Governance in peer-to-peer networks is a design problem

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Abstract. Peer-to-peer networks are gaining momentum, and its revolution is accelerating. Examples of peer-to-peer systems are Bitcoin and Corda, which are enabled by blockchain technology. Even the firmest supporters of blockchain, acknowledge the most significant challenge for successful adoption and growth of peer-to-peer networks is governance in a decentralized way. A lack of governance design poses a risk, as the decentralized network will not prevail in the long term which can even lead to a centrally orchestrated system. In this paper, we argue that the finding an appropriate governance structure is a design problem.

1 Introduction

Even the firmest supporters of the blockchain revolution have conceded that the biggest challenge for the growth of distributed ledgers will be *governance* [10]. Blockchain technology is an important example of peer-to-peer technology, which is a technology that proposes decentralized solutions to avoid centralized components such as brokers and alike. In case of blockchain projects, decentralized solutions boil down to avoiding intermediate parties such as banks, insurance companies and travel agencies. As such, blockchain is not only a technological debate but also a business- and eco-system discussion, namely about removal of the middlemen. In practice, many eco-systems are effectively governed by one, or at most a few parties. For example, Apple governs the eco-system of iPhones, Google does the same for Android, and Cisco is an eco-system of hard- and software suppliers, consultants, system integrators and customers, led by, indeed Cisco.

Peer-to-peer eco-systems in general, and blockchain technology in particular, are seen by many, e.g. the European Commission, as the answer to the large tech companies such as Facebook, Amazon, Google, Netflix and Amazon. Additionally, Tim Berners-Lee announced in his Turing Award acceptance speech that the current formation of the world-wide-web, with a few very dominant players is not how the inventors envisioned the web initially. Instead, the idea was a much

more equal level playing field. Question is how to arrive at such a situation without exceptional power concentrations as we currently have. We argue that an important requirement for arriving at a level playing field is that the governance of peer-to-peer- and blockchain networks is decentralized, hence preventing the emergence of power concentrations that can control the eco-system.

In this paper, we claim in Sec. 3 that finding an appropriate governance solution for a blockchain enabled eco-system is a *design* problem, meaning that several artefacts have to be designed that reflect the selected governance model. We show by means of two very different blockchain platforms, namely the Bitcoin and Corda, that the design is, as usual, dependent on the context of problem, which for Bitcoin and Corda is very different. Bitcoin as a community-based movement, which wants to remove middlemen like banks. Corda on the other hand is initiated by large banks, and therefore compliance, and related to that, governance, is very important. In Sec. 2, we explain what we understand by the idea of 'governance' in general, as well as how governance works out in peer-to-peer eco-systems.

2 Governance in peer-to-peer eco-systems

2.1 Governance

We apply the control paradigm of Blumenthal (see e.g. [1] and later [4]) to arrive at the *governance paradigm*. Fig. 1 shows our governance paradigm. Essentially, there is a *governed* system (such as the operations of a company) that has to obey to rules, regulations and laws set by the governing system (e.g. the management of that same company). In most cases, the governing system does not make the regulations and laws itself, but only directs the governed system to follow the regulations and laws. The latter are set by an environmental system, e.g. the government. However, the governing system defines a set of rules the governed system should comply to. The governed system provides monitoring information to the governing system, which that system uses to changes rules, and/or to provide monitoring information the environment (e.g. the government and the shareholders of an enterprise). Parties in the environment may use that information to change the rules, regulations and laws. The governed system performs *value adding operations*, such as providing a video stream to customers in return for money (Netflix), providing user contributed content in return privacy sensitive data (Facebook), etc. The idea is that by doing these operations, the governed system generates a net positive cash flow. It is very well possible that the governed system and the governing system are part of the same legal entity, e.g. as the workforce of a company (governed system) and its board of directors (governing system). The governed system directly interacts with the environment, e.g. in terms of customers and suppliers. Furthermore, it is important that we understand *system* as in system's theory: A system consists of entities with relationships. The governed system can be a single person, an enterprise, or even a country. In our work (see also the next section) we consider the governed

system as a *network* of enterprises (also called a networked value constellation [7] or as of today, an eco-system [6]).

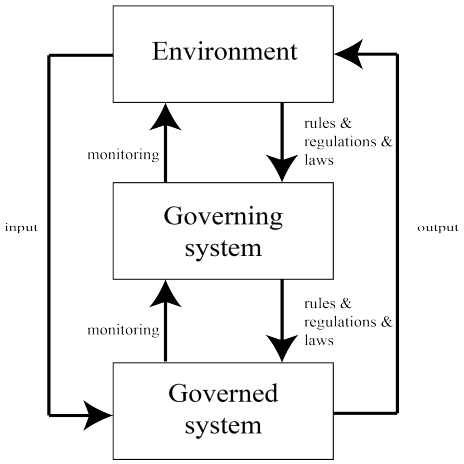

Fig. 1. The governance paradigm

Regulations and laws are usually set by the government or organizations under control of that government. Rules however are determined by the governing system, e.g. based on the monitoring information, or by internally set (strategic) goals. The scope of the rules is very broad, in fact anything that is needed to control the governed system. It can be about the hire & fire policy of a company, about rules concerning the internal administrative controls, targets in terms of profit, revenues, and costs, roles with corresponding responsibilities of the staff and much more.

2.2 Governance in peer-to-peer eco-systems

In many cases, governance is considered from a *single actor* perspective. Take for example a large bank. In such a case, the bank has governance mechanisms in place to ensure that the operations comply with rules, regulations and laws, and more specifically with the regulatory frameworks for banks. However, the focus is still on the single enterprise, in this case the bank. In contrast, our work focuses on governance on *networks* of enterprises end-to-end users which are also called *eco-systems*. Following Moore [6] we define an eco-system as a collection of companies that work cooperatively and competitively to satisfy customer needs. Additionally we concentrate on *peer-to-peer* eco-systems. A peer-to-peer driven eco-systems are eco-systems where one or more *intermediate functions* are removed. Well known intermediate functions are payment & transaction processing (banks) to facilitate lack of trust between buyer and seller, insurance to facilitate risk sharing, clearing of intellectual property rights, search, etc. Intermediate

functions sit between the customer(s) and supplier(s) of goods and services, and in most eco-systems, an intermediate function is performed by a single enterprise. Intermediate parties can become quite powerful, e.g. large banks, Google (intermediate between searchers and suppliers of goods and services), Netflix (intermediate between private persons who want to be entertained and content owners), etc.

In many cases, intermediate functions are required (for example, often a payment processor is needed) but it is not necessarily the case that it should be performed by *single parties*; in contrast, they can be performed by peers themselves, or even by the network as such. This is precisely what Bitcoin does; it removes the assignment of the function of payment processing to a single bank and instead assigns the function to the nodes in the Bitcoin network. Note that even Bitcoin did not succeed to remove the middlemen completely, as identifiable parties are needed to convert bitcoins in to fiat money and vice versa.

Peer-to-peer eco-systems are often enabled by peer-to-peer technology. Blockchain technology (e.g. as used by the Bitcoin) is an example of peer-to-peer technology but certainly not the only one. For example, peer-to-peer technology was and is used to (illegally) share and download music and videos. Whereas in the previous section, we considered the topic of governance in the scope of a single enterprise, however this is different for eco-systems. First of all, the system to be governed now is the eco-system, consisting of a number of enterprises. Moreover, it is likely that the governing system is also an eco-system, perhaps, but not necessarily, with the same parties who participate in the governed eco-system. Since governing eco-system in case of peer-to-peer eco-systems usually consists of multiple independent actors, hierarchically coordination as used in a single enterprise is not an option. Instead, all parties in the eco-system want to have a say in the governance of the eco-system at hand. With as a result, the governance becomes much more a *negotiation process*.

In the past few years, we have visited a number of blockchain projects, which are supposed to be peer-to-peer eco-systems. In practice however, there often was one dominant player in the eco-system, namely the company who operated the blockchain. We admit that this is fully against the underlying design philosophy of blockchain technology, but in reality we see it happen often. It also means that the governance, if thought about it at all, is under control of a single enterprise. We argue that the lack of distributed governance in such eco-systems is one of the main reasons why so many blockchain projects fail. Consequently, we consider the *design* of *peer-to-peer* governance mechanisms, and the associated software tool support, as crucial for the development of peer-to-peer systems in general, and blockchain systems in particular.

3 Peer-to-peer governance is a design problem

In [8], a distinction is made between governance by *design* and governance by *dynamics*. The latter case of governance recognizes that governance is not a static construct, but rather emerges and continuous to develop as a result of a changing

environment. Although important, in our research we consider governance first as a *design problem*,in the philosophy of Design Science [3] as an artefact to be (re)designed. To understand the design problem to be solved in somewhat more detail, we study the governance in two well-known blockchain platforms, namely the Bitcoin and Corda. We use these two platforms because they are very different in terms of governance.

3.1 Bitcoin

Bitcoin is a decentralised currency and payment system that seeks to eliminate the need for trusted third parties. It relies on a peer-to-peer network and cryptographic protocols to perform the functions of traditional financial intermediaries, such as verifying transactions and preserving the integrity of the system [2]. The most important impact of Bitcoin is that it decreases the need for a trusted third party, namely a bank. This has consequences for the network at hand, because a powerful actor (e.g. bank) becomes much smaller or even obsolete. In terms of governance, Bitcoin is the world's first blockchain driven open source system, with all the governance problems that typically come with an open source project. The main artefact in terms of governance is the Bitcoin protocol. This protocol determines how participants are added or removed from the network, how consensus amongst participants is reached (this is needed because the administration of bitcoin transactions is fully decentralised), and how the mining process of bitcoins works (this is needed to generate bitcoins, to validate transactions, and to solve the double spending problem). Obviously, the protocol should be resistant to attacks from malicious parties (under certain conditions). Ultimately, the most important parties regarding governance are the Bitcoin miners. These miners run the Bitcoin network by executing software, and they decide whether to run a new version of the Bitcoin protocol by means of upgrading their software. In case sufficient miners decide not to run the newest (or: a competitive version), and the newest version relaxes the protocol, a hard fork occurs, which in worst case results in a new currency. One could consider the occurrence of a hard fork as a failure in the governance process.

It is interesting to understand how a new version of the Bitcoin protocol is developed and, more importantly, decided upon. Initially, Bitcoin protocol development and decision power was end-to-end in the hands of Satoshi Nakamoto, this entails that all proposed changes are reviewed only by Satoshi. In 2011, Satoshi left Bitcoin and handed it over to one lead blockchain developer. We do not know if Satoshi is a single individual or a group, but it gives the impression that initially, the decision power concerning the Bitcoin protocol was in the hands of a few persons, and quite centrally led. In 2011, the Bitcoin Improvement Proposal (BIP) was introduced. It entails a standardized process to review new submissions to the Bitcoin protocol. Changes to the Bitcoin protocol are seen as a continuous innovative process which are implemented after consensus has been reached. BIP's main objective is basically everyone can propose changes to the protocol and submit improvements regarding security and stability of the network. A BIP should comply to a predefined format before it is considered

further. First, an editor should approve the proposal, and then 95% of the active miners. The role of the editor can be considered as a centralized component in the governance process; s/he might censor what the miners would see to approve.

A criticism regarding the choice to give the miners final decision power regarding governance issues, is there is a tendency that miners seem to concentrate, e.g. in China, and therefore facilitate centralisation of decision power. Ethereum, which is quite similar to Bitcoin in the sense that it is also a permissionless system, but however Ethereum has a more centralized governance system. The lead developer of Ethereum, Vitalik Buterin has quite some decision power, which was demonstrated how DAO disaster was handled by him. The DAO disaster was dealt with by rolling back the Ethereum blockchain to undo the damage done by the disaster[5]. It led to a hard fork in which Ethereum Classic remained faithful to the idea that code is law and the forked Ethereum followed the idea that the DAO as implemented was not the intention of its designers. In both branches of the fork, people took responsibility for a decision.

3.2 Corda

Corda is a permissioned open source blockchain platform specifically designed for the financial industry and it is enabled by distributed ledger technology. Corda is worlds first enterprise DLT platform. When comparing Corda with other open source blockchain platforms, Corda is specifically built to overcome privacy and governance problems in a peer-to-peer network. Corda is designed to promote a transparant governance structure, which is referred as "Corda Network Foundation". Corda explicitly refers in their governance documentation that its network should not be controlled by a single enterprise. They promote a fair, transparent and open governance foundation, accessible by every enterprise within the network. It is also stated that this type of governance structure is a crucial aspect for a sustainable and long term existences of the network. In 2018, Corda's governance structure took a significant step. The governance which was previously under control of the R3 consortium, has now been set in an autonomous independent foundation which is a non profit organization. The Foundation, oversees the governance of the Corda network and it has no stakeholders. Furthermore, the foundation provides openness and transparency regarding decision making, costs of running the system and a flexible approach in managing the network. In figure 3, the governance structure of Corda is summarized [5].

1. A Governing Board ('the Board') of 11 representatives ('Directors').
2. A Technical Advisory Committee ('the TAC'), comprised of representatives of Participant organisations.
3. A Governance Advisory Committee, comprised of representatives of Participant organisations.
4. A Network Operator ('the Operator'), charging the Foundation reasonable costs for providing network and administration services, paid by the Foundation through membership funds, and accountable directly to the Board.

[5] https://corda.network/governance/index.html

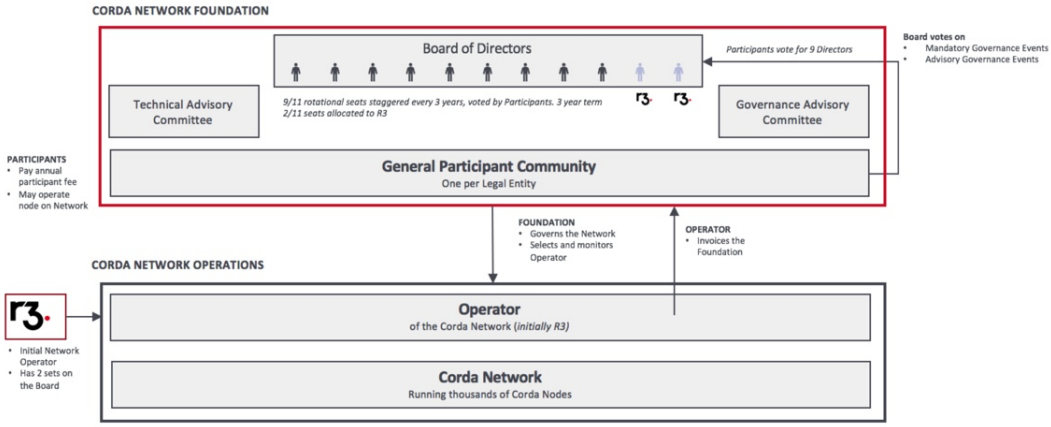

Fig. 2. Corda Network Foundation

5. Foundation is operating on behalf of: Participants ('Participants'), open to any legal entity participating in Corda Network, and independent of R3 alliance membership.

3.3 Discussion

Bitcoin and Corda have a very different view on governance. In case of Bitcoin, the parties (e.g. the miners, submitters of improvements to the protocol, and editors in role of approvers) are often not known, at least not as parties with a name and address. Their public key is known, but not necessarily their personal details. In the case of Corda, parties are known, and can be traced back to persons and/or organizations, which has consequences in terms of liability. Although Bitcoin has a governance process in place by means of a workflow for submitting and approving BIPs, the process is quite informal, as can be concluded by the many debates of participants at e.g. Reddit. In contrast, the governance of Corda is much more formal, with an extensive organization structure and procedures. Design Science is about developing one or more artefacts, which solve real world problem in particular context [9]. The context explains why the governance of the Bitcoin is so different than the governance of Corda. Bitcoin has a history of developers and ideologists who wanted to remove the middlemen, e.g. the banks for financial transactions. Initially, it was a small community, driven by anonymous people (Satoshi her/himself is the best example), who wanted to fight the traditional banks, with all their compliance issues. Governance was not really an issue. Later on, when the Bitcoin scaled up, governance procedures were needed. However, the development of governance procedures for the Bitcoin protocol was an evolutionary process. In contrast, governance was an explicit concern during the design of Corda. Corda was initiated by large financial institutions, and these institutions have serious compliance issues. In conclusion, governance solutions

for peer-to-peer governance systems can be very different and depending on the context.

4 Conclusion

What can be concluded is that (1) governance is a serious issue in blockchain / peer-to-peer eco-systems that (2) has to be designed. Governance design can be done from the start of a project as we have seen with Corda, or can gradually emerge (Bitcoin). Furthermore, we found in our consultancy experience with blockchain projects that after the proof of concept phase, in which the technology has been demonstrated with a viable product, the project does not gain a momentum, amongst other by neglecting the required governance model for the project at hand.

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