# A Decentralized Fair Governance Model for Permissionless Blockchain Systems

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Permissionless-based blockchain, decentralized governance, fair governance Characteristics, Bitcoin BIP, Ethereum EIP, Tezos Amendment.

**Abstract.** Blockchain systems are a new way to reduce or even eliminate the role of the middlemen in an eco-system. For example, the Bitcoin, as one of the most well-known blockchain platforms, shows that it is possible to transfer money without the need of any (intermediate) bank at all. More generally, it allows for the decentralization of roles. In this paper, we focus on permissionless blockchains, which are systems that allow participation without upfront approval on other parties, as opposed to permissioned blockchains. Permissionless blockchain systems support direct business transactions between peers, so without any intermediate and centralized entity very well. However, the organization of the governance of such systems is less obvious. We argue that, in order to arrive at a really decentralized eco-system where power is fairly distributed, the governance should be decentralized; in other words, it should not be in the hand of one controlling entity. In this paper, we analyse, in a model-based way, for three well-known blockchain systems (Bitcoin, Ethereum, Tezos) the governance processes. Based on this analysis, we draft an improved governance process for permissionless blockchains.

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## 1 Introduction

Networks of enterprises and end-users can be viewed as *eco-systems*: "collection of companies that work cooperatively and competitively to satisfy customer needs" [1]. Many of such eco-systems are fairly centralized, and often called platforms. In [2], a platform is considered as "a set of components of a bigger system". We consider a platform as an eco-system *itself* that provides services to some other eco-system. Examples of platforms include Google/Android, Apple/IOS, Facebook, LinkedIn, Uber, AirB&B, and many more.

All these examples are controlled by a single enterprise, although they have many participants. We call such platforms *centralized* platforms as they are governed by one party only. Centrally led platforms can easily lead to symptoms

of *value extraction*: Generating income not by producing anything new but by charging above the competitive price, usually by exploiting a monopoly [3]. Although companies such as Uber and AirB&B do add *something* new (namely a matching service), they do not own taxis or hotels themselves. They achieved a very large market share, often by initially offering services for a very low price of even for free, to increase prices significantly, once a dominant market share is obtained. This is symptom of value extraction.

It is doubtful whether value extraction behavior of many platforms is beneficial to society. At least, it would be useful to have facilities for enabling *decentralized* platforms and eco-systems such that decision power is *fairly* distributed over the participants. This would make it much more difficult to expose value extracting behavior and can serve as aid for eco-systems that want to offer a fair alternative to centrally governed eco-systems.

Blockchain is a technology that allows to build peer-to-peer eco-systems, that is: without intermediate parties, where participants do not need to trust each other on beforehand but instead rely on crypto-techniques to create trust. The most well-known example is the Bitcoin [4] but many alternatives exists. Often, a distinction is made between permissioned and non-permissioned blockchains. For the latter, everyone can participate, whereas for permissioned blockchains, others have to approve participation of a user on beforehand. By offering peer-to-peer business transactions without the need of an intermediate party such as a bank, blockchain can be considered as a strongly decentralized technology, enabling also a fully decentralized eco-system.

To support decentralized eco-systems to the maximum extent, there is however more functionality needed than just peer-to-peer transactions without an intermediate party. In particular, the *governance* of the operational peer-to-peer system should also be decentralized. We define governance in decentralized eco-systems as "the set of rules a system has to obey, and which are set by another system" [5]. Potentially, elements (e.g. participants) of both systems may overlap. Moreover, in case of decentralized eco-systems, governance has to be decentralized too, and preferably in a fair way, as often the justification for a decentralized eco-system is the avoidance of power-concentrations as often seen in platform-oriented centralized eco-systems.

Unfortunately, the governance of non-permissioned blockchains such as the Bitcoin and Ethereum is (1) not fully decentralized, and (2) quite informal. With respect to informality, for the Bitcoin there is the mechanism of Bitcoin Improvement Proposals (BIPs) and Ethereum has a similar mechanism. But still, these mechanisms lead many things open to the imagination.

The contribution of this paper is twofold: First, we formalize the governance processes of three non-permissioned blockchains, namely Bitcoin, Ethereum, and Tezos with the goal to analyze them with respect to *fair governance*. Second, we use this analysis to propose a fair governance process for non-permissioned blockchains.

## 2 Fair governance in eco-systems

We define governance in decentralized eco-systems as "the set of rules a system has to obey, and which are set by another system" [5]. Governance comes with setting rules on the hand, and continuously monitoring whether systems comply to the stated rules on the other hand. A system can be a person (e.g. a director that sets rules for an employee and on a monthly basis evaluates whether the employee satisfied the rules), an enterprise (e.g. a large company and its shareholders), or a government (e.g. a municipality sets rules for its inhabitants).

From a modelling point of view, many perspectives can be taken on governance. For example, governance can be seen as formal contract that states the rules explicitly, and can be modelled, e.g. with Symbolio [6]. Since governance, if done well, is a substantial effort, a sound business case should be present for the governance task itself, which can be represented by e.g. an $e^3value$ model. But in many cases, governance takes a behavioural, process oriented point of view mainly. Many rules and regulations are put into operation by means of procedures which can be represented by process models. In this paper, we utilize the Business Process Model Notation (BPMN) 2.0 [7] for that purpose.

We are interested in decentralized eco-systems, with a *fair* distribution of governance power, as a realistic alternative for the big tech-platforms. We define fairness in eco-systems following [8, 9] as follows:

- **Participation.** Fair governance requires active involvement in the decision-making process of *all* who are affected and other interested parties. It includes all participants interacting through direct or representative democracy. Such a broad involvement requires that the affected be well informed and organized in order to participate constructively. Furthermore, participants should be able to participate in an unconstrained and truthful manner.
- **Rule of law.** *All* participants should be treated equally and fairly by obeying the law. Fair legal frameworks, with its underlying democratic principles put no participants above the rules of law. Without rules, anarchy will prevail. Anarchy or chaos are caused by governments acting beyond their scope of power, and participants neglecting the law.
- **Effectiveness and efficiency.** Fair governance fulfils societal needs by incorporating effectiveness while utilizing the available resources efficiently. Effective governance ensures that the different governance actors meet societal needs. Fully utilizing resources, without being wasted or underutilized, ensures efficient governance.
- **Transparency.** Information on matters that affect their participants and whom they may concern must be freely available and accessible. The decision-making process is performed in a manner which is clear for all by following rules and regulations. Transparency also includes that enough relevant information is provided and presented in easy to understand forms or media.
- **Responsiveness.** A responsive fair governance structure reacts appropriately and within a reasonable time frame towards its participants. This responsiveness stimulates participants to take part in the governance process.

– **Consensus-oriented.** Fair governance considers the different participants' viewpoints before decisions are made and carried out. Such governance is defined as consensus-oriented because it achieves a broad community consensus. In order to reach this wide consensus, a firm mediation structure, without any bias towards its participants, should be in place.
– **Accountability.** Accountability is defined as responsibility or answerability for one's action. Decision-makers, whether internal or external, are responsible for those who are affected by their actions or decisions. These decision-makers are morally or legally bound to clarify and be answerable for the implications and selected actions made on behalf of the community.

## 3 Fairness of governance in three non-permissioned blockchain platforms

To understand fairness of decentralized blockchain eco-systems with respect to governance, we have analysed three non-permissioned blockchain platforms, namely Bitcoin and Ethereum (as these are the two most popular platforms), and Tezos, which is in contrast to the first two platforms a blockchain platform with on-chain governance.

For all three platforms, we have developed BPMN process models for the governance processes. To the best of our knowledge, this is the first attempt to formally describe the governance processes of these platforms. For Bitcoin, the governance process is partly described by the Bitcoin Improvement Proposal (BIP) process [10]; for Ethereum something exists as the Ethereum Improvement Proposal (EIP) [11]. However, the process descriptions are mainly textual, informal, and high level. The actual processes are much more complicated, and not explicitly articulated. For example, many issues are settled as informal discussions on Reddit. Therefore, we have not only looked into the BIPs and EIPs, but also harvasted more informal information regarding decision processes in Bitcoin and Ethereum.

Tezos is considered as a self-amending distributed ledger. Unlike Bitcoin and Ethereum, Tezos has the ability to perform meta-updates to its own code. Meta-updating of its own code is done by incorporating its stakeholders' consensus through an on-chain governance mechanism [12]. Tezos' governance process of proposing changes and features is achieved by following the Tezos Amendment proposal process (see e.g. [13]). We analyzed the Tezos Amendment process mainly by the official Tezos Medium [14] and the Tezos governance explorer (see https://forum.tezosagora.org/).

For Bitcoin, Ethereum, and Tezos we modelled the governance processes using BPMN. Due to lack of space, we can not present the models in this paper, but they can be consulted online [15]. We limit ourselves to an assessment of fairness of the governance process based on the BPMN models in Table 1.

| | Off-chain | | On-chain |
|---|---|---|---|
| Fair governance characteristics | Bitcoin (BIP) | Ethereum (EIP) | Tezos (Amendment) |
| Participation | All participants have an active role in the governance process. The process employs a mailing-list to inform and exchange knowledge. There are no limitations on who can participate in a BIP submission. | Not all participants are actively involved in the governance process (e.g. users and miners). Four discussion platforms are utilized to exchange and organize information about proposals. Anyone may participate in submitting EIPs without any limits. | Only bakers (miners) are admitted to taking an active role in the governance process. The process empowers discussions using messaging and blogs. Bakers are limited in participation, depending on the number of rolls which prevents power centralization. |
| Rule of Law | BIP outlines the governance rules and framework informally with off-chain governance. The governance mechanism is not always clear or precisely described (e.g. status change from final to obsolete). | EIP describes the governance rules and framework informally with off-chain governance. The governance mechanism is not always clear or precisely described (e.g. the number of editors responsible per EIP). | The amendment process formally describes the governance rules and framework with on-chain governance. The only identified exception is regarding hard forks that can occur, but are not formally defined. |
| Effectiveness and efficiency | The case that hard, soft, and user activated forks occur is evidence that the BIP governance process is not always effective. These forks cause inefficiencies by enabling multiple blockchains to exist. | Even though hard forks are not a part of the EIP governance process, they do occur. These hard forks result in not effectively meeting the participants' needs. The outcome influences efficiency by fragmenting the system in multiple coexisting blockchains. | On-chain governance effectively meets participants' needs, which results in reducing the dependency on hard forks to exist. Without hard forks, there is no fragmentation in the blockchain, which promotes efficient use of the resources. |
| Transparency | BIP's process provides the necessary information through channels such as email and GitHub, which can be freely perceived. However, the barrier exists in being informal, technical, and not clearly presented. | EIP's process offers the required information through multiple discussion platforms. The platforms can be accessed by anyone wanting to participate. However, the numerous platforms covering different information causes information fragmentation. Other barriers are informality, technical jargon, and not easy to digest. | Amendment process information can be perceived freely by anyone. The Amendment information can be perceived on multiple platforms, which offer the same information. It is presented formally, organized, and elaborated on technical as well as non-technical topics. |
| Responsiveness | Two time frames are identified in BIP's process covering only two specific decisions in the process and not the whole governance process. The lack of timeframes for the remaining processes results in poor governance responsiveness. This poor responsiveness negatively affect participation | One time frame is identified in EIP's process covering only a specific decision in the process and not the whole governance process. The lack of time frames for the remaining processes results in poor governance responsiveness. This poor responsiveness negatively affect participation | Five time frames are identified in the Amendment process encompassing the whole governance process. These precise time frames result in a responsive governance process. This responsive governance constructively affects participation. |

| | | | |
|---|---|---|---|
| Consensus-oriented | Every user is able to vote for hard forks and miners for soft forks in the BIP governance process to reach a consensus. The identified BIP editor role consists of only one person, which can entail bias. A miner's voting power depends on the miner's available hashing power. This power centralization can lead to bias consent. | Only a small group of core developers vote in the EIP governance process to reach a consensus. The identified EIP editors consist of eight persons, which is a relatively small number and can lead to bias. Miners and users have no voting power in the EIP governance process and must accept the consensus reached by the core developers in order to participate. | Every baker (miner) is able to vote when enough rolls are acquired. Delegators (everyone else) can only indirectly vote by delegating tokens to selected bakers. This token delegation causes an increase in a baker's voting power. Bakers are limited to 20 votes, which results in mitigating centralization of the voting power and bias consent. |
| Accountability | The stakeholders' respective activities represent their responsibilities. Even though a BIP adoption happens in the Bitcoin system which follows its code, it is still voted on by miners and users. Therefore, accountability for the activities taking place in the Bitcoin system lies with the miners and users. | The stakeholders' respective activities represent their responsibilities. Accountability for adopting EIPs lies with a small group of core developers. | The stakeholders' respective activities represent their responsibilities. Bakers are the only one accountable for the Amendment process in Tezos. |

Table 1: Summary of eco-system fairness for Bitcoin, Ethereum and Tezos

## 4 A fair governance proccess for non-permissioned blockchain platform

An interesting question is if we can construct a better (meaning a more fair) governance process based on our analysis of the Bitcoin, Ethereum, and Tezos governance process. For this new governance process, a significant part is from Tezos as this (1) an on-chain process (and hence can be automatically supported and thus specified as such) and (2) this process is best articulated. The rest of the proposed process is a combination of Bitcoin's and Tezos' governance processes. The combinations are from the participation, rule of law, and consensus-oriented characteristics. Our proposal, represented as BPMN model can be found online [15]/ Below we summerize the highlights of our improvement proposal.

– **Participation.** A combination of Bitcoin's and Tezos' governance process will be useful to fulfil participation. Bitcoin's governance process best incorporates participation by fulfilling the goal of involving all the affected stakeholders. All the different stakeholders can actively participate in the governance process of Bitcoin, compared to the other two permissionless blockchain systems. Anyone is able to submit a proposal, not limiting it to only a specific group of stakeholders. However, to create fair participation from the stakeholders, Tezos' governance process of limiting participation through a maximum number of votes and available rolls will be utilized. The combination of Bitcoin's and Tezos' governance processes facilitate fair participation and power balance. Furthermore, the type of communication

channels that are used in the Tezos Amendment process (such as blogs and messaging) will be incorporated. The motive behind the communication selection is to prevent information fragmentation and is further elaborated in the transparency characteristic.

- **Rule of law.** The utilization of on-chain governance requires the rules and frameworks to be formally defined. Adoption of Tezos' on-chain governance process, rules and framework pursues this requirement. However, adoption of the amendment process also means adopting its informally defined hard fork process. As in Bitcoin's BIP, formally defining hard fork processes can further strengthen the rule of law in the derived fair governance process. Hence, the vagueness surrounding the process is mitigated by formally defined governance rules and frameworks.
- **Effectiveness and efficiency.** Effective governance best approximates people's needs by avoiding hard, soft and user forks in the process. Applying Tezos' on-chain governance that is employed in their amendment process follows the same intent of diminishing those forks. The Tezos Amendment process further influences the efficient use of resources by preventing other co-existing Tezos blockchains.
- **Transparency.** Integrating Tezos' Amendment governance process results in information that is presented formally, organized, and elaborated on technical as well as non-technical topics through several communication channels. Communication channels which can be perceived by anyone in understandable forms and media (e.g. Medium, GitHub, Twitter, and Telegram messaging) will be incorporated in the new derived fair governance process.
- **Responsiveness.** Tezos' Amendment governance process is the most responsive due to the integration of timeframes throughout the whole governance process (see section 3.3). Embracing similar timeframes in the derived fair governance process will also positively impact participation.
- **Consensus-oriented.** In order to get a wide community consensus, it is essential that all stakeholders are able to express their vote without a bias consent. Incorporating both Bitcoin's and Tezos' governance processes can result in a fair consensus while mitigating bias. Adopting Bitcoin's process to allow any stakeholder to vote creates a wide community consensus. Applying Bitcoin's process of allowing miners as well as users to vote for adopting a proposal supports this wide consensus. Management of proposals is done by a single person (editor) in Bitcoin's governance process, which can lead to bias. By adopting Tezos' on-chain governance to manage proposals, will mitigate this bias. Furthermore, incorporating Tezos' voting limitation of 20 votes per stakeholder avoids cultivating power centralization and bias consent.
- **Accountability.** The stakeholders' accountability in the Bitcoin, Ethereum, and Tezos governance processes can be perceived by their activities represented in the BPMN models. The main difference in the stakeholders' accountability in the three blockchain systems lies in the fact that only selected stakeholders can vote on the proposal. In the derived fair governance process, both miners and users can vote on-chain for a proposal. This puts the accountability with the voter.

## 5 Conclusion

In this paper, wew have presented a proposal for a derived decentralized fair governance model, based on analysis of the strengths and weaknesses of three distinct existing permissionless-based blockchain systems. Decision-making processes in the analyzed blockchain systems (Bitcoin, Ethereum and Tezos) are determined by either off-chain or on-chain governance. The analysis showed that on-chain governance (formally defined through its code) can reduce deficiencies that were observed in off-chain, and informally specified, governance blockchain systems. This reduction is especially apparent in the formally defined decision-making process, a key characteristic of on-chain governance, that positively affects the identified fair governance characteristics. The Tezos Amendment process, which utilizes on-chain governance, served as the foundation from which proposal for a more fair process is derived. However, the Tezos Amendment process falls short on three identified fair governance characteristics when compared to Bitcoin's BIP process. Thereby, a combination is made of Tezos' Amendment process and Bitcoin's BIP process regarding the fair governance characteristics of participation, rule of law, and consensus-oriented. Participation and consensus-oriented characteristics better meet their goal by adding users to participate in the derived fair governance process. Improvement of participation in the governance process can lead to wider community consensus surrounding proposals. Rule of law is further strengthened in the derived fair governance model by formally defining fork processes. The improved rule of law also has a positive impact on fair governance characteristics such as participation and responsiveness. Future research can build upon the analysis of fair governance characteristics in order to establish a more refined fair governance model. The derived decentralized fair governance model can act as a steppingstone to develop and adjust the governance process for permissionless-based blockchain systems.

## References


1. Moore, J.F.: The Death of Competition: Leadership and Strategy in the Age of Business Ecosystems. Harper (1996)
2. Baldwin, C., Woodard, C.J.: The architecture of platforms: A unified view. Platforms, Markets and Innovation (09 2008)
3. Mazzucato, M.: The Value of Everything: Making and Taking in the Global Economy. Penguin Books (2018)
4. Nakamoto, S.: Bitcoin: A peer-to-peer electronic cash system. `http://www.bitcoin.org/bitcoin.pdf`, visited 2021-01-14 (2009)
5. Kaya, F., Gordijn, J., Wieringa, R., Makkes, M.: Exploring governance in a decentralized energy trading eco-system. In: Proceedings of the33RD BLED e-conference: Enabling Technology for a Sustainable Society. (2020)
6. Parvizimosaed, A., Sharifi, S., Amyot, D., Logrippo, L., Mylopoulos, J.: Subcontracting, assignment, and substitution for legal contracts in symboleo. In Dobbie, G., Frank, U., Kappel, G., Liddle, S.W., Mayr, H.C., eds.: Conceptual Modeling - 39th International Conference, ER 2020, Vienna, Austria, November 3-6, 2020,

Proceedings. Volume 12400 of Lecture Notes in Computer Science., Springer (2020) 271–285
7. OMG: Business process model and notation, version 2.0. https://www.omg.org/spec/BPMN/2.0, visited 2021-01-14 (2011) Object Management Group (OMG).
8. Graham, J., Plumptre, T., Amos, B., on Governance, I., Canada, P.: Principles for Good Governance in the 21st Century. Policy brief. Institute on Governance (2003)
9. Sheng, Y.: What is good governance (2009) United Nations Economic and Social Commission for Asia and the Pacific.
10. n.a.: BIP 1: BIP purpose and guidelines. https://github.com/bitcoin/bips/blob/master/bip-0001.mediawiki, visited 2021-01-14 (2011)
11. n.a.: Governance on Ethereum. https://docs.ethhub.io/ethereum-basics/governance/, visited 2021-01-14 (2020)
12. Allombert, V., Bourgoin, M., Tesson, J.: Introduction to the tezos blockchain. CoRR **abs/1909.08458** (2019)
13. Goodman, L.: Tezos — a self-amending crypto-ledger - white paper. https://tezos.com/static/white_paper-2dc8c02267a8fb86bd67a108199441bf.pdf, visited 2021-01-14 (2014)
14. Arluck, J.: Amending Tezos. https://medium.com/tezos/amending-tezos-b77949d97e1e, visited 2021-01-14 (2018)
15. Jairam, S.: BPMN models for the governance in Bitcoin, Ethereum and Tezos. https://www.thevalueengineers.nl/governance-non-permissioned-blockchain/, visited 2021-01-14 (2021)