unanticipated Events and Informal Decisions

Formalizing and publicizing processes for emergency procedures during unanticipated events is a relatively new trend. Until now, there have been controversial situations where founders, foundations, or developer teams have taken control during emergencies in ways that some community members have criticized.

The 2013 Bitcoin "accidental hard fork" is one example. On March 11, 2013, a severe incompatibility issue between Bitcoin client 0.7 and 0.8 versions caused the main chain to fork into two separate chains. Once the problem was detected, a handful of Bitcoin core developers quickly deliberated on the action in the #bitcoin-dev IRC channel. There were two potential solutions: instruct miners and merchants to upgrade to the 0.8 version and stick to the newer chain or downgrade to the 0.7 version and stick to the older chain. One of the largest Bitcoin mining pools, BTC Guild, joined the conversation. Together, Bitcoin core devs and BTC Guild decided that downgrading to the 0.7 was the least risky solution and hoped miners would agree to do so, too. Afterwards, core developer Peter Wuille posted on the website bitcointalk.org instructing miners, mining pools, miners, and merchants to downgrade their clients. The crisis was resolved in a matter of six hours. Some important voices in the Bitcoin community, such as Vitalik Buterin—who had not launched Ethereum yet—commended the work done during the 2013 crisis. However, Vitalik himself argued that the instruction to downgrade to 0.7 may have been unnecessary. According to him, even if the core developers had done nothing, the Bitcoin network would have continued to work, albeit with some monetary loss. Echoing some worries felt across the community, Vitalik also pointed out that the handling of the accidental hard fork crisis may have left some feeling that "Bitcoin [was] clearly not at all the direct democracy that many of its early adherents imagine." While he ultimately downplayed these fears, the episode revealed aspects of the Bitcoin governance that may not have been so clear to the community at large, including the power concentrated in mining pools and the role played by Bitcoin core devs during unanticipated events.

Ethereum does not have pre-defined, formal processes for addressing states of exception. "The DAO" hack and the process that led to the Ethereum hard fork is another example of an exceptional procedure to resolve a critical incident. The DAO, launched in April 2016, was an investor-driven venture capital fund managed as a decentralized autonomous organization (DAO). In June 2016, an attacker exploited a vulnerability in The DAO's smart contract code to drain about one-third of its funds: over $50 million worth of Ether at that time. The Ethereum community faced a dilemma: either accept the consequences of the hack to preserve the immutability of the Ethereum blockchain or intervene to remediate the harm by violating the protocol rules of the Ethereum blockchain. The decision to hard fork contradicted the immutability and irreversibility principle that many Ethereum community members seemed to hold dear. As mentionedin the "Governance Mechanisms" section, eventually, the decision was subject to an on-chain vote through the Carbonvote platform, with approximately 85% of the participants (amounting to only 5.5% of the total Ether supply) voting in favor of the hard fork. The decision to hard fork split the Ethereum community into two camps: those who supported the fork to recover the funds and those who opposed it. This event led to the emergence of a separate blockchain network, Ethereum Classic (ETC), which rejected the hard fork and continued on the original Ethereum blockchain. Critics of the hard fork saw the decision to fork as a demonstration of centralized power, where a few core developers and the Ethereum Foundation had significant influence in a decision affecting the Ethereum network as a whole.[64]

Similarly, in 2021, Polygon had to introduce a hard fork to resolve a critical vulnerability in the PoS genesis contract discovered by two whitehat hackers and reported via the blockchain security and bug bounty platform Immunefi. Over 9.27 billion MATIC were at risk, representing nearly the entirety of the token's total supply of 10 billion MATIC. According to an article released by Protocol Labs, the Polygon core team and Immunefi experts addressed the very critical vulnerability with an "Emergency Bor Upgrade," informing validators and the full node community to update their software. Within 24 hours, around 80% of the network transitioned to the new client, successfully preventing any network disruptions. The security resolution process followed a "silent patches" policy, which mandates reporting critical bug fixes several weeks after implementation to prevent exploitation risks during the patching process. While some validators voiced concerns about their nodes falling out of sync, they did not seem to have criticized the upgrade or its implementation. The article released by Protocol Labs, which detailed the security concerns behind their decision, may have likely helped garner support and understanding from various stakeholders regarding the actions taken.[65]

These examples show that when blockchain These examples show that when blockchain systems don't have formalized governance processes for emergencies described in public documentation nor make efforts to clearly inform about the steps and rationale that had to be followed to address the emergency, exceptional interventions are likely to be opposed more firmly by community members. As happens in nation-states during "states of exception," influential actors can leverage unanticipated events to further their own political (or economic) interests. For this reason, a proper formalization of "emergency procedures" is necessary for legitimate intervention.

Impact

Blockchain communities must formalize how blockchain security will be preserved and maintained without creating attack vectors for political centralization. This requires balancing specialized expertise and technical pragmatism to delineate if, when, and how specific actors in a blockchain system can invoke "states of exception." At the time of writing, core developers and in-house security teams remain among blockchain governance's most trusted stakeholders.

59 A Distributed Denial of Service (DDoS) attack on a blockchain network is a significant threat, though it's less common compared to traditional networks due to the inherent design of blockchain technology. To learn more about this topic, see: Rob Behnke, "How blockchain DDoS attacks work," Halborn, October 19, 2021, https://www.halborn.com/blog/post/how-blockchain-ddos-attacks-work

60 Danilo Lessa Bernardineli, Michael Zargham and Jamsheed Shorish, "Reviewing the FIP-0056 and CDM debate on Filecoin," BlockScience Medium, March 23, 2023, https://medium.com/block-science/reviewing-the-fip-0056-and-cdm-debate-on-filecoin-6a6af0ed4b78

61 CoinMarketCap, "A history of 'The DAO' hack," CoinMarketCap Academy, October 13, 2021, https://coinmarketcap.com/academy/article/a-history-of-the-dao-hack

62 Polygon Labs, "All You Need to Know About the Recent Network Upgrade," Polygon News, December 29, 2021, https://polygon.technology/blog/all-you-need-to-know-about-the-recent-network-upgrade

Conclusion

Blockchain technology has the potential to transform from small aspects of our daily lives all the way to and entire industries by offering a secure, transparent, and decentralized way of recording and verifying transactions. As blockchain has continued to grow in significance, many blockchain systems have emerged. Blockchain systems are techno-socio structures that encompass the underlying blockchain technology and the human input required to develop and maintain the ledger and other integrated software. Understanding how blockchain systems are governed is crucial to unveiling how these technologies operate, evolve, and interact with various stakeholders. This report is a crucial milestone in our ongoing exploration of Web3 governance dynamics, laying the foundation for the forthcoming Manual on Best Governance for Blockchain and Decentralized Technologies, scheduled for release in April 2024. The insights gleaned from our extensive review of eleven leading blockchain protocols across six interconnected domains underscore the complexity and nuances inherent in analyzing blockchain governance. The key findings of this report will guide the formulation of good governance recommendations providing pragmatic guidance to stakeholders in the Web3 space. Below, we delineate a set of preliminary hypotheses that might constitute the basis of these recommendations.

1. Legal Entities

While the creation of legal entities can improve legal certainty in the Web3 ecosystem, they also introduce (both intended and unintended) power asymmetries that must be accounted for by the relevant blockchain communities. To maintain legitimacy in the eyes of the community, it might be necessary for these legal entities to adopt open and transparent accountability measures to mitigate power imbalances and foster an equitable governance structure.

2. Power Distribution

Governance in public blockchain networks is "polycentric" to the extent that decision-making power is distributed across multiple governance areas and stakeholder groups. Yet, polycentricity is not always necessarily synonymous with political decentralization. Hence, having blockchain communities develop governance frameworks that explicitly acknowledge and account for the polycentric nature of blockchain networks might be crucial for fostering more inclusivity and mitigating power concentration risks.

3. Planned vs. Actual Decentralization

Decentralization requires a clear and operationalized definition and a strategy against re-centralization dynamics. This suggests that it may not be sufficient to design decentralized systems. It may also be necessary to develop protocols that will remain decentralized over time by identifying relevant strategies against concentration dynamics that could compromise the decentralized nature of these protocols.

4. Governance Formalization

Despite the high degree of on-chain formalization, many governance processes in the Web3 ecosystem still rely on off-chain governance practices characterized by implicit and tacit norms and procedures. Bridging the gap between on-chain and off-chain governance requires further formalization of off-chain practices, ensuring more transparency and accountability in blockchain governance.

5. Governance Mechanisms

There are no one-size-fits-all governance mechanisms. Different scenarios may require different approaches to governance. Governance mechanisms thus need to be tailored to the specific context of decision-making, which includes the nature of the decision, the scope and characteristics of the participants, and the overall goals of the blockchain system. A combination of "rough consensus" and "signaling and voting" might be required to achieve a more flexible and dynamic governance process capable of catering to different needs and situations.

6. Security Measures and Breaches

Swift decision-making is crucial for addressing security incidents during a state of exception. However, rapid response might require a more centralized decision-making process, which may reduce legitimacy and introduce political attack vectors. Accordingly, blockchain communities that implement exceptional governance frameworks might need to clearly identify the actors involved in these specific governance processes while also implementing appropriate safeguards against potential political manipulation during a state of exception.

Through the continued collaboration between the Project Liberty Institute, BlockchainGov, and the Governance Multistakeholder Council, we will further elaborate these recommendations and incorporate them, along with a series of best practices and guidelines, into the Manual on Best Web3 Governance Practices. While we do not purport to normatively prescribe how the governance of blockchain communities should be implemented, we hope these recommendations will serve as a guiding compass to support technologists, industry leaders, policymakers, and practitioners invested in shaping novel, effective, and resilient governance frameworks for the Web3 ecosystem.

Bibliography

Alston, Eric, "Constitutions and Blockchains: Competitive Governance of Fundamental Rule Sets." Case Western Reserve Journal of Law, Technology & the Internet 11, no. 1 (2020), https://scholarlycommons.law.case.edu/jolti/vol11/iss1/6

Alston, Eric, "Governance as Conflict: Constitution of Shared Values Defining Future Margins of Disagreement." MIT Computational Law Report (2022), https://law.mit.edu/pub/governanceasconflict/release/1.

Barbereau, Tom, Smethurst Reilly, Papageorgiou Orestis, Sedlmeir Johannes, Fridgen Gilbert, "Decentralised Finance's timocratic governance: The distribution and exercise of tokenised voting rights." Technology in Society 73, (2023), https://doi.org/10.1016/j.techsoc.2023.102251. Feichtinger, Rainer, Fritsch Robin, Vonlanthen Yann, Wattenhofer Roger, "The Hidden Shortcomings of (D)AOs -- An Empirical Study of On-Chain Governance," arXiv, (2023), https://doi.org/10.48550/arXiv.2302.12125

Behnke, Rob. "How blockchain DDoS attacks work." Halborn, October 19, 2021, https://www.halborn.com/blog/post/how-blockchain-ddos-attacks-work

Benjamin, Godfrey, "Cardano (ADA) Voltaire era to be launched following three major steps: Details." U.Today, March 2, 2023, https://u.today/cardano-ada-voltaire-era-to-be-launched-following-three-major-steps-details

Bernardineli, Lessa, Zargham Michael and Shorish Jamsheed, "Reviewing the FIP-0056 and CDM debate on Filecoin." BlockScience Medium, March 23, 2023, https://medium.com/block-science/reviewing-the-fip-0056-and-cdm-debate-on-filecoin-6a6af0ed4b78

Bernie Jones, "A comparison of consensus and voting in public decision making." Negotiation Journal 10 (1994): 161-171, https://doi.org/10.1007/BF02184175

Bitcoin Magazine, "Bitcoin Miners Are Signaling Support for the New York Agreement: Here's What that Means." Bitcoin Magazine, June 20, 2017, https://www.nasdaq.com/articles/bitcoin-miners-are-signaling-support-for-the-new-york-agreement:-heres-what-that-means

Bodo, Balazs and Giannopoulou Alexandra, "The logics of technology decentralization – the case of distributed ledger technologies." In Blockchain and Web 3.0 1st Edition, (Routledge, 2019): 114-129, DOI:10.4324/9780429029530-8

Braiins, "Bitcoin's Decentralization with Stratum V2." Braiins, June 29, 2020, https://braiins.com/blog/stratum-v2-bitcoin-decentralization

Brekke, Jaya Klara, Beecroft Kate and Pick Francesca, "The Dissensus Protocol: Governing Differences in Online Peer Communities." Frontiers in Human Dynamics 3 (2021), https://www.frontiersin.org/articles/10.3389/fhumd.2021.641731.

Buterin, Vitalik, "Bitcoin Network Shaken by Blockchain Fork." Bitcoin Magazine, March 13, 2013, https://bitcoinmagazine.com/technical/bitcoin-network-shaken-by-blockchain-fork-1363144448

Buterin, Vitalik. "The Meaning of Decentralization," Medium, February 6, 2017, https://medium.com/@VitalikButerin/the-meaning-of-decentralization-a0c92b76a274

Cardano's Monetary Policy, see: Cardaniansio, "Understanding Cardano Monetary Policy," Cexplorer.io, Sep 11, 2023, https://cexplorer.io/article/understanding-cardano-monetary-policy

CoinMarketCap, "A history of 'The DAO' hack," CoinMarketCap Academy, October 13, 2021, https://coinmarketcap.com/academy/article/a-history-of-the-dao-hack

De, Nikhilesh, "SEC Chair Gensler Declines to Say if Ether Is a Security in Contentious Congressional Hearing." CoinDesk, April 19, 2023, https://www.coindesk.com/policy/2023/04/19/sec-chair-gensler-declines-to-say-if-ether-is-a-security-in-contentious-congressional-hearing/

De, Nikhilesh and Nelson Danny, "Filecoin Price Drops After SEC Asks Grayscale to Withdraw Application to Make Trust Reporting." CoinDesk, May 18, 2023, https://www.coindesk.com/policy/2023/05/17/filecoin-price-drops-after-sec-asks-grayscale-to-withdraw-fil-trust-application/.

De Filippi, Primavera, Mannan Morshed, Nabben Kelsie, Cossar Sofia, Kamalova Jamilya, Merk Tara, Noa Silke, Crepaldi Marco, Dávila Joshua, "Blockchain Constitutionalism: The Role of Legitimacy in Polycentric Systems." (2023), https://blockchain-gov.eu/wp-content/uploads/2023/11/EUI-Conference-June-2023-FINAL.pdf

De Filippi, Primavera, Mannan Morshed, Nabben Kelsie, Cossar Sofia, Merk Tara, Kamalova Kamilya, "Report on Blockchain Technology and Polycentricity." (forthcoming).

De Filippi, Primavera, Mannan Morshed, Reijers Wessel, Berman Paula, Henderson Jack. "Blockchain Technology, Trust & Confidence: Reinterpreting Trust in a Trustless System?." SSRN Scholarly Paper 4300486, (December 2022), https://doi.org/10.2139/ssrn.4300486.

De Filippi, Primavera and Loveluck Benjamin, "The Invisible Politics of Bitcoin: Governance Crisis of a Decentralised Infrastructure." Internet Policy Review 5, no. 3 (2016), https://hal.science/hal-01382007.

De Filippi, Primavera and McMullen Greg, "Governance of blockchain systems: Governance of and by Distributed Infrastructure." Blockchain Research Institute and COALA, (2018), https://hal.science/hal-02046787/document.

De Filippi et al., "Report on Blockchain Technology & Legitimacy," SSRN Scholarly Paper 4300502, (2022), https://doi.org/10.2139/ssrn.4300502.

Esber, Jad and Kominers Scott Duke, "Progressive decentralization: a high-level framework." A16z Crypto, Jan 12, 2023, https://a16zcrypto.com/posts/article/progressive-decentralization-a-high-level-framework/

Faguet, Jean-Paul, "Decentralization and Governance." World Development 53, (2014): 2–13 https://doi.org/10.1016/j.worlddev.2013.01.002

Faustino, Sandra, Faria Inês and Marques Rafael, "The myths and legends of king Satoshi and the knights of blockchain." Journal of Cultural Economy 15, no. 1 (2021): 67-80, https://doi.org/10.1080/17530350.2021.1921830

Ferdous, Md Sadek, Chowdhury Mohammad Jabed Morshed, Hoque Mohammad A. and Colman Alan, "Blockchain Consensus Algorithms: A Survey." arXiv, (2020), https://doi.org/10.48550/arXiv.2001.07091.

Han, Rong, Yan Zheng, Liang Xueqin, Yang Laurence T., "How can incentive mechanisms and blockchain benefit each other? A survey," ACM Computing Surveys 55, no. 7 (2022): 1-38, https://doi.org/10.1145/3539604

Hinman, William, "Digital Asset Transactions: When Howey Met Gary (Plastic)." U.S. Securities and Exchange Commission, June 14, 2018, https://www.sec.gov/news/speech/speech-hinman-061418.

Karakostas, Dimitris, Kiayias Aggelos and Ovezik Christina, "SoK: A Stratified Approach to Blockchain Decentralization." arXiv, (2022), https://doi.org/10.48550/arXiv.2211.01291

Kelly, Liam J., "DEFI bribes are on the rise." Decrypt, Jan 13, 2022, https://decrypt.co/90276/defi-bribes-are-on-the-rise

Kim, Christine, "The Ethereum Governance Process." ETHGlobal Youtube, September 29, 2023 https://www.youtube.com/watch?v=2T4h-r9wu44.

Kroah-Hartman, Greg, "9 lessons from 25 years of Linux kernel development." Opensource.com, December 14, 2016, https://opensource.com/article/16/12/yearbook-9-lessons-25-years-linux-kernel-development

Leporati, Alberto, "Studying the Compounding Effect: The Role of Proof-of-Stake Parameters on Wealth Distribution." In Proceedings of the Fifth Distributed Ledger Technology Workshop (DLT 2023), ed. Paolo Mori, Ivan Visconti and Stefano Bistarelli, (2023), https://ceur-ws.org/Vol-3460/papers/DLT_2023_paper_2.pdf.

Loop, Jameson, "Who Controls Bitcoin Core?," Medium, December 15, 2018, https://medium.com/@lopp/who-controls-bitcoin-core-c55c0af91b8a.
Hudson Jameson, "What is an Ethereum core developer?," Hudson Jameson, June 22, 2020, https://hudsonjameson.com/2020-06-22-what-is-an-ethereum-core-developer/#:~:text=Definition,layer%2C%20such%20as%20client%20code.

MacDonald v. Dynamic Ledger Sols., Inc., Case No. 17-cv-07095-RS (N.D. Cal., 2017).

Mannan, Morshed, De Filippi Primavera and Reijers Wessel, "Blockchain Constitutionalism." In Oxford Handbook of Digital Constitutionalism, ed. Giovanni de Gregorio, Oreste Pollicino and Peggy Valcke, (forthcoming).

Mitchelhill, Tom, "Vitalik Buterin on fix for Ethereum centralization: Make running nodes easier." Cointelegraph, September 5, 2023, https://cointelegraph.com/news/vitalik-buterin-ethereum-centralization-issues-running-nodes-easier

Nabben, Kelsie, "Cryptoeconomics as governance: an intellectual history from 'Crypto Anarchy' to 'Cryptoeconomics'." Internet Histories 7, no. 3 (2023): 254–276, https://doi.org/10.1080/24701475.2023.2183643.

Naranayan, Arvind, "Analyzing the 2013 Bitcoin fork: centralized decision-making saved the day." Freedom to Tinker, July 28, 2015, https://freedom-to-tinker.com/2015/07/28/analyzing-the-2013-bitcoin-fork-centralized-decision-making-saved-the-day/

Pete Resnick, "On Consensus and Humming in the IETF." Internet Engineering Task Force, June, 2014, https://datatracker.ietf.org/doc/rfc7282/

Phillips, Daniel, "The Bitcoin.org website is getting a new owner." Decrypt, May 21, 2020, https://decrypt.co/29517/the-bitcoin-org-website-is-getting-a-new-owner.

Polygon Labs, "All You Need to Know About the Recent Network Upgrade." Polygon News, December 29, 2021, https://polygon.technology/blog/all-you-need-to-know-about-the-recent-network-upgrade.

Sai, Ashish Rajendra, Buckley Jim, Fitzgerald Brian, Le Gear Andrew, "Taxonomy of centralization in public blockchain systems: A systematic literature review." Information Processing & Management 58, no. 4, (2021), https://doi.org/10.1016/j.ipm.2021.102584.

Schädler, Lukas, Lustenberger Michael and Spychiger Florian, "Analyzing decision-making in blockchain governance." Frontiers in Blockchain 6 (2023), https://doi.org/10.3389/fbloc.2023.1256651.

Schneider, Aaron, "Decentralization: Conceptualization and measurement." Studies in Comparative International Development, 38, no. 3 (2003): 32–56, https://doi.org/10.1007/BF02686198

Schneider, Nathan, "Admins, mods, and benevolent dictators for life: The implicit feudalism of online communities." New Media & Society 24, no. 9 (2021): 1965-1985, https://doi.org/10.1177/1461444820986553

Securities and Exchange Commission v. Binance Holdings Limited, BAM Trading Services Inc., BAM Management US Holdings Inc., and Changpeng Zhao, Civil Action Case 1:23-cv-01599 Document 1, (D.D.C., 2023), https://www.sec.gov/files/litigation/complaints/2023/comp-pr2023-101.pdf.

Securities and Exchange Commission v. Ripple Labs, Inc., Case 1:20-cv-10832-AT-SN Document 874, (USDC SDNY, July 2023), https://www.nysd.uscourts.gov/sites/default/files/2023-07/SEC%20vs%20Ripple%207-13-23.pdf

Sirinivasan, Balaki S., "Quantifying Decentralization." Medium/news.earn.com, July 12, 2017, https://news.earn.com/quantifying-decentralization-e39db233c28e

Treisman, Daniel, "Defining and Measuring Decentralization: A Global Perspective." SSCNet UCLA Social Sciences, (2002), https://www.sscnet.ucla.edu/polisci/faculty/treisman/Papers/defin.pdf

van Pelt, Rowan, Jansen Slinger, Baars Djuri and Overbeek Sietse, "Defining Blockchain Governance: A Framework for Analysis and Comparison." Information Systems Management 38, no. 1 (2020): 21–41, https://doi.org/10.1080/10580530.2020.1720046.

Voshmgir, Shermin and Zargham Michael, "Foundations of Cryptoeconomic Systems," Research Institute for Cryptoeconomics, Vienna, Working Paper Series 1 (2019), https://assets.pubpub.org/sy02t720/31581340240758.pdf.

Wandmacher, Ralf, "Tokenomics." In Cryptofinance and Mechanisms of Exchange: The Making of Virtual Currency, ed. Stéphane Goutte, Khaled Guesmi and Samir Saadi (Springer International Publishing, 2019), 113-123, https://doi.org/10.1007/978-3-030-30738-7_7

Werbach, Kevin, "The Siren Song: Algorithmic Governance by Blockchain." In After the Digital Tornado: Networks, Algorithms, Humanity, ed. Kevin Werbach (Cambridge: Cambridge University Press, 2020), 215-40.

Wood, Gavin. "DApps: What Web 3.0 Looks Like." Gavin Wood. April 14, 2014, http://gavwood.com/dappsweb3.html.

Zargham, Michael, Alston Eric, Nabben Kelsie and Ben-Meir Ilan, "What Constitutes a Constitution?." BlockScience Medium, April 7, 2023, https://medium.com/block-science/what-constitutes-a-constitution-2034d3550df4.

Zargham, Michael and Nabben Kelsie, "Aligning 'Decentralized Autonomous Organization' to Precedents in Cybernetics." SSRN Scholarly Paper 4077358, (2022), https://doi.org/10.2139/ssrn.4077358.

ZeusLawyer, "For decentralized governance on Ethereum, why is Snapshot considered "off-chain" but Tally considered "on-chain"?" [Forum post]. Ethereum Stack Exchange, May 2, 2022, https://ethereum.stackexchange.com/q/127331.

Ziolkowski, Rafael, Parangi Geetha, Miscione Gianluca and Schwabe Gerhard, "Examining Gentle Rivalry: Decision-Making in Blockchain Systems." In Proceedings of the 52nd Hawaii International Conference on System Sciences, HICSS 52, edited by Tung Bui, Hawaii, USA, (2019), https://doi.org/10.5167/uzh-160377.

Blockchain Governance Dynamics Matrix

This is the model matrix that was used to research and analyze every 11 blockchain networks selected in this report

Organizational Profile							
Year	Founder	Tech Stack Layer	Animating Purpose	Funding Model	Legal Personhood	Environment: Law	Environment: Market

Governance Surfaces		
On-Chain Constitution	Off-Chain Material Constitution	Off-Chain Formal Constitution

Governance Areas						
Short description of governance area						
Secondary rules	A. Standards and interopera-tibilityinterope-ratibility	B. Block production	C. Monetary policy	D. Treasury management	E. Contributions rewards policies	F. Security measures and breaches

Governance Mechanisms				
1. Stakeholders entry and exit	2. Stakeholders power distribution	3.A. Governance mechanisms	3.B. Description of decision-making process	3.C. Debate
3.D. Signaling/voting	4. Enforcement	5. Participation incentives	6. Internal dispute resolution	7. Amendability

Governance Evolution			
Power distribution	Governance scope	Governance complexization	Governance formalization

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