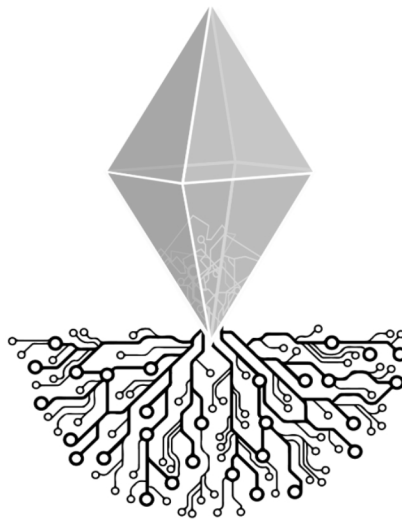


Pando Network [★]

<http://www.pando.network>
<https://github.com/ryhope/pando>
https://twitter.com/pando_network

2

contact@pando.network



Abstract. Pando is presented as a decentralized Versioning Control System that functions via a linked data structure that leverages content stored on IPFS with linked hashes in the Ethereum Network. Push and merge rights are democratized by turning every repository into a DAO on Aragon OS. The aim is to offer a decentralized cooperation, distribution and valuation infrastructure to Commons Creative Contents (CCC) i.e. any kind of content produced through an open process such as - but not restricted to: Open Source Software, Books licensed under Creative Commons, Music licensed under Creative Commons, etc

Keywords: Blockchain · Ethereum · IPFS · Aragon · DAO · Versioning Control System · Open Source Software

Ethos

[★] Supported by a grant from the Nest Program

Among scholars, the notion of human collaboration is frequently referred as the major cause for the species success in its environment. Collaboration in the human context has been far from static. Evolutionary patterns can be observed throughout history, triggered by changes in the environment or technological paradigm shifts. As the scale of our ambitions as a species grew, the need for new tools arose. Coercion filled this void in the absence of technological enablers, usually in the form of slavery or serfdom. It is possible to see the extension of this tradition, subtly embedded in today's systems. As the intermediary step between coercion based coordination & incentive based methods lie the firm and its compensation schemes. The incentives are determined and controlled to maximize the firm's utility. Sometimes these interests are aligned with its participants and most of the times not, leading to criticisms such as wage slavery, labor abuse etc which expose the coercive tendencies arising from extractive profit maximization function of the firm. There are however recent paradigms like the open source movement which has the voluntary coordination of autonomous nodes at its core. This movement has been attracting the attention of scholars wishing to create an empirical framework around the fuzzy incentive structures present in these efforts. Most findings suggest a mix of altruistic identity and other financial, social rewards as the main drivers behind contributions. Open source development is fundamentally different in that quantifying/valuing contributions is crucial in order to provide the optimal incentive design to substitute hierarchical compensation schemes. But even though we have OS achievements such as Wikipedia, Linux, Bitcoin etc. we are still lacking the tools to allocate fair authorship to its contributors. We are trying to build this missing link in the form of a distributed VCS enforcing DAO-based versioning, contribution tracking and governance built on top of IPFS, Ethereum and aragonOS. Pando aims to contribute to the evolution of human collaboration by providing the missing link: A direct, transparent, trusted, decentralized, automated bidirectional link for transfer of value between the open source producers and the open source consumer.

1 Decentralized Autonomous Contents

1.1 Content production and distribution in Web 2.0

Censorship

ISP filtering, Article 13 will force content hosters to actively filter content for copyrighted material, DMCA, Over 400 Million people use VPN. The cat and mouse game goes on with no end in sight, putting content on an a censorship resistant immutable ledger will take this matter out of the hands of regulators and politicians. If censorship there is it will have to come with a very high threshold to attain consensus that requires forking the blockchain and removing these contents.

Data Silos

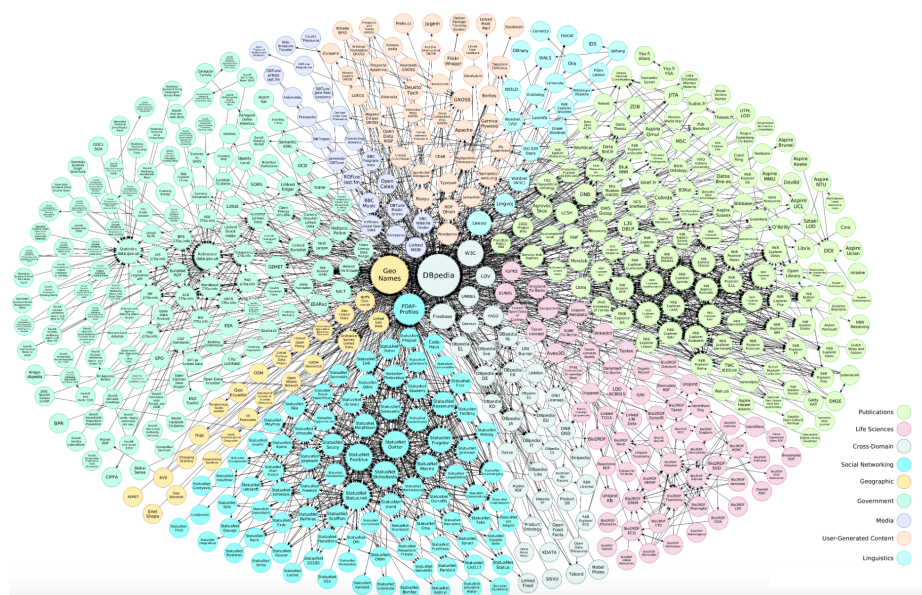
The FANGs and BATX behemoths of Web 2.0 have built their empires upon a

concentration of siloed data collected by data farming their users, tracking and profiling them across their online lives. These silos are not restrained only to FANGs and the backlash

No linked data structure

Web 2.0 is a web of documents and not a web of contents due to the addressing system native to Web 2.0 that does not allow a precise trace-ability on the whole history of the contributions which took part in the production of a document. Nor does it clearly attach value to the activities of the various contributors (remix, translation, adaptation, correction, etc.)

Efforts are underway, notably under the direction of Tim Berners Lee to push for Linked Open Data Structures. Yet this requires active efforts by groups of individuals solely dedicated to this effort. Solutions are needed now more than ever for valuable content to be tagged and linked in a native manner.



Today content cannot generate a fair return in value between all contributors as the technical infrastructure on which content is based - web 2.0 - is not yet capable of clearly answering the following questions:

”Who did what ? ”

”What is the value of each person’s contributions? ”

As Creative Commons also pointed out in a 2016 post: ” *The Web has obviously changed significantly since 2002 when CC launched, but the way the CC licenses*

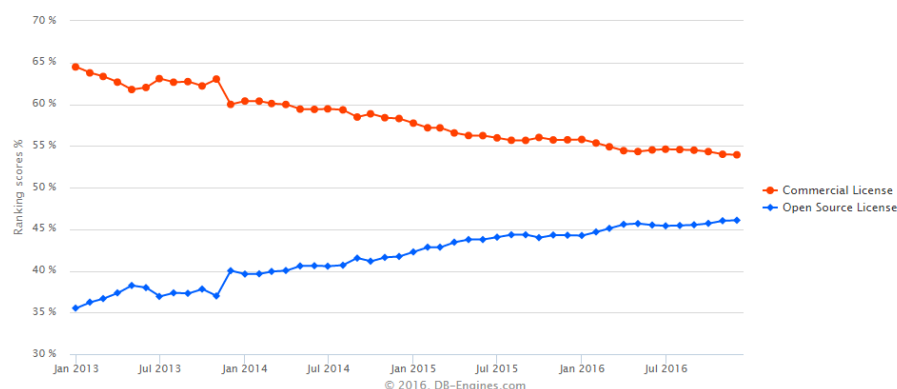
work hasn't. While most web services and apps are data-driven and accessible via API, CC's licenses are largely static, devoid of data, and rooted in markup. There are no services to enhance the user experience, or provide additional value and create connections. Users still have to manually provide attribution. There are no analytics about use or re-mix. Adding a work to the commons is a huge gift, but contributors get very little in exchange no feedback, no analytics, not even a like or a thank you. While CC is integral to many kinds of creativity and sharing on the web, it has yet to capitalize on this influence to connect and light up the commons. "

Centralized Reputation Systems Our digital lives are determined by centralized reputation systems whether they are state backed (Social Credit System in China, Credit score in the USA) or private (ridesharing and matchmaking apps). Users are not in control of their reputation and their life choices increasingly determined by these identity and reputation systems. Much is being done to change human identities to safer, more decentralized systems. (Decentralized Identity Glen Weyl and Vitalik, Way Network etc..) Yet there is lack of such a system for ensuring reputation of content creators and contributors.

1.2 The Open Source Paradigm

The Open Source movement has grown to a full fledged societal movement as evidenced by the increasing share of software and creative contents used and developed under free open source and creative licences.

Popularity trend



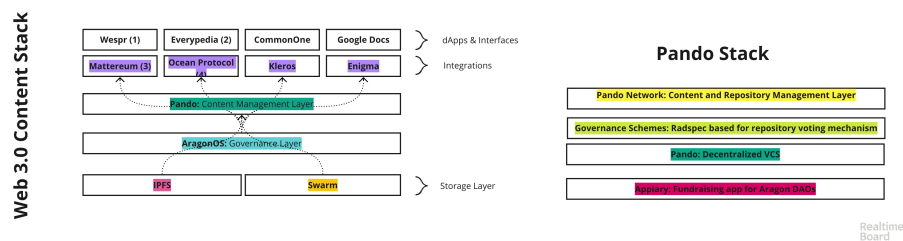
Despite these positive signs of change bottlenecks persist and pose an existential risk to these developments. The vast majority of repositories are hosted on centralized services such as Github (now owned by Microsoft), Gitlab etc.. They are thus at the mercy of censorship as well as the economical policy of these platforms that can change at a whim. The movement has been helped by the appearance of new financial incentive mechanisms such as tokenization and ICOs. (source: "Financial incentives for open source development: the case of

Blockchain”, Luca Canido) However, these projects still push code under a ”one repository,one maintainer” dictate where the maintainer (be they a person or a foundation) has the final say on the code that is pushed and rewardal of contributions is chosen via the same forums. This has caused popular demand for a mechanism to emerge allowing coders and creators to democratically decide on the allocation of the fruits of their labor.

1.3 DAOs and collective intelligence in Web 3.0

DAOs represent a fundamental shift in how value is created and shared in Web 3. Members of such an organization can democratically allocate the budget choosing both the preferred governance scheme and a The DAO landscape is actually going through a Cambrian-explosion like era. A wide variety of DAO schemes have arisen in the past few years. Our belief is that a wide range of DAOs - though not all - will share a small set of principles: to gather people around a project, to allow newcomers to easily join in, to ease openness and experimental cooperations, to engineer new authority metrics and decision procedures, to offer alternatives to waged labor. None of these characteristics is relevant within the framework of traditional organizations nor seizable within the framework of inherited laws. Thats why we believe DAOs wont be legally mapped as profit - or even non-profit - organizations but as a network of contributors: a collective of people sharing the ownership of a common good anyone can contribute to craft. For that reason, our proposal aims to explore the ability to legally mirror DAOs within the framework of creative licences and right-of-use rather than in the framework of profit or non-profit organizations.

2 The Pando Tech Stack



2.1 Layer 1- Pando

IPLD addressability

Lineage

2.2 Layer 2- Pando Network

The Pando Network is thereafter defined as the graphical interface and decentralized app (Dapp) used in order for creators and consumers of content to search, use and collaborate.

Indexation

Having to search content using a blockchain explorer would require painstaking efforts on the behalf of users. The Pando Network enables quick and intuitive querying of all data surrounding content creation via an indexation of all repositories, pushes and commits that were made using the Pando protocol.

Content Valuation

Reintroduction to curved bonding. However, such classical curved bonding protocol can incentivize unwanted short-term speculative behavior. Indeed, if a given content gains a lot of momentum in a short period of time through a buzz effect, actors are incentivized to buy more of its bond in the hope of a short-term profit, thus consolidating the buzz effect, leading to a self-fulfilling prophecy. Staking money over the long term has a major interest in limiting the effects of unwarranted speculation. Indeed the staking mechanism prevents a hyper-rational position of speculators who frantically observe the curves to sell at the best moment, threatening and denying at the same time the content concerned. Moreover this mechanism leads to a real attachment between the stakers and the content, giving them skin-in-game to support staked content. Indeed staking mechanism makes it possible to relieve the cognitive load which an ordinary bet makes weigh on the spirit of the staker i.e the staking mechanism separate the gambler from his act because his bet can no longer be taken back.

Time sensitive curved bonding primitive To circumvent such a dead end, the Ryhope Network will rely on an especially designed curved-bonding crypto-primitive: a time-sensitive curved-bonding protocol. In such a protocol, actors not only buy bonds, but also stake these bonds for a given period of time: they do define a period of time during which they will not be able to sell back their bonds. For instance, one can buy for 5 dollars of bonds and stake them for a period of 3 months. For these three months, they wont be able to sell-back their bonds, whatever the evolution of their price is. Moreover, in such a time-sensitive curved-bonding protocol, the buying and selling prices of a bond are not a direct function of the current bond supply anymore, but a function of what we call the belief parameter: $B = \text{bondsQ} * (\text{Bend} - \text{Bnow})^{22}$ if $\text{Bnow} \leq \text{Bend}$ And $B = 0$ if $\text{Bnow} > \text{Bend}$ Where : Q is the number of bonds bought Bend is the block number at which the staking period of these bonds takes end - and thus at which these bonds can be sold back. Bnow is the current block number is a configuration parameter Such a formula allows us to quantify more accurately the actual belief one put in the value of a content. Indeed, this belief grows when one buy more bonds of a given content, but it also grows when one accept to stake these bonds for a longer period of time. Inversely, this belief drop when one buy less bonds of a given content or when the end of the staking period

draws closer. Thus, the belief crowds put in a content is not only a function of the number of bonds they buy, but also of the risk they are ready to take toward this content. The longer they stake their bonds, the less they can predict the evolution of their price. Their belief thus turn into an real belief, i.e. a pure sentiment which cannot rely on the risk calculation of their investment.

Governance Kits

Governance Kits are bundles of rules that determine the rights members of a Decentralized Autonomous Content have over the repository. Pando Network offers several common governance schemes that are intuitively comprehensible and can be deployed in one click.



The Pando team acknowledges these could never cover the unique requirements of every single content and project, thus the approach vies to be exhaustive enough while allowing for the addition of new schemes by the Pando team and the community.

Governance kits are based on Aragon's Radspec ([link to github](#)) and are named after the corresponding voting systems. The following is a primer on a few of these kits:

- dictator kit: one maintainer has all the voting power
- democratic: one contributor one vote
- plutocratic: votes are determined by the amount of economic tokens owned
- meritocratic/technocratic: votes are determined by the amount of reputation tokens owned*
- communistic: one contributor one vote (SAME AS DEMOCRATIC)
- quadratic: the number of a user's votes is equal to the square root of the amount of tokens they dedcide to allocate to the proposal.
- futarchic:

-aristocratic:

In a content DAO operating under a meritocratic governance scheme, the voting power of each user is proportional to their reputation token balance. Each Decentralized Autonomous Content may have a different idea of how reputation is transferred and thus contributions evaluated, leading to a myriad of variants on the meritocratic scheme.

Decentralized Autonomous Licence

Pando Network will offer a full set of licences inspired from Free and Open Source Licenses (or similar licenses like the IANG License or PPL Peer Production Licence) specifically augmented and designed to support DAOs in their self-governance. This project helps define "Content DAOs" : DAOs organized around content such as video-games, software, books, etc - in defining the modalities of collective decision making, value sharing, and the types of possible utilization of the creative collaborative content outside the blockchain ecosystem. The final objective of our team is therefore to provide freely usable contractual frameworks, as standards, allowing DAOs to collectively define the terms of use and governance of collaborative creative contents. Pando Network will host a full set of licences implementing an isomorphism between DAOs governance rules - as defined through blockchain-based smart contracts - and nation-states juridical frameworks. This attempt will rely on the following hypotheses and rationale.

1. Most attempts to back DAOs by legal entities - i.e. entities acknowledged by nation-state jurisdictions - refer to profit or non-profit organizations: corporations, foundations, etc. The hypothesis underlying this project is that referring to DAOs as contents instead of organizations may fit with most DAOs use-case while drastically simplifying the problem of their legal status. Indeed, conceiving DAOs as contents allows to express their legal status within the scope of intellectual property, thus excluding most of the juridical concerns about DAOs: utility token vs security token, ownership, etc.
2. To offer DAOs a convenient isomorphism between blockchain-based governance rules and intellectual property-related categories we intend to leverage, improve and extend the existing licenses (the Peer-Production Licence being the main candidate). Our goal is to identify and map a simple but powerful governance-related parameters - income redistribution, decision-related primitives, etc. - into licence-related clauses. We thus intend to turn the complexity of blockchain-based governance rules into a small-set of parametrable but human-readable licensing rules.
3. We believe that such an isomorphism, though not suited to all DAOs needs, would offer a lot of advantages to the DAO ecosystem. First, it would allow a lot of DAOs to circumvent the quite cumbersome organization-related right in favor of the much more straightforward Intellectual property right. Secondly, it would drastically lower the barrier for new entrants in the cryptospace by providing them a set of standard, human-readable and easy to use - though highly parametrable - licensing / governance scheme. Thirdly, the use

of such a standardized license / governance framework would radically ease the interoperability - and thus the possibility of much more complex cross-interactions - between DAOs. Finally, it would allow DAOs to immediately profit from nation-state jurisdictions in case of disputes unresolvable neither in the framework of their own governance nor in the one of the upcoming Aragon Network Jurisdiction.

4. The Aragon Network Jurisdiction will exist as a technological layer capable of settling a series of conflicts within a DAO : this is important insofar we know that this type of conflicts regulation structurally implies the emergence of common goods. However, if conflict management can not be sufficient to resolve conflicts outside the blockchain environment it will be necessary to create legal tools capable of supporting DAOs in contact with traditional law. The creation of a licence capable of accompanying contents which are governed by a DAO could be an easier point of contact between DAOs and traditional law and could drastically reduce costs and manners of entry into traditional law.

2.3 From corporate law to creative law

The technology behind Pando will allow the sharing of value and rights of stakeholders engaged in the production of a common good. Unlike a conventional corporation, a DAO also function as a contribution aggregator and collective decision making mechanism around common goods, as such DAOs will be of great use wherever we need to coordinate collective intelligence independent of wherever it concerns a content or a company. In fact, in many cases, the DAOs will not be constituted in the form of classical entity such as a "Limited Liability Company" but will just drive network effects around a content - such as video-game, music, book or software - whose creation and evolution is open and based on a DAO organizational form. Therefore, bringing the flexible and stimergic character of DAOs into corporate law seems to be of particularly difficulty operation as this will face a variety of legalistic difficulties : jurisdictional arbitrage and compliance, bureaucratic hurdles for establishing companies, payments of annual fees, location of the bank account etc.. More generally combinatory relationships between DAOs and corporate law may lead to deeper problems: Setting up a legal-DAO requires thinking in the categories of the traditional world which are cognitively exhausting due to a complex intrication of legal rules in this field that remain incomprehensible to non-technical people. This pushes the DAO to a bureaucratic heaviness that it would better left avoiding to take advantage of its de-materialized and computerized form. Making DAOs exist via such bureaucratic manoeuvres risks greatly limiting their flexibility and their potentials to create network effects. This places DAOs under the burden of complying with an array of potentially arbitrary national policies of the company's or foundation's host country, thus threatening the autonomy of the latter by increasing the risk of enclosure. This is why it is necessary to create an isomorphism between traditional law and DAOs, thinking from the point of view of creation law. This because leverage use of an immutable ledger such as a blockchain also solves a

series of problems inherent to content creation and distribution that are specific to Web 2.0.

Addressability Each content has its own Ethereum Address that tracks all versions of the repository. This allows external users and apps to interact and transact with the content DAO.

2.4 A Governance layer for contents

Pando network is an infrastructure layer placed above the Pando protocol and which offers the user features specific to the management of a Content-DAO. The Pando protocol has been crafted to be the most modular as possible. The Pando Network overlay goes further and has to be thought as a DApp builder on which users could build their own specialized and dedicated applications, by modulating the different rules of DAO-content in order to offer an ever more favorable creative framework according to the application domain (blog platform, collaborative writing, design, composition of music), and a fair and decisive exploitation of the DAO-content that will emerge.

2.5 Layer 3 - Dapps

Dapp Builder

cross platform contents, utilisation et liens entre les contenus, blockchain traceability for the commons, etc.

Maintenir l'inspiration dans le sillage (Alex)

Cross repository rep use Comment les applications peuvent se servir de la réputation cross-dapps et cross-app (Nolwenn) Exemples. **Integrations** The Pando stack will interact with a host of specifically developed dapps as well as the wider web 2 and 3 ecosystem. To name a few with a cursory explanation of the potential:

Dapps: (1) Mattereum: Allows any content to be also protected via intellectual property and gain recognition in the physical world via a Ricardian contract.

(2) Ocean Protocol: Any content DAO can purchase or sell data sets, this allows for example a Machine Learning algorithm that generates movie scripts to purchase datasets that improve the script quality and thus potential revenue accruing to the DAO.

(3) Kleros: giving the ability to a content dao to solve disputes between collaborators and other daos outside of physical courts and Aragon Network. (4) Enigma: Gives the DAO ability to enter into secret contracts

(5) Dharma Protocol: Content DAOs can raise debt via the protocol

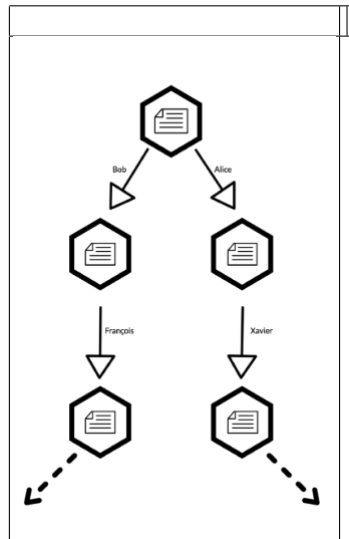
(6) LaTeX editors: Allows researchers to collaboratively work on research papers and push modifications to Pando Network. Leading to decentralized autonomous papers and DAO academic journals.

(7) Wikipedia: Import existing articles

(8) Google Docs: Replicate change log into Pando for contribution valuation.

Dependencies between parent and children contents The traceability that blockchain technology allows is a major asset for the constitution of co-operatives but it offers more granularity by not considering the cooperative as simple a group of workers but as a network of contributors.

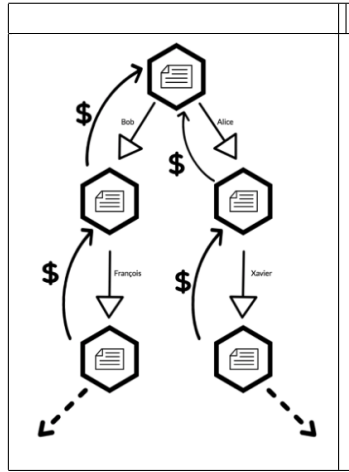
Table 1.



Keeping track of each modification on a file also offers the ability to remunerate the contributors of open creative contents while rewarding all the dependencies from whom each new modification born. This is in fact one of the possibilities opened by blockchain technologies as CC-France is trying to do with Book project and also by our valuation network build on the top of Pando and called Ryhope Network. On this layer, if forks or contents built on top of another content gains income, their original contents gain income too. This is a way for remunerating the history from which each contribution always comes, and a way to encourage open-source creation.

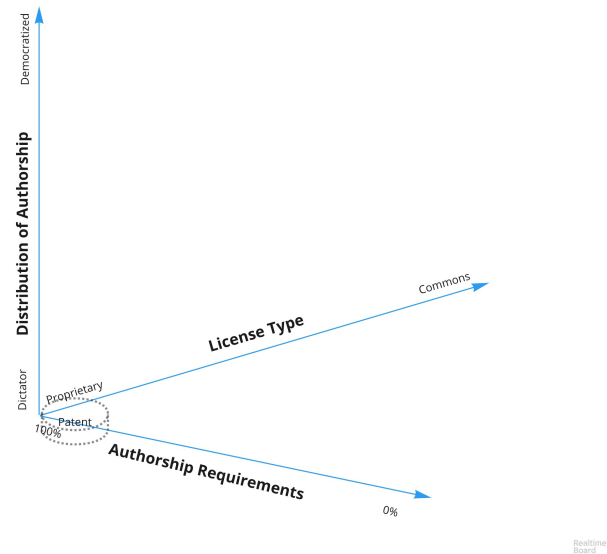
Thus the design of a software, the writing of a book, or the realization of a video-game can rely on a DAO within which each member has a determined quantity of authority on the content and in which it is possible to know who did what and for what quantity of authority. With content-DAO, ownership is no longer considered as an absolute right of a person over a content but falls within a bundle of rights connecting the owner to other people about his content. As the economists Dans Alchian and Harold Demsetz said in 1973: *It is not the resource itself which is owned; it is a bundle, or a portion of rights to use a resource that is owned*. The authority of contributors over a content is thus

Table 2.



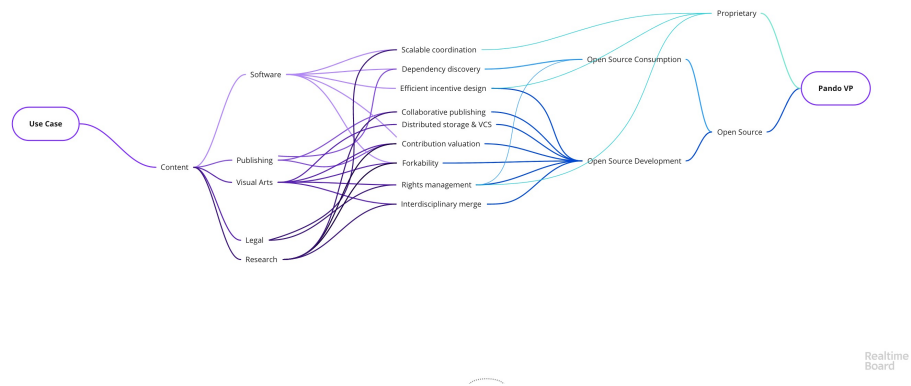
distributed over the contributions of each within the DAO according to rules established upstream by members. With content-DAO a creative collaborative content is therefore defined by the bundles of rights that pass through it. In order to bring the DAO in contact with the traditional jurisdiction it is possible to work on this proposal: A content is a DAO whose rules of governance, norms of sharing and exploitation are defined by the DAO itself through a specific dynamic licence

In this perspective, contents are DAOs and therefore require a set of "turnkey - modular" licenses adapted and consistent with new forms of organization promised by blockchain technology.



3 Pando DAICO

3.1 Value Proposition



The Pando tech stack addresses profound issues in the open source movement and collective knowledge work: Blockchain projects still push code with a one project one maintainer rule (either a person or a foundation) which leads to a centralization bottleneck. Blockchain and open source software projects use

Github in the overwhelming majority of cases and the recent acquisition of Microsoft has massively increased the search for a truly decentralized alternative. Turning any content into a DAO opens new ways of massively scaling cultural creation while rewarding contributors and related projects in much fairer and transparent ways. Traditional legal rights and forms such as copyrights, trademarks, patents and limited liability corporations will soon be able to be governed via a DAO. The creation of a bridge is currently being researched thanks to another grant by the Nest program and would open use of Pando to a much larger class of users than developers of Open Source Software. This will be the first DAICO issued on top of the Aragon framework within a context of renewed interest for alternatives to ICO that offer a better alignment of stakeholder incentives. First large scale project to use a continuous funding mechanism that correlates project value much closer to the facts on the ground rather than speculative hype.

3.2 Continuous Token Issuance

3.3 Token Utility and Valuation

The more people use the protocol and auxiliary services built on top of it, the more tokens are requested by users and thus emitted by the automatic market maker smart contract. The smart contract mints and burns tokens according to a pricing function that is increasing with token supply. Tokens are used to access or purchase auxiliary services: stake on repositories, open private repositories, access protected contents, etc. Tokens are used to participate to the Pando Network DAICO and will entitle holders to some governance rights over the proceeds of the fundraise.

3.4 Funding

Projected financing requirements for preparatory work preceding the DAICO and subsequent 5 years of development stand at X Million USD. An additional X million USD could be raised depending on investor appetite in order to provide ecosystem funding for developers building software on top of the stack (in the form of grants hackathons). Given the lack of appetite in the ICO market, the founders believe it is in the best interest of the project to secure funding from private and institutional investors in the private phase before proceeding with the innovative continuous emission model. The founders are searching for one or several lead investors in order to secure the full amount needed to develop the project.

Investor ROI can only be quantified when the DAICO details are set in stone and Pando is searching for investors committed for the long-term, nevertheless several opportunities will be present for investors to exit with a high multiplier:

After the opening of the curve to the public and the termination of the respective lock up period investors can resell their tokens to the automatic market maker smart contract.

As the curves slope is fastest increasing in the early stages of the project, a relatively small amount of money put in the contract would push price of the tokens over seed and private phase implied prices.

3.5 Continuous Token Emission Model

Note: Pando Networks token emission details are not fixed and seed funding will be used to prepare the groundwork for a token emission that aligns incentives and maximizes values for all stakeholders. The general lines of Pando funding are: A seed funding in fiat of approximately USD X M\$ in order to fund the DAICO costs as well as developing the test net versions with a front-end for all layers of the stack. This funding will take place via SAFT with a discount with a token price close to zero and a flat shape in order to issue the tokens for early investors. 20 % of the initial emission are allocated to the team and 20% to a development reserve with long lock-up periods in order to further finance the prt for investors and a lengthy lock up period. A private sale of approximately X M with a lighter discount rates and lock-up periods The bonding curve is initialized with a token price close to zero and a flat shape in order to issue the tokens for early investors. 20 % of the initial emission are allocated to the team and 20% to a development reserve with long lock-up periods in order to further finance the pr public for a public continuous token emission with an increasing price function. All entities wishing to do so can then send their tokens to the automatic market maker contract where they are burned and redeemed against ETH. The increasing price function is parametrized in order to balance compensation of early investors within a reasonable delay while limiting price volatility that could hinder protocol usage and hurt token holders.

3.6 Continuous Issuance Smart Contract

Theorem 1. *This is a sample theorem. The run-in heading is set in bold, while the following text appears in italics. Definitions, lemmas, propositions, and corollaries are styled the same way.*

Proof. Proofs, examples, and remarks have the initial word in italics, while the following text appears in normal font.

For citations of references, we prefer the use of square brackets and consecutive numbers. Citations using labels or the author/year convention are also acceptable. The following bibliography provides a sample reference list with entries for journal articles [1], an LNCS chapter [?], a book [?], proceedings without editors [?], and a homepage [?]. Multiple citations are grouped [1, ?, ?], [1, ?, ?, ?].

References

1. Author, F.: Article title. Journal **2**(5), 99–110 (2016)