

# Paratii: a distributed attribution protocol and peer-to-peer video streaming engine

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## Abstract

Video is the fastest growing medium on Earth, engulfing a large share of online traffic<sup>1</sup>. The opportunity costs of assessing every frame seen online make audiences resort to “arbiters of attention”<sup>2</sup> in order to navigate an ever increasing amount of web content. In turn, relying on permissioned attribution<sup>3</sup> and curation engines spawns gatekeepers who semi arbitrarily allocate attention and rights. The lack of public monetisation tooling disenfranchises independent creators in a media-first, optimisation-driven industry. Paratii is a meta-layer for attributing and curating videos, that optimises not for value capture, but rather for system-wide efficiency. This paper introduces the market utility and relevance of the Paratii registry, describes the protocol used to construct it, and outlines the software components being built to fulfill its goals.

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<sup>1</sup> <https://www.recode.net/2017/6/8/15757594/future-internet-traffic-watch-live-video-facebook-google-netflix>

<sup>2</sup> [https://userfeeds.io/Userfeeds\\_Protocol\\_Whitepaper\\_\[Draft\].pdf](https://userfeeds.io/Userfeeds_Protocol_Whitepaper_[Draft].pdf)

<sup>3</sup> <https://www.quora.com/Can-I-apply-for-content-ID-if-I-havent-uploaded-any-videos-on-my-YouTube-channel-yet>

This document describes the currently ongoing work and also anticipated plans of the Paratii Foundation for a protocol and token mechanism. It does not constitute an offering. Nothing below shall be read as a guarantee or promise on how the Paratii Foundation, the protocol and the token will develop. Specifications and plans henceforth outlined can change, and the success of the network depends on many factors outside of Paratii's control. Statements on future events are based solely on Paratii's analysis of issues explored.

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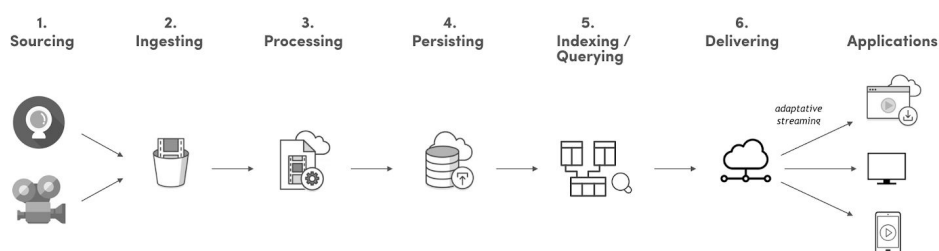
# I. Introduction

Over 2 billion people watch online videos every month<sup>4</sup>. The medium is responsible for ~80% of global internet traffic, and grows 25% annually<sup>5</sup>, fueled by (and fueling) the spread of high quality broadband access in underdeveloped regions of the globe, increasingly smaller processing units and bigger screens, besides a radical rejuvenation of the average audiovisual consumer<sup>6</sup>. All these vectors haven't shown signs of slowing down.

Audiences are used to omnipresent, low-latency, ever-abundant video. Content suppliers must deliver it. Depending on their position on the digital media supply chain, they resort to a spectrum of technology solutions, most of whom end up being served on some level by Google and AWS - the *de facto* private backend processors for most videos in the web<sup>7</sup>.

Online video has distinguished business models for B2C, or self-publishing (e.g. YouTube) and B2B, or Video-as-a-Service (e.g. Ooyala). As per today, the latter approaches value capture with high margins and lower asset turnover, while the former enjoys thinner margins on exceptionally higher volume - and may end up accumulating enough bargaining power to execute vertical integration and expand influence<sup>8</sup> (e.g. Google buying YouTube). The classification is not exclusive: sometimes, companies do both self-publishing and VaaS (e.g. Dailymotion or Vimeo).

The video streaming stack is an intricate, hermetic machinery. Jeff Bezos referred to it, in some sense, as “undifferentiated heavy lifting”, in the early days of AWS<sup>9</sup>. Its underlying process can be abstracted into a generic 7-step sequence<sup>10</sup>, and each part of it has grown in complexity over the last decade. It's impractical to compete with the oligopolies who master the flow and bundle it well, in economies of scale, but feasible to do so in specialising in a specific step (service) in the stack. That's what the rise of custom media players, transcoding services, QoE analytics and others have been proving<sup>11</sup>.



Above, a generic 7-step video streaming pipeline.

On the other hand, the true benefits of distributed-ness to improve the performance and lower costs of media streaming are largely overhyped, even if the feature of censorship-resistance is invaluable to some. For instance, storage, today, is commoditised. Few publishers would rather host their files on IPFS, for example, instead of in negligible-cost AWS, which still offers much more granular permission control.

Paratii builds on the belief that the boldest value of blockchains for content creators comes from the monetisation features that tokenization and an open financial system bring to light. Ads didn't push content monetisation in the web to a dead end<sup>12</sup>. It was our lack of imagination that did<sup>13</sup>.

<sup>4</sup> <http://www.businessinsider.com/youtube-user-statistics-2018-5>

<sup>5</sup> <https://www.statista.com/outlook/201/video-on-demand>

<sup>6</sup> [https://www.ofcom.org.uk/\\_\\_data/assets/pdf\\_file/0020/108182/children-parents-media-use-attitudes-2017.pdf](https://www.ofcom.org.uk/__data/assets/pdf_file/0020/108182/children-parents-media-use-attitudes-2017.pdf)

<sup>7</sup> <https://www.wired.com/2012/11/amazon-google-secret-servers/>

<sup>8</sup> [https://csinvesting.org/wp-content/uploads/2013/07/Measuring\\_the\\_Moat\\_July2013.pdf](https://csinvesting.org/wp-content/uploads/2013/07/Measuring_the_Moat_July2013.pdf)

<sup>9</sup> [https://aws.amazon.com/blogs/aws/we\\_build\\_muck\\_s/](https://aws.amazon.com/blogs/aws/we_build_muck_s/)

<sup>10</sup> [https://cdn-images-1.medium.com/max/2000/1\\*Stja7KlZct8tNyPw2-va\\_w.png](https://cdn-images-1.medium.com/max/2000/1*Stja7KlZct8tNyPw2-va_w.png)

<sup>11</sup> [www.forbes.com/sites/amitchowdhry/2018/03/30](http://www.forbes.com/sites/amitchowdhry/2018/03/30)

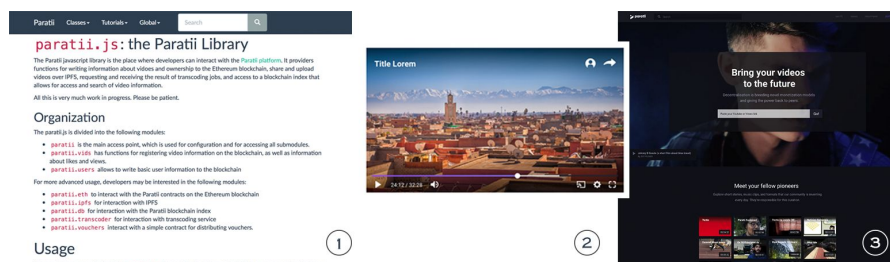
<sup>12</sup> <https://www.theatlantic.com/technology/archive/2014/08/advertising-is-the-internets-original-sin/376041/>

## I.a. What is Paratii?

Paratii is a registry of videos properly attributed, non-copyright infringing, and a platform to monetise them throughout the web with no data lock-in. Combining a decentrally-curated list with a mechanism for deepening categorisation, it creates a multilevel data substrate for open media applications. This registry is permissionless: anyone can claim a spot, and any token holder can adjudicate over it. Its objectives are to provide applications with non-copyright infringing videos to sort from (weeding away those deemed inappropriate), to assess their relevance, and give content owners access to public monetisation tooling.

Offering a unified point of entry for applications and end-users to sort through, publish and collaborate on video metadata - and derived assets - Paratii allows for **independent creators** to secure collaborative works in an uncontested manner, for **studios** to share rights data of audiovisual content without waving control away to distributors, for festivals or creative **collectives** to effectively organise to keep alive cultural heritage, and more. Above it all, Paratii is an experimental **attempt to spawn video applications that are decentralised, truly open and ultimately self-sustainable**. Main ways through which audiences will interact with Paratii are:

- **Paratii.js:** a JavaScript library any developer can use to **put** a video stream and **get** a playable url for it, easily building out-of-the box *decentralisable* video web applications. It has functionalities for handling ERC20 tokens too, meaning one can also set monetisation models for videos, collect earnings, participate in curation, and else<sup>14</sup>.
- **Paratii Player:** an embeddable player that **users** might see on Twitter, Telegram, or a random Medium article/blog post; and that can be used by **publishers** like Vice, ESPN, Globo.com, SoccerClipsFromTheTown.com or any domain owner who's picked it up as its player + video tech of choice. The player has a token wallet inside itself, and serves as an ephemeral node in the underlying peer-to-peer network.
- **Any web-based interface:** we exemplify this with the Paratii Portal (an on-ramping tool and template for easily replicable web-based video-sharing applications), that uses the Paratii.js library with a custom built React interface and allows **creators** to upload content in a simple drag & drop window, organise it into playlists, control monetisation policies or income, and manage identity or privacy settings. Web-based interfaces talking the Paratii protocol can range from stats-driven block explorers to freemium online course platforms to mobile GIF-sharing platforms.



Documentation for Paratii.JS (1); the Paratii player (2); the protocol's first web app, a Portal (3).

## I.b. Business case

The convenience provided by the one-size-fits-all, better-than-free, venture-capital-cash-strapped self publishing platforms is undeniable, to most kinds of audiences - both

<sup>13</sup> <https://medium.com/p/130b907ad324>

<sup>14</sup> <https://docs.paratii.video>

for small sized publishers and amateur creators, as well as for bigger publishers who can pay for freemium products. The “creative middle class”, though, is pushed to the fringes of value capture as such platforms optimise objectively for traffic, in order to keep the influx of ad-money (measured in *impressions \* average cost of impression*) and sustain fat dividend distribution. **Youtube sends 90% of its audience to 1% of its creators**<sup>15</sup>. This number is up from 40%, about a decade ago - that’s pure algorithm-driven optimisation, and stockholders are the ultimate beneficiaries. Hence the increasing adoption of complementary revenue streams in the form of alternative monetisation models - Patreon, streaming on Twitch, etc.

By unbundling content filtering - whitelisting, categorisation and aggregation from the rest of the stack, we can offer application developers with unopionated, “tax-free”, out-of-the-box monetisation tooling in the video-based products they come to build. **Creators**, using this applications, can explore **new revenue streams** and audiences for their content, hedging against ever-shrinking ad-earnings on legacy platforms.

**Key use case 1 (now):** Alice is a creator being algorithmically censored by YouTube. She seeks a platform where at least she can reach her audience, be found, and identify herself with. She goes to the Paratii portal application, mirrors her stuff there, and share it on her Twitter and Telegram groups.

**Key use case 2 (in 6 months):** Bob is an audacious videodev. In the new marketplace for freemium courses he’s building, he chooses to pull data from Paratii and use ParatiiJS to sort content libraries and drive user engagement around giving them NFT certificates to customers who finish lessons.

**Key use case 3 (in 12 months):** Charlie is the curator of the country’s biggest independent short-film festival. He’s well connected to studios, festivals and independent collectives, and wishes to secure the cultural ark he’s got access to and ensure it’s being properly monetised online. He goes to CultFlix, a subscription service built on Paratii, registers attribution rights, puts up a security deposit and makes the content available, without waving away royalties and making sure these are properly distributed at the source.

**Key use case 4 (in 24 months):** Danielle is a high level technology executive at a major publisher, whose sports videos (e.g. goals of the weekend) have spiky, ephemeral audiences, incurring unpredictably high distribution costs. She asks her team to integrate our player in their website (many big publishers already use the same framework behind Paratii’s player)<sup>16</sup>, and uses it to distribute the publisher’s fantasy football native token, which at this point is already an ERC20, to most engaged users.

## I.c. Value proposition

From 2006 to 2017, the top 3% monetised YouTube creators went on from being responsible for 40% of the audience to gathering over 90% of total views in the platform<sup>17</sup>. Today, 10% of the attention spent on YouTube is sparsely distributed among the remaining 97% creators (plus the non-monetised ones). Questions are frequently raised about the elitist nature of the incentivisation and recommendation policies in place, but the behemoth has been undeniably doing a good job in optimising for value capture - if not for value creation or network-wide efficiency. These “top 3%” group encompasses all YouTube’s monetised creators that earn above US-poverty line incomes. The remaining 97% can’t fund their living - according to the U.S. Department of Health & Human Services<sup>18</sup> - through their work.

Paratii’s main **value proposition to creators** is that niche-content is currently underexplored when it comes to the attention and money it garners online, and that creators of such can earn up to an

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<sup>15</sup> <http://eprints.mdx.ac.uk/22876/3/Introduction%252C%2520Final.pdf>

<sup>16</sup> <https://github.com/clappr/clappr>

<sup>17</sup> <https://thenextweb.com/insider/2018/02/28/shoulda-been-a-doctor/>

<sup>18</sup> <https://www.dol.gov/general/topic/wages/minimumwage>

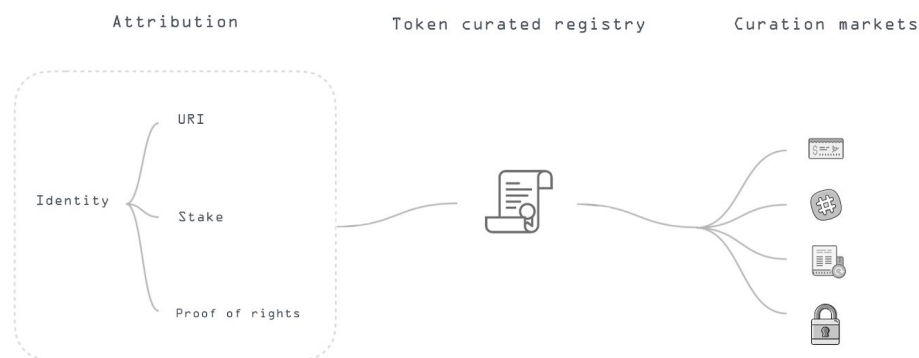
order of magnitude more if they coordinate effectively (in making their collective output worth more than the sum of its individual creations).

The Paratii protocol incentivises such coordination through ‘cryptoeconomics’ we presume will pass unnoticed by most of the average creators, and that will ultimately result in worthy content owners and curators accruing consistent value streams. Advertising-first didn’t only conquer the battleground for video monetisation in the web because it’s a frictionless model. It brought to life one of the most granular price discovery mechanisms we’ve ever put in practice for media<sup>19</sup>. With token-incentivised curation, the tools to build even more effective mechanisms are on the table - even YouTube has considered turning flagging and curation in a secondary market, pre-crypto<sup>20</sup>.

## II. The Paratii protocol

Paratii is a protocol for attribution and curation. An attribution is a claim, by any identity, that carries a unique resource identifier (URI), a proof of rights, and a stake. Claims are included in a token curated registry<sup>21</sup> whose focal point is to whitelist non-copyright infringing, properly attributed content. Videos are further categorised into token curated playlists, from where applications can read semantic data and offer novel forms of curating and monetising content.

For content owners or distributors, Paratii offers a unique entry point for monetising video beyond the limits of the currently dominant models. For app developers, it offers a source of reliable media and semantic metadata.



Paratii uses the blockchain to strengthen protections of rights holders against censorship and rights violations, to keep track of attributions and to put in practice a crypto-economic design that enables direct and value-producing relationships between creators and their audiences. It does not force developers to rely on any particular distributed video delivery stack, although the project provides open libraries for those willing to venture in this direction.

### II.a. Paratii registry

A token-curated registry is a list fueled by an “intrinsic token to assign curation rights proportional to the relative token weight of entities holding the token”<sup>22</sup>. To make curation happen, TCRs lay down a propose-challenge mechanism in which agents can submit an item to the list by depositing a stake, and any token holder can challenge the inclusion of an item by putting up an amount equivalent to the listees stake. Such a challenge starts an open but secret voting round, and lets a smart

<sup>19</sup> <https://twitter.com/VitalikButerin/status/992068638982238208>

<sup>20</sup> [www.hunterwalk.com/2016/11/26/how-we-almost-gamified-copyright-infringement-detection-on-youtube-ideas-for-fake-news](http://www.hunterwalk.com/2016/11/26/how-we-almost-gamified-copyright-infringement-detection-on-youtube-ideas-for-fake-news)

<sup>21</sup> <https://medium.com/@ilovebagels/token-curated-registries-1-0-61a232f8dac7>

<sup>22</sup> [https://docs.google.com/document/d/1BWWC\\_-Kmso9b7yCL\\_R7ysoGFIT9D\\_sfjH3axQsmB6E/edit](https://docs.google.com/document/d/1BWWC_-Kmso9b7yCL_R7ysoGFIT9D_sfjH3axQsmB6E/edit)

contract wrap up all inputs to produce a final decision. Hence, a generic framework for distributed curation.

The protocol that governs the Paratii registry is based on the specifications of the TCR 1.0 implementation<sup>23</sup>, with added design tweaks that aim to increase the list's bandwidth and "maximum economy size"<sup>24</sup>. In general lines, token holders can help maintain the registry by:

- submitting videos to the registry,
- signalling in favour or opposition of videos through *stakes* or *counterstakes*,
- calling an explicit challenge for a particular item, or
- voting in face-offs.

Applications into the Paratii registry fit the structure of a standard TCR listing<sup>25</sup> (given as arguments, below, are what we call the URI, the stake, and the proof of rights, respectively):

```
function apply(bytes32_listingHash, uint_amount, string_data)
```

Making an application into the registry is simple. One points to a content-addressed file, provides metadata, chooses licensing or monetisation options and makes a stake. Specifically, the Paratii protocol outlines the following steps:

- The creator/owner **submits a video** to the list. Each item  $i$  in the registry is associated with an amount of  $staked\_i$  tokens that are staked in favor of the item's permanence in the list; and  $challenge\_i$  tokens, that are staked in favor of its removal. The applicant must submit a stake of at least MIN\_DEPOSIT, which will go to  $stake\_i$ . **The applyStageLen is initialised at one hour, and can go down to zero if parameterized that way:** an item is by default *in* the list from the moment it's applied and not pointed to early enough, and can be challenged for removal at any point thereon.
- Other token holders can support the submission by adding to the listee's  $stake\_i$ , or oppose it by staking tokens on a challenge and contributing to  $challenge\_i$ . While an item is in the registry but not being voted on, all token holders can freely add tokens to either  $staked\_i$  or  $challenge\_i$ . **This is the "faites vos jeux" period, or the stakingStage.** This stage functions as a **prediction market** in which token holders can bet on whether the item will be removed or not.
- As soon as the challengers' stakes add up to MIN\_DEPOSIT, a countdown period starts after which the market will be closed. This ends the **stakingStage**.
- The protocol decides, randomly, whether the item will be put to the vote or not. At every timed round, a percentage of items is chosen. The probability of an item being picked depends on the total amount staked (i.e.  $staked\_i + challenge\_i$ ), the entropy of the vote ( $challenge\_i - stake\_i$ ) and the age of item in the listing.
- Voting works just as in the canonical TCR: we use a "partial lock commit reveal" (PLCR) scheme, in which the voting process is divided into two periods, a **commitStage** when voters commit to a (still secret) vote, and a **revealStage** when voters reveal the vote, after which they are tallied. **Tokens must be staked to participate in the voting process:** in order to vote, token holders must lock up their tokens in the voting contract for a period that they choose themselves.
- After the **revealStage** ends, **votes are tallied**. The votes are weighed by the period that they are staked: votes from token holders that lock their tokens for a longer time count more. **Voters are rewarded from the block rewards for their work.** As the difficulty of the minting process grows (i.e. less tokens issued), the reward is gradually replaced by a fee on the prediction market (this fee is determined by the DISPENSATION\_PCT, which is initially set at 100%, meaning "no fee"). In this way,

<sup>23</sup> <https://medium.com/@ilovebagels/token-curated-registries-1-1-2-0-tcrs-new-theory-and-dev-updates-34c9f079f33d>

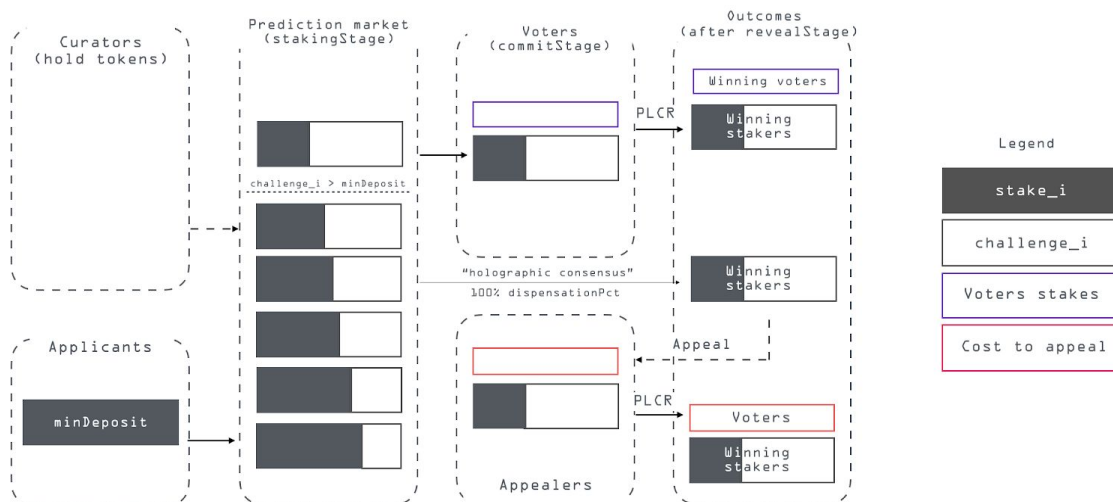
<sup>24</sup> <https://medium.com/paratii/curation-markets-infinite-staking-247e8b72caa3>

<sup>25</sup> [https://github.com/skmgoldin/tcr/blob/master/owners\\_manual.md](https://github.com/skmgoldin/tcr/blob/master/owners_manual.md)

token holders that are not participating are diluted by the inflationary block rewards, which only go to active voters. In other words, token holders have a direct incentive to vote. They can either do this themselves or delegate their votes to specialists in exchange for a percentage of the rewards they earn. Because token holders have staked their tokens for a certain amount of time, they want to see the value of their assets go up in value, and because the value of the token depends on the quality of the list, they want good curatorship: they have an incentive to vote well or choose a capable curator to delegate their vote to.

- The vote **settles the prediction market** in the following way. In the case of a delisting, dispensed tokens (a DISPENSATION\_PTC of all *stake<sub>i</sub>* tokens, which includes the stakes from the original listing owner + further *stakers*) are shared among *challenge<sub>i</sub>* counterstakes, in proportion to the vote. The remaining *stake<sub>i</sub>* tokens are used as voter rewards (see the previous step). In the opposite case, *mutatis mutandis*, and the original *stake<sub>i</sub>* *stakers* win.

- If the item is not put to the vote, the prediction market decides: the side with the most stakes wins, and the payout is as before, with the difference that there are no voters to be compensated (so the DISPENSATION\_PCT in this case is effectively 100%). To avoid that decisions can be swayed by simply buying the prediction market, the losing side can make a new stake to *appeal*, and call a vote. In this case, the losing side must compensate the voters for their work.



One problem with the “there is a fixed stake that can be challenged by matching that stake” approach of the canonical TCR is that it’s more attractive to challenge “easy” items, i.e. those with a high probability of either winning or losing the challenge. Items that are somehow “ambiguous” may never be put to vote in detriment of low-hanging fruits, which hold equal rewards for less risks. The schema proposed above tries to address this issue by allowing for more granular signalling. Betting on (the winning side) of non-controversial items will attract more stakes on that side, increasing the amount of people the winnings will have to be shared among, making effective payouts lower. At the same time, risk-taking is rewarded since optimising for the biggest “honeypots” with the less amount of people to share with means aiming to vote against the majority of *stakers* or *counterstakers*, in cases where the difference between both sides of the “*faites vos jeux*” prediction market is high (big honeypot, one side with few people).

Given a subjective probability of  $P_i$  that an item will remain in the list, the expected payout for each staked token is (disregarding opportunity costs):

$$P_i * challenge_i / staked_i$$



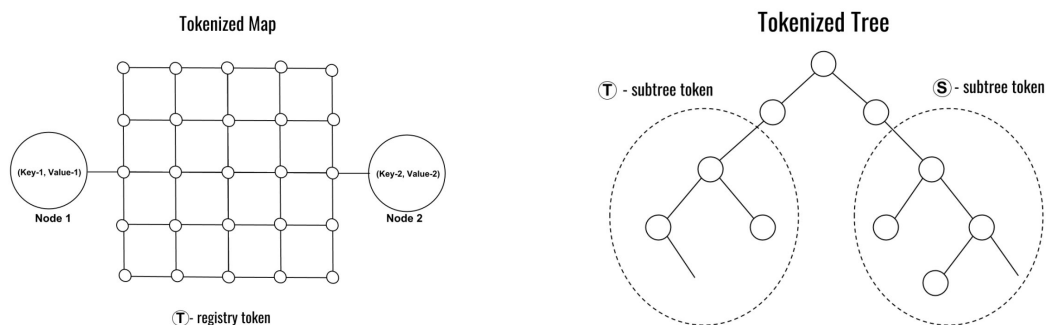
Rational *stakers* will add to *staked<sub>i</sub>* if this value is  $> 0$ , and to *challenge<sub>i</sub>* if this value is  $< 0$ . If we oversimplify and assume that  $P_i$  is the same value for all token holders, there is a natural equilibrium where  $P_i * challenge_i / staked_i = 0$ , or  $challenge_i / staked_i = P_i$ . Divergences from this natural equilibrium represent arbitrage opportunities for curators.

**To maintain a high-level of diligence over an ever-growing registry, voter turnout must rise accordingly**, which is a problem with registries with a large number of items and a large number of users. With the proposed scheme, we construct a prediction market with regards to outcome of votes. This invokes Matan Field's idea of *holographic consensus*<sup>26</sup>, in which *predictions rather than actual votes* are used to achieve objective results (in a hologram, every piece contains the information about the whole). The decision to keep or delist an item is only occasionally exerted by a plenary among all token holders (which keeps the prediction market in good behaviour). In most cases, "professional" speculators do just as fine, betting on the outcome of voting and reflecting the will of the majority.

## II.b. Token curated playlists

**Media-oriented registries**<sup>27</sup> like Paratii list assets (a domain, a website, a video, an image) which are cheaper to produce than the assets listed in naturally-constrained TCRs, such as Messari (cryptocurrencies) or TruStory (ICOs). Hence, media-oriented registries have a huge number of potential applicants; but also a very widespread, blurred audience; therefore making it harder to capture specific value. In the absence of a proper mechanism for categorising content and catering to niches effectively, they may just drift loosely towards a vague target.

The Paratii protocol combines a "mother" token curated registry with potentially infinite "children registries". Individual entities (humans or machines) can deploy a bonding curve<sup>28</sup> market maker contract to spawn a new token, that will be used to govern a sub-list of the main curated registry, or a sub-list of another sub-list. The bonding curve contract uses PTI tokens as a collateral. A channel is a type of sub-list. A publication with shared access (as in Medium) would be another.



A representation for the Paratii registry, on the left, and for Token Curated Playlists, on the right. Merging them would yield a three-dimensional chart where tokenized trees "drip" from the map on the left. Borrowing visualisations from *Tokenized Data Markets*, by Computable.io<sup>29</sup>

The market maker contract mints newly created tokens for whoever wants to acquire them with the mother token, and allows for these to be redeemed against the collateral held, at any point. Prices are algorithmically determined and get higher as more tokens are in circulation (i.e. when

<sup>26</sup> <https://forum.daostack.io/t/holographic-consensus-by-matan-field-fromtelegram/72>

<sup>27</sup> <https://medium.com/paratii/token-curated-playlists-1-thoughts-on-staking-and-consumer-applications-2a50bc837a94>

<sup>28</sup> <https://hackernoon.com/how-to-make-bonding-curves-for-continuous-token-models-3784653f8b17>

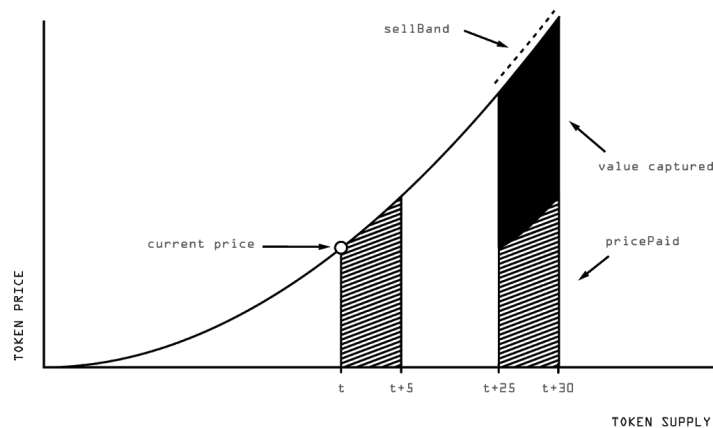
<sup>29</sup> <https://arxiv.org/pdf/1806.00139.pdf>

demand for the token increases), and lower as the supply decreases. Redeemed tokens are simply burned.

On deployment, the creator of the list determines the supply of his new token, as well as how much of it she intends to pre-mine for herself. She can use these tokens to kickstart the list by using them as stakes in applications of videos of her choice, and keep a part of the tokens as a personal investment in the list that may pay off when the list is successful.

These sub-lists can use the tokens of the sub-list to incorporate other ways of value capture over and above the simple right to co-curate the list. For example,

- One can deploy a channel with an access token, that floats in price according to popularity<sup>30</sup> of the content listed or broadcast, translating the demand for the content into objective value.



*A bonding curve for dynamically pricing access to certain content. Ann buys 5 tokens at **currentPrice** when outstanding supply is  $t$ , 25 more tokens are sold by the market maker, Ann gets tired of her “subscription rights” and redeems them, starting when supply is  $t + 30$ , pushing token prices downwards along the sellBand (every token sold pushes the price a little down) - the difference in price from what she paid earlier being the value the tokens captured through demand.*

- One can deploy a list of “common goods” and coordinate for their use. Film production companies sit on unused footage, and don’t ever have an incentive to share or recycle. By deploying a list of such content, and a token that gives both access to consumption (hold or pay to download without watermarks) and right of entry (stake to apply your footage too), one can kick start a grassroots Shutterstock-like membership club, with a “ticket” that reflects its value, and that can also be used to redistribute further revenue (e.g. proceedings from sales).

- One can deploy a segmented list that is referenced by media promoters or advertisers and drives earning to *listees*<sup>31</sup>, yielding returns to the creator of the category through appreciation or commissions.

- One can deploy a crowd sourced channel, selling out rights or distributing them selectively (e.g. an online school with teams spread out and in need of external contributors).

- One can deploy a normal subscription service, through autonomously selling non-transferable access tokens.

The mechanism can be indefinitely extended, making for multiple levels of “child-TCRs”, or Token Curated Playlists. Whenever one wishes to deploy a new sub-list, he can stake a collateral to mint fresh new tokens, and kickstart the TCP under a novel focal point. Allowing for lists TCRs within TCRs<sup>32</sup> has some upsides in relation to simply having one level of lists under a global whitelist.

<sup>30</sup> [https://docs.google.com/document/d/1c-cpE6O2L03Hg\\_Vvup8Jr4OkNhu1WzRJKeftLepNHgo](https://docs.google.com/document/d/1c-cpE6O2L03Hg_Vvup8Jr4OkNhu1WzRJKeftLepNHgo)

<sup>31</sup> <https://medium.com/paratii/what-if-0x-could-be-used-for-decentralised-real-time-bidding-advertising-9fcb733d8e84>

<sup>32</sup> <https://medium.com/@simondlr/continuous-token-curated-registries-the-infinity-of-lists-69024c9eb70d>

**First and foremost**, a sub-list inherits the curation properties of its source collection. This allows for curator diligence to be more focused on the specific focal point of the sub-list. If OhHeyMatty's<sup>33</sup> new video got delisted from the *Crypto-influencers most credible content* TCP, it will automatically be delisted from my sub-list *Best ICO Reviews*. If Ian Balina's<sup>34</sup> new video eventually got listed in the top-level registry, token holders would be signalled it's probably a good fit for the sub-list. This favours a natural trait of curation: it unfolds in multiple levels of depth. Expertise fields can be interdependent without necessarily overlapping in nature. One can be the best *sommelier* of organic wines in the world, and still have to rely on certifiers to separate genetically-modified grapes from verifiably organic ones.

**Second**, the original design of TCRs works best with lists that have an incomplete or ever-growing nature. If a list is complete, or not attracting new submissions, the token value will remain stable, and so voters will not have an incentive to "vote correctly" anymore. With Token Curated Playlists, comprehensive (and well-curated) lists have another driver of value if they are attractive to creators of sub-lists derived from it. Since these sub-lists use their mother token as a collateral in the bonding contract, they increase demand of the upper-level token, directly benefiting all upper-level token holders.

TCPs allow for multi-level curation, complementing the binary nature of the original TCR design. **The value of a TCP token can stem from (1) demand for the token as an admission ticket:** how much more its *listees* gain in revenue, in comparison to *listees* of the list immediately above (be it through ad-placements or pay-per-view, in the case we're already curating to end-consumers) - and how does that relate to the min\_deposit of the TCP (a proxy to the risk-return of "betting" on the monetisation system built upon the TCP); **(2) demand for the token as a chip:** how attractive it is to curators of sub-lists (again, how costly is the min\_deposit *vs* how much demand there can be for narrower collections within the list); **(3) demand for the token as an asset:** how much the list is worth, as measured by the content it gives access to, in the case of subscription-like tokens; **(4) demand for the token as a say:** how appealing it is to people who simply want to support specific videos / creators, or have the ability to shape a collection that offers a higher level of engagement.

## II.c. Block rewards

The PTI token mechanism design must incentivise high-quality curatorship as well as encourage the submission of videos deemed valuable by the curators.

In Proof-of-Stake inspired systems, work is assessed on the basis of a proof, and measured in accordance to the native token staked in exchange for the right to provide that work. In Ethereum PoS, you stake ETH and validate transactions. In Livepeer's proof of transcoding, you stake LPT and transcode streams. In Ocean's curated proof markets, you stake OCT and deliver datasets.

In Paratii's token curated playlists, you stake PTI, which gives you the right to vote on items that require curatorship work. This work is rewarded from inflationary block rewards together with a fee implied on the staking process itself.

The TCR protocol has a self-sustaining circular economy, in the sense that the costs of the decision process (i.e. the reward for the voters that do the work) is paid for from the stakes of the losing side. Effectively, the *stakers* and *counterstakers* in the propose-challenge process are paying a fee to the voters for providing the decision on which of the two sides has won. The fact that the challenge process charges a fee makes the prediction market less efficient as it would be otherwise, and the inflationary block rewards are in the first place rewarding voters from inflation, so the fee, in practice, can be lowered or even removed. **Block rewards pay stakers in the protocol for the curatorship work they are doing.**

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<sup>33</sup> <https://medium.com/u/f4f101ab4817>

<sup>34</sup> <https://medium.com/u/22a92e81f6b1>

Deciding whether an item should be in a list or not, by nature, tends not to be fully verifiable by a machine. Instead of claiming or competing for a reward by showing a proof, workers in Paratii compete to create the right proof themselves. The mechanism is akin to other proof of human work<sup>35</sup> tokens, where objective consensus must be achieved from subjective inputs.

However, it makes little sense to incentivize the curation process if there are no videos to curate in the first place. The protocol doesn't care about the specifics of how that provision of content happens. A share of the block rewards (initially set at 12%) goes towards maintainers of apps that mediate the most interactions with the Paratii registry. The protocol is also unopinionated on what is done with such capital: application owners can subsidise usage by giving some tokens to every newly validated (by the method of their choice) user they get; they can charge for the service but award frequent prizes to users; they can even run away with the tokens they earn, but that will likely drive users off to competitors and lose them earnings potential, anyway.

Worth noting, there is an argument to be made that relying on protocol-level incentive systems that spawn distributed developer contribution increase the 'legal' decentralization of the project.

## II.d. Key agents

Key agents in the Paratii protocol are applicants, consumers, curators, voters and third parties.

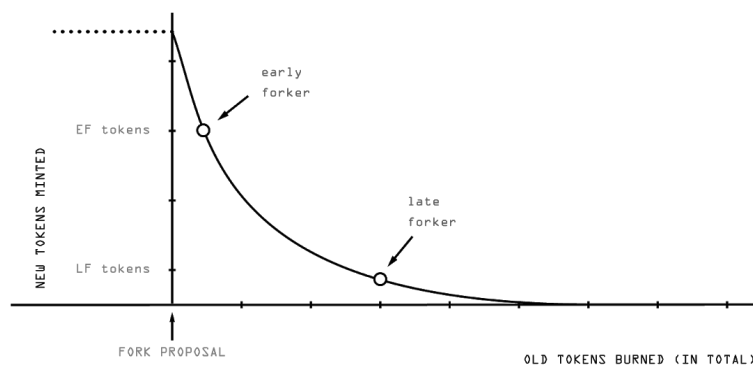
	<b>Applicants</b>	<b>Consumers</b>	<b>Predictors</b>	<b>Deciders</b>	<b>3rd parties</b>
<b>Description</b>	Individual or institutional content owners that register their content.	Institutional or individual media promoters, advertisers, publishers, or app owners.	Humans or bots willing to risk capital to earn with interest, mid-term.	Human or bot willing to invest in competing for short-term forfeited stakes.	Non-token holders interested in capturing value flowing through the network.
<b>Examples</b>	Video makers, studios, film production companies, creative collectives.	Self-regulation bodies (IAB, film rating boards, etc), advertisers, publishers, app owners.	Engaged fans, binge-watchers, archivists, researchers, film hobbyists.	Similar to the left, wider - trained recognition-based algos, content owners themselves, etc.	Developers, entrepreneurs, digital media businesses.
<b>High-level incentives</b>	Be on the list, get surfaced and monetise.	Bootstrap content offering, increase customer engagement, lower coordination costs.	Speculation, capitalising work previously "done for free", token value appreciation.	Capital accumulation, token value appreciation.	Interest in complementary revenue streams or novel business models.
<b>Interactions with the registry</b>	Attestation; initiating applications; staking for applying to the list.	Read-only, mostly; voting on relevant parameterization.	Stake / counterstake in prediction market; acquire sub-list tokens.	Stake in voting contract, and vote to support or oppose listings under scrutiny.	Develop custom interfaces; deploy block explorer for curation stats; deliver ads on a list.

<sup>35</sup> <https://hackernoon.com/proof-of-human-work-5e7e7f7d8914>

## II.e. Attack vectors

A number of attack vectors are known to token curated registries. Before them, worth noting, there's the probability that weak subjectivity causes collaboration failure - under unclear rules, cognitive load or dissonance, token holders' alignment gets "loosened" and the list's focal point fades away.

**51% attack:** a capitalised entity may come to hold 51% of all outstanding tokens and dominate parameterization. The minority's recourse in the case is to rely on social consensus, either forking the Registry.sol and the Token contract and mirroring new-to-old token balances while blacklisting the malicious actor; or, in cases when such actor can't be identified, deploying a burn & mint contract to issue new tokens to "rebels" willing to burn their current holdings in order to mint the new asset, according to their willingness to do so earlier or later<sup>36</sup>. Mitigating the risk of such attacks at protocol level can be done by implementing quadratic voting, but that needs a more universal identity standard than the ones currently available.



**Spam:** capitalised entities may submit a large number of low-quality applications, severely damaging the quality of the list. The attack's cost is a function of the MIN\_DEPOSIT size for each application, as set by the registry parameters. Paratii is designed to have a lower entrance barrier than most TCRs, via the dispensation of a share of block rewards to "favour onboarding through application subsidies". One thing it does to address this attack in the long-run is to halven such subsidies, effectively increasing the cost of entry, as the amount of listed items in the registry grows. Another possibilities, under research, are that of making the MIN\_DEPOSIT dynamic, as a function of the averaged frequency of applications to the registry in the last block interval, and that of "freezing" accounts or contracts (in the perspective of the registry) that submit abnormal quantities of applications in too short time.

**Bribery:** entities that offer bribes to stakers and voters may be within the set of token holders or be complete alien to their economy. The risk increases linearly with the legitimacy of the registry, and can manifest in the form of bribes for stakers and counterstakers (unlikely, due to the granularity of the market and the lack of decision influence when it comes to payouts), and in the form of bribes to voters. Two straightforward approaches to combat bribery are (1) to tally a random subset of votes in order to determine the outcome of voting rounds, doubling the cost of bribery, from having to pay 51% to needing to reach 100% of voters; and (2) to force the increase of funds at stake based on the contentiousness of votes during a challenge. The latter increases the risk of the briber, measured in the amount he needs to disburse  $[(P^1 + \epsilon) + (P^2 + \epsilon) + \dots + (P^n + \epsilon)]$  where  $n$  is the number of bribed voters<sup>37</sup>: a deposit is put to vote<sup>38</sup>; when 51% choose IN and 49% choose OUT, the entire deposit is taken away from OUT voters; as the voting result becomes less contentious, less of the deposit is taken away from the minority. While any successful bribery attack will be ultimately zero-cost, these

<sup>36</sup> <https://medium.com/@simondlr/burning-bridges-to-greener-grass-incentivizing-tokenized-forking-393c69dfecab>

<sup>37</sup> <https://medium.com/mosaic-network-blog/mosaics-cryptoasset-research-report-june-11-2018-6060cf923191>

<sup>38</sup> <http://www.truthcoin.info/papers/truthcoin-whitepaper.pdf>

approaches try to maximise the capital required to credibly commit, and to minimise the marginal benefit of single bribes in enlarging lists.

**“Vandalism”/ *a posteriori* modifications:** once a video is listed, its owner has the right to upsert new metadata and potentially invalidate previous curatorship, or obviate the nature / put in risk the stakes and counterstakes behind it. The attack is unlikely as it risks applicants earnings and status themselves, but it can also be used in coordination with a bribery attack to weep away stakes behind items with medium-sized support and accounts with no corresponding relevance themselves (a large enough honeypot, a small enough cost for bribers, too little at stake for the applicant). Prevention happens through returning stakes to curators (resetting the prediction market) whenever proof-of-rights metadata is altered by a *listee*, and disabling such modifications when a video is being voted on.

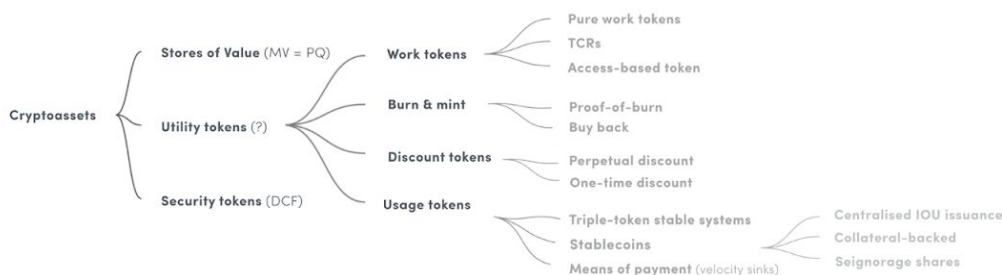
### III. The PTI token

*The Paratii protocol relies on a native utility token (\$PTI) that grants access to agents willing to provide value to the network and compete in earning its rewards.*

The token is emitted according to the ruleset encoded in the main net versions of the ParatiiToken.sol and Curated Registry (TCR) contracts, and inseparable from the protocol. **Network stakers who provide worthy curation services earn tokens via inflationary rewards. Tokens will be issued over an extended period of time.**

#### III.a. Classification

The PTI is a work-token, where “a service provider stakes a native token to earn the right to perform work for the network”<sup>39</sup>. Work tokens address free-riding as holders with idle tokens that are not put to use forgo cash flows opportunities<sup>40</sup> and end up having their ownership diluted. The work, in our case, is that of curatorship.



This is similar in nature to the designs of AdChain<sup>41</sup>, Messari<sup>42</sup>, Civil<sup>43</sup>, Relevant<sup>44</sup> and Ocean<sup>45</sup>, when it comes to the usage of a tokenized registry for weeding out pieces of content that do not abide by an overarching rule set, through rewarding righteous curators and punishing misbehaving agents.

<sup>39</sup> <https://multicoins.capital/2018/02/13/new-models-utility-tokens/>

<sup>40</sup> <https://medium.com/@patrickmayr/improving-network-incentives-through-work-tokens-94193b0dd922>

<sup>41</sup> <https://adchain.com/>

<sup>42</sup> <https://messari.io/tcr/whitepaper.pdf>

<sup>43</sup> <https://blog.joincivil.com/the-civil-registry-a-tcr-for-quality-journalism-a2452f363665>

<sup>44</sup> <https://hackernoon.com/relevant-an-introduction-5b79ef7afa9>

<sup>45</sup> <https://oceanprotocol.com/tech-whitepaper.pdf>

The PTI can also be seen as a *proof-of-human work* token<sup>46</sup>. In this sense, it is akin to Numerai<sup>47</sup>, Earn.com<sup>48</sup>, Steem<sup>49</sup> and other crypto-assets which reward work that's not fully objective (or that has to arrive at objective outputs from partially subjective inputs). We believe it to be one model that accrues value efficiently<sup>50</sup>, once the token price derives directly from the value provided by the registry over which the token confers the power to govern.

### III.b. Issuance & distribution

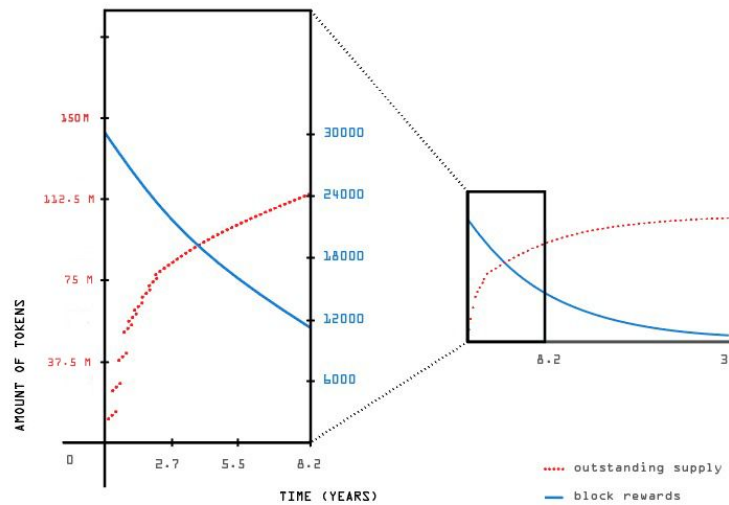
PTI has a maximum capped supply of 150.000.000 tokens. 40% of the tokens are reserved for the Paratii foundation, founding team, advisors, strategic content partners and early investors, according to a vesting scheme detailed in the token summary<sup>51</sup>.

<b>60%</b>	<b><i>Minting block rewards.</i></b>
<b>15%</b>	<b><i>Investors.</i></b>
<b>12%</b>	<b><i>Foundation.</i></b>
<b>7%</b>	<b><i>Advisors and strategic partners.</i></b>
<b>6%</b>	<b><i>Founding Team.</i></b>

60% of the tokens, or 90 million, will be released following an exponentially decreasing curve, starting at 29.000 tokens/day, along a constantly diminishing rate, with a half-life of 2160 days (a bit less than 6 years). The precise formula is:

$$f(t) = \left( 29000 \cdot (0.5)^{\frac{t}{2160}} \right)$$

where  $t$  is the time in days.



Blue line represents the amount of tokens released per day; red line, the amount of tokens (outstanding supply) in circulation.

<sup>46</sup> <https://hackernoon.com/proof-of-human-work-5e7e7f7d8914>

<sup>47</sup> <https://numer.ai/whitepaper.pdf>

<sup>48</sup> <https://earn.com>

<sup>49</sup> <https://steem.io/steem-whitepaper.pdf>

<sup>50</sup> <https://medium.com/paratii/on-the-immaturity-of-tokenized-value-capture-mechanisms-1fde33f2bc8e>

<sup>51</sup> <https://medium.com/paratii/pti-token-summary-edf048d36245>

Issued tokens bootstrap the growth of the network, as described in section II.c. They ultimately flow partly to voter rewards, partly to foster onboarding of users. As the difficulty of the minting process goes up and the registry grows, issuance will not be enough to cover the voter rewards. Just as with bitcoin, where transaction fees constitute a greater part of the compensation for miners as the block rewards go down, and will ultimately replace them completely, in Paratii, issuance will be gradually replaced by fees from the propose-and-challenge mechanism to pay for voter rewards.

### III.c. On utility value

The Paratii protocol and token don't carry an embedded revenue generation model. They exist to spawn a registry of sorted videos for applications to deliver and explore. Being on this registry is useful for video owners as they can ensure proper attribution of work, safeguard against rights violations and potentially get exposure to audiences via distinct products, besides having access to natively enabled monetisation models with no rent-seeking. Monetisation is not a fixed offering: we begin with simple consumer-to-creator payment methods (e.g. tipping) and expect to broaden the range of options consistently (SVOD, dynamic access pricing, etc). For instance, if a national television network decides to sort and license "PG rated indie films" (whitelisted content for public TV) through Paratii, that represents a new revenue opportunity for listees who happen to fit such categorisation.

Applying to this registry has "a cost". That's where its value come from, ultimately, as in other TCRs. Anyone willing to "put a video in the list" has to make a stake. Applications upon Paratii that tailor for a general public can "sponsor" that cost by giving away some tokens to users (*see section II.c*).

But this registry's rules are simple: not copyright-infringing (properly attributed), not illegal content. Outperforming the curatorship granularity of it is easy, so anyone can deploy sub-lists. Instead of hammering down one global, but narrow enough focal point, Paratii prioritises breadth at a base level, and leaves value to be captured by curation that happens through sub-lists. Making a sub-list (a creator channel, a publication, an niche-focused category for an app itself, a hashtag for media buyers to segment upon<sup>52</sup>) requires a stake between one and two orders of magnitude higher than the min\_deposit for uploading a video. If creators / publishers want to feed the mother-TCR with content they can do so through general-public apps (like the Paratii Portal) that will likely "annulate" their perceivable costs up to certain point, but to open an own aggregation of content (a child-list, a channel) inevitably requires a stake.

In surface, this is very similar to what Civil<sup>53</sup> does with newsrooms. It's where demand pressure stems from the most<sup>54</sup>.

How to measure the utility of being in a registry? What's the value it provides? Although the procedures to formally address such questions<sup>55</sup> are just being bred, we outline below three approaches to generically assess the utility value of token curated lists:

- Finding a proxy for the amount of value the list secures: in the absence of empirical data, one can estimate, for a given industry or sector, the value in being compliant with a specific rule set, (transparency standards, in the case of Messari; fraud-preventing practices, in the case of AdChain; attribution rights, in the case of Paratii). Coordination tools can have inherent value: think what Content ID would be worth, if stripped off from YouTube and redistributing "faulty" monetised revenue to worthy contributors.

- Calculating the cost to permanently diverge the list from its focal point: if the value of the Bitcoin network is proportional to the cost of breaking its objective function (i.e. double-spend), a list's

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<sup>52</sup> <https://medium.com/paratii/what-if-0x-could-be-used-for-decentralised-real-time-bidding-advertising-9fcb733d8e84>

<sup>53</sup> <https://civil.co>

<sup>54</sup> The way applications present lists is up to them. The <http://portal.paratii.video> will require a stake to open a channel, simple as that. A GIF platform that uses Paratii may ask a stake to create a new hashtag/category, leaving it free for users to upload generally. An online education platform may ask stakes to professors willing to open their own courses rather to contributing to existing ones.

<sup>55</sup> <https://medium.com/@jacobscoff/the-emergence-of-cryptoeconomic-primitives-14ef3300cc10>



value can be seen as that of “bringing its ruleset” down, through bribery or any other forms of attack. Ideally, as a result of effective design, this comes down to a natural equilibrium: the cost for attackers is equivalent to the price interested network participants are willing to pay to keep the registry secure (attacks costing a function of active stakes at any given time). How much would the collective of crypto projects pay to self regulate and avoid external regulatory interference? How much are domain owners and advertisers willing to put up to ultimately combat fraud? How much are creators and publishers willing to stake to earn more than they currently do, in legacy monetisation platforms?

- Ultimately, TCR-like tokens become the unit of account for a kind of specialised curatorship work. Assessing the value being paid to equivalent work by real-world businesses can yield good proxies. How much, on average, does a video platform pay for its team of content filterers (Paratii)? How much SSPs spend on verifying the domains they pull inventory from (AdChain)? How much is spent by investors on “crypto diligence” (Messari)?

In a broader sense, Paratii is a protocol for shared attribution of media assets, not through top-down hierarchy, nor through equity ownership, but rather through stakes. Hence, another reasonable prism is to see the value of the Paratii registry as a function of the expectation of future cash flows for *listees* opened up via the monetisation models permitted by it.

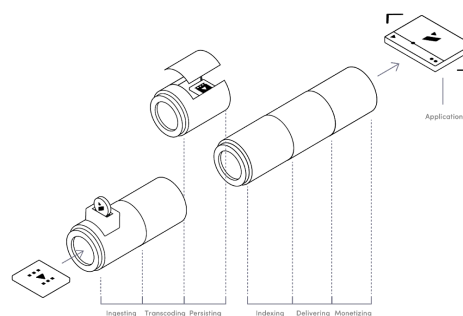
## IV. Distributing the video streaming stack

Complete decentralization is a medium-to-long-term vision. From 2016 onwards, a wave of applications embarked on the mission to build or rely upon trustless video streaming infrastructure. Some of the most audacious approaches were arguably ahead of their time<sup>56</sup> or failed to deliver real-world benefits in a reasonable timeframe; most pragmatic ones are reaching main net by this time.

### IV.a. Paratii.JS: an open pipeline for streaming

The Paratii registry can be read by any application that supports or connects to a web3 instance. Paratii.JS is a library to assist **developers** in building p2p-video-powered apps and plugins, bundling access to disintermediated service providers.

The library can be used to **put** a video stream and **get** a playable url for it, while it gets ingested, stored, transcoded, indexed and distributed behind the scenes. With this, one can easily build out-of-the box *decentralisable* video-powered web applications. Paratii.JS has functionalities for handling tokens too, meaning one can use it to set monetisation models for videos, collect earnings, participate in curation, and else.



To give an example, the heavy lifting of the acquisition part of the video pipeline is done by the function `paratii.vids.uploadAndTranscode`. This function uploads a given video to the Paratii

<sup>56</sup> <https://blog.userfeeds.io/part-i-the-end-of-the-journey-173f669d70bc>

"cloud", transcode it, publish the result on IPFS, and returns a multihash of the transcoded result, along with an `EventEmitter` instance which will report about progress (and eventual errors) in the process:

```
const pathToYourFile = './some/file.mp4'
const ev = paratii.vids.uploadAndTranscode(pathToYourFile)
ev.on('transcoding:error', console.error )
ev.on('transcoding:done', function(hash, transcoderResult) {
  console.log(`https://gateway.ipfs.io/ipfs/${transcoderResult}`)
})
```

The notion of an open streaming engine revolves around **modularity**. We're working towards not having IPFS "hooked in" as a go-to file system, but rather offer interchangeable video persistence. On the multiplexing side, the aim is to provide a wrapper (akin to Snickers<sup>57</sup>, built by our advisor Flávio), that chooses among the most adequate provider for each job request (e.g. a more expensive service for live/breaking news; something cheaper and slower for old documentaries; a specific one for VR). Reaching the desired level of interoperability with sister networks likely involves using 0x for token abstraction<sup>58</sup>, or can be facilitated as more networks migrate away from means of payment token models and simply accept *ether* for their services.

## IV.b. Multiplexing

Video and audio that is streamed over a heterogeneous network needs to play on a wide range of different devices and file formats. In video processing, combining audio and video into a single coherent data flow can be done according to a variety of codecs, bitrates and containers. To ensure that the requirements of all devices are met, proprietary platforms rely on media servers who convert ("multiplex") source files into suitable formats before handing them over to content delivery networks, or CDNs, that take care of distribution.

Although the process involves different transmutations, transcoding is usually used as an umbrella term<sup>59</sup>. LivePeer<sup>60</sup> is developing a protocol for the incentivized transcoding that accepts *ether* as a means of payment, RTMP as input format and outputs RTMP/HLS streams. In the LivePeer protocol, job requests are posted to a smart contract together with an escrow in LPT, while transcoders and broadcasters interact to verify input data and ensure enough persistency, perform the job and output the target stream.

We're working towards offering support to Livepeer transcoding out-of-the-box with Paratii.js, which would provide application developers with easy access to a decentralised network for supplying one of the most crucial steps in the streaming pipeline. We were able to test the integration on Rinkeby with a couple caveats, and follow the LivePeer team's efforts in extending support to VoD, in addition to live streaming. Specifically, developments we look for include: (1) their media server to accept a query with the `video_id` passed, in a way that not only the last `manifest_id` is returned; (2) time segments to be kept for a bit longer than few milliseconds after the stream ends so we can capture the last chunk; and (3) the ability to pass a query to the media server to initiate local transcoding before we trigger the actual start the stream.

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<sup>57</sup> <http://blog.flavioribeiro.com/snickers-open-source-api-for-media-encoding>

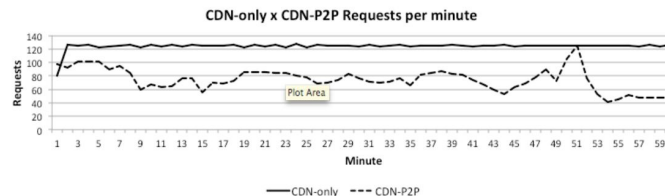
<sup>58</sup> <https://www.youtube.com/watch?v=9d019RycObk>

<sup>59</sup> In fact, **transcoding** means decoding to an intermediate uncompressed format and re-encoding into a target format (in order to support popular codecs); **transrating** means altering bitrate to support bandwidth-scarce broadcasts and/or adjust bitrate according to available bandwidth, making streaming adaptive; and **transmuxing** means packaging data into various container formats and delivery protocols.

<sup>60</sup> <https://github.com/livepeer/wiki/blob/master/WHITEPAPER.md>

### III.c. Streaming: where peer-to-peer matters

Delivery is a piece of the puzzle where decentralisation has thrived, in cost-effectiveness. Peer-to-peer assisted streaming has helped major media companies replace or complement CDNs when it comes to peaked, mass consumption of audiovisual content. Most notably in live streaming, where audiences are concentrated in time, and usually geography, the market has lately seen increased adoption of “hybrid-CDN” implementations.



*Beyond the hype: this is what p2p-assisted streaming can do to improve query frequency<sup>61</sup> in comparison to traditional CDN-based distribution.*

Some of these approaches provenly offload CDN traffic and reduce bandwidth consumption costs by up to 98%<sup>62</sup> - Peer5 and Streamroot<sup>63</sup> are fiat-friendly businesses built upon this very premise. ParatiiJS relies on IPFS as a CDN, and is being developed to both interoperate with the network’s in-the-works incentive mechanism, as well as to be independently pluggable to other hash-linked file systems. Worth noting, IPFS’ usage at present time is indirectly and directly subsidised by Infura, Protocol Labs, and smaller organisations to the extent of the Paratii Foundation, who runs a couple bootstrap nodes and gateways, and permanence won’t be trustlessly assured likely until Filecoin<sup>64</sup> goes live.

### III.d. Metadata & querying

There is no standard querying protocol for off-chain stored data in the Ethereum space. Existing clients do not offer much functionality for searching and indexing, so we defined an API and coded a REST service that indexes the relevant data on the blockchain and IPFS. This is akin to what Ujo and other end-user web3 applications have been doing.

This constitutes a traditional (replicable) DB for storing and querying mutable metadata. ParatiiJS allows any application developer too hook up an own indexing system for private or permissioned data, or rely on the publicly accessible one by default. Under clear classes that abstract interaction with major nested components of the streaming stack (ParatiiConfig; ParatiiVids; ParatiiUsers; ParatiiEth; ParatiiIPFS; ParatiiDB and ParatiiTranscoder), one can easily, for example, after a quick npm install, search for videos with a keyword:

```
const { Paratii } = require('paratii-js')
const paratii = new Paratii()
paratii.vids.search({keyword: 'cats'})
```

### III.e. The Paratii player

The Paratii player is an embeddable client that bundles access to the underlying peer to peer infrastructure. Built upon the Clappr framework<sup>65</sup>, it is designed to facilitate the deployment of web or

<sup>61</sup> <http://www.sbr2014.ufsc.br/anais/files/wp2p/ST4-1.pdf>

<sup>62</sup> <https://www.peer5.com/>

<sup>63</sup> <https://techcrunch.com/2017/09/07/streamroot-raises-32-million-for-its-peer-to-peer-video-delivery-technology/>

<sup>64</sup> <https://filecoin.io/filecoin.pdf>

<sup>65</sup> <https://github.com/clappr/clappr>

mobile applications by developers, and for publishers to leverage p2p-assisted streaming and Paratii's attribution protocol, pasting a single line of code in a page.

The player is bundled with a javascript wallet that stores encrypted private keys in localStorage, for interacting with Ethereum contracts without having to run a local node. Its hooked web3 provider can connect to a remote node which relays transactions - once the wallet is unlocked, it can perform micropayments or series of correlated transactions. Setting up a threshold in either *amount of tokens traded* or *frequency* is paramount for safety. Best practices also point to applications prompting users to connect a secure account (whenever assuming control of a wallet) towards which funds in excess of a certain limit can be piped to. This is similar to earning via a self-publishing platform that credits your bank account every end of week.

HTML5 player; oEmbed & Embed.ly support	Lightweight & adaptative (native on Twitter, Medium)	Integrated ERC20 wallet
Configurable, API-enabled	Clappr-based & customisable	1080p, 60fps, full HD

## V. Project structuring

Paratii entered 2018 with a private testnet alpha of its first dApp (the Portal), a lively community and a small team dedicated to the project (7 people full-time, 11 in total). So far, we:

- Released version 0.0.1 of our p2p video player in the end of 2017. The application was tested on Twitter, Telegram, Medium and Wordpress, and integrated with embed providers such as Embed.ly and oEmbed, garnering a bit over 1,000 views. Released version 0.0.2 of our player in Feb'18, and a developer preview of Paratii.JS in Apr'18.
- The Paratii Portal began its rollout through a private testnet alpha, including the basic features of upload, registration, search and share, besides an ever improving performance over libp2p / IPFS (6 issues opened, 4 PRs closed, and a lot of direct collaboration on the js-ipfs repo).
- Some dozens of creators have made over 400 videos available via Paratii, including established mid-sized ones like the director Toddy Ivon (46k subs on YT); Brazil's influential crypto-personality Fernando Ulrich (72k subs); LGBT activist Hugo Nasck (95k subs), and Cannes & Clio-awarded director Giuliano Saade.

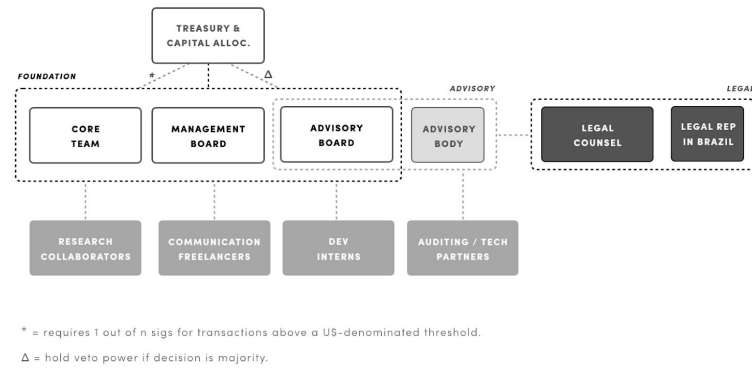
Spread over a few different time zones, we meet for an open development call every Monday (weekly planning) and Friday (weekly recap), besides holding a community/communications check-up call every Wednesday. Work is publicly followable on Paratii's GitHub repositories<sup>66</sup> and Gitter open chat rooms<sup>67</sup>.

Treasury management and operations are under the legal responsibility of the Foundation's management board, and non-trivial transactions are communicated in written form to at least one team member and the advisory board, the latter having the right to veto if by majority.

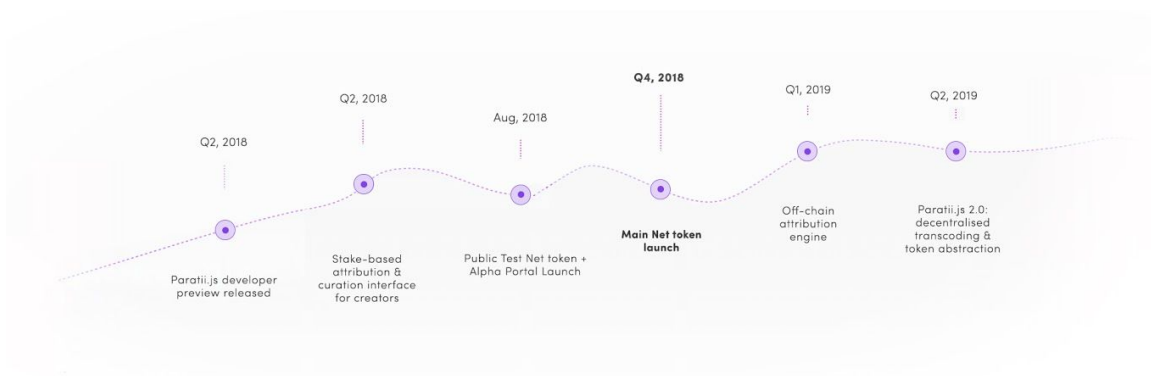
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<sup>66</sup> <https://github.com/paratii-video>

<sup>67</sup> <https://gitter.im/Paratii-Video/dev>



## V.a. Roadmap



A simplified roadmap-to-launch is presented above. More details can be found in Paratii's separate go-to-market document.

## V.b. Market landscape

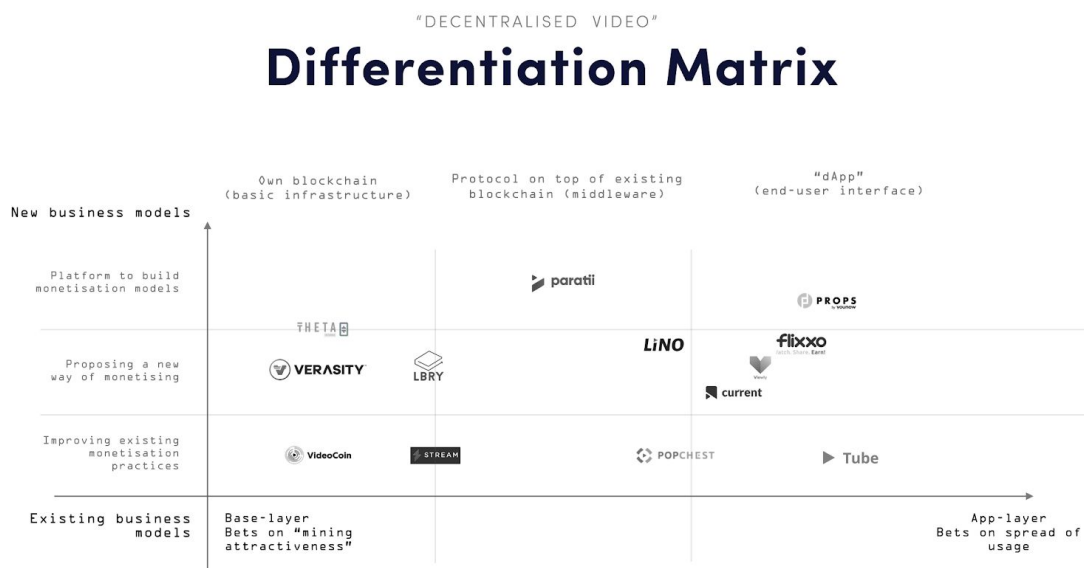
There are many distinct efforts aiming to provide decentralized alternatives to Tubes and Flixes<sup>68</sup>. The 'boom' was imminent for those watching the space from the beginning<sup>69</sup>. A few elements make Paratii stand out from everything else out there in the ecosystem right now:

- It does not have its own blockchain; it's also not a specific dApp (the player can be seen as an application, though) - it's a protocol for distributed curation and an open streaming pipeline built partly on top of an existing blockchain (Ethereum).
- The liberty to choose your own model for monetization. Paratii is not against ads, like DTube, or against micro-tipping, or against paywalls - the only things we're opposed to are imposing a single model instead of allowing the creator to choose, and taxing transactions.
- The embeddable player that serves as an ephemeral node in the underlying p2p network (wherever it is).
- Everyone who uses the player can be rewarded by the player itself without having to be tied to a single platform or environment, as it's made to be freely embedded on the web. This is made possible through an in-player wallet, and is up for "embedders" to set up.

<sup>68</sup> <https://medium.com/paratii/the-state-of-decentralised-video-q4-2017-42663ff94b28>

<sup>69</sup> <https://prestonbyrne.com/2015/02/28/this-is-how-you-use-smart-contracts>

- Less capital concentration. By forgoing a traditional ICO and prioritizing distributing tokens through minting once the network is live, we avoid giving control over to whales or turning what was supposed to be a democratic system into an oligarchy of sorts.
- Fully open source.
- A specific decentralized curation framework derived from TCRs.
- First and only of its kind in Brazil (+200 million people market, second biggest one for YouTube, after the US).



## VI. Conclusion

Criticism of ‘exploitative’ value capture by web empires that profit from ‘free labour’<sup>70</sup> of its users (both producers and consumers of value) is at its historical heights. The romantic label of “**prosumers**”<sup>71</sup> has been shadowed by the bold crudeness of its sister term “**produsage**”<sup>72</sup>. The *zeitgeist* of decentralisation comes and goes, as the neverending rise and fall of P2P networks demonstrate, but it’s become clear, after Bitcoin’s success, that there are feasible means of **overcoming the monopolistic nature of the firm with more cost-effective and economically fair means of coordination**.

Paratii is not the first nor the last protocol to align itself with a broader “proof of human work” movement<sup>73</sup> in tokenized systems all around. Some examples are Steem<sup>74</sup>, Earn<sup>75</sup>, CCCoin<sup>76</sup>, Userfeeds<sup>77</sup> and Numerai<sup>78</sup>. In common, the proposal for a new layer of incentivisation on top of the first generation computing-driven PoW, that aims to constitute, piece after piece, **a social data substrate capable of granting basic equity** of the world’s data (and, potentially, income), to all individual agents, equivalently to how much they are contributing in value and work to this “system of systems”.

<sup>70</sup> [https://acawiki.org/Free\\_Labor:\\_Producing\\_Culture\\_for\\_the\\_Digital\\_Economy](https://acawiki.org/Free_Labor:_Producing_Culture_for_the_Digital_Economy)

<sup>71</sup> <http://journals.sagepub.com/doi/10.1177/1469540509354673>

<sup>72</sup> <https://eprints.qut.edu.au/6623/1/6623.pdf>

<sup>73</sup> <https://blog.mediachain.io/a-new-cryptocurrency-to-reward-creative-commons-creators-e41e1791c4c0>

<sup>74</sup> <http://steemit.com/>

<sup>75</sup> <https://earn.com/token/>

<sup>76</sup> <http://www.mediachain.io/>

<sup>77</sup> <http://userfeeds.io/>

<sup>78</sup> <http://numer.ai/>

In this document, we outline a crypto economic system to align incentives of network users towards the provision of relevant videos and worthy curatorship, ultimately allowing value to be captured through shared ownership and righteous work.

Instead of locking in creators, we give them enough liberty and power as so they will keep coming back. Instead of monopolising users' data, we teach them how to take care of it. Instead of hiding secrets, we keep all our code open source, for public scrutiny and collaboration. Instead of charging for its usage, we make it free. Instead of competing for market share (how much each agent is able to "ransom" from its user base, as the traditional metric goes), we aim to grow the pie as a whole.

Instead of avoiding regulators, we encourage them to build better copyright tracking tools on our platform. Instead of telling studios and media companies their businesses are dead, we propose a new, complementary way, to secure their attributions and monetise novel revenue streams. Instead of disregarding crypto illiterates, we aim to educate them. **Instead of building a moat around us, we are building a magnet.**