PRM Whitepaper

PRM: Decentralized, Evidence-Based Marketplaces for Curating, Buying, and Licensing Digital Content

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Abstract

In today's digital landscape, most content is either locked behind a few licensing monopolies like Getty, or chaotically distributed across social media without compensation or attribution. Therefore, it is either priceless or useless. By now, most people have heard about blockchain and its ability to record information in a publicly-verified, traceable way across a decentralized network of devices. While this technology naturally lent itself to cryptocurrency, its potential is now being harnessed to break down silos in nearly every field imaginable.

Priime believes that the next revolution in blockchain will be in digital content. Blockchain's security and verifiability will allow users to establish Proof-of-Existence and Proof-of-Ownership. Beyond that, in a community-driven marketplace where everyone can stake Token into content they believe has utility, blockchain has the unique ability to facilitate evidence-based value. As opposed to relying on prices arbitrarily set by monopolies or untrustworthy metrics from social media, Buyers could have confidence that a price point was democratic, scientific, and fair in the new PRM Economy.

PRM is a network of decentralized, evidenced-based marketplaces for curating, buying, and licensing digital content. The markets run on a Protocol PRM Token built on Ethereum. Anyone can create marketplaces, called Decentralized Curated Lists (DCLs), and invite Creators to license their digital content. In allowing both Creators and Curators to invest and earn revenue, DCLs:

- Remove the dependency on large stock photography companies
- Scale the supply of today's digital content to markets that monopolies can't reach
- Increase Buyer confidence in purchase price
- Set fair, evidence-based value for the work of Creators

Note: PRM is constantly evolving. New versions of this paper will appear at https://priime.com/prm. For comments and suggestions, contact us at prm@priime.com.

Paper Structure

This whitepaper will have nine sections:

1. Introduction
2. Related Work
3. Overview
4. Protocol
5. The New PRM Economy
6. Priime, Inc.
7. Research and Development Roadmap
8. Additional Resources
9. Acknowledgements, References, and Appendix

Section 1: Introduction

The concepts of decentralized marketplaces on the blockchain have huge implications in the world of digital content licensing. Stock photography alone is predicted to be a $4 billion USD market by the year 2020, but the ROI on digital content is incredibly unclear. Massive companies like Getty take advantage of this lack of clarity, as well as the naivety of those new to the licensing space, by convincing Creators to give their work away with Creative Common Zero licenses as a trade for exposure. For Buyers, the price points on this digital content is seemingly random. Without evidence-based value, stock companies can set lower prices for volume and take a higher commission. Ultimately, this sours the market for nearly everyone involved. Creators become discouraged to create good work for licensing and Buyers are either forced to pay high prices, or turn to free, low-quality stock alternatives.

For Creators, an unforgiving marketplace is only half of the problem. When it comes to the mystery of pricing their work, there is no real precedent. Photographers who have developed their work on Instagram, for example, tend to base their value on social signal sums: likes, comments, and followers. The issue is that these metrics are all incapable of proving true value. There is no calculable and recognized correlation between a “like” and actual purchase prices in licenses — let alone the difference between a comment and a follow. In addition, social signal sums can be purchased, distorted, or fabricated.

In the opaqueness of online engagement, influencer marketing is impacted as well. In the age of social media, one person can wield more influence than an entire corporation. While the world

of influencer marketing is fast-growing, the options for them to create steady income comes only from paid sponsorships or revenue lead sharing.

The massive growth of digital content has left the traditionally centralized marketplaces without a way to scale the supply. There is a surplus of talented photographers with high-quality work, but either their lack of experience or reluctance to compete in the crowded stock monopolies keeps them out of the marketplace.

Finally, most infringement issues today stem from the fact that existing laws and regulations are largely designed to protect big corporations. DMCA and Safe Harbor laws, for example, are not helpful for the majority of modern-day Creators.

For Creators, Curators, and Buyers, PRM introduces an ecosystem for the evidence-based value of licensable digital content. Through components like DCLs, Margin Power, and Proof-of-Ownership, PRM removes the friction from the entire content lifecycle.

Section 2: Related Work

PRM is able to flourish by building off concepts of blockchain, decentralization, Proof-of-Ownership, as well as key learnings from the art gallery world.

2.1 Blockchain

Blockchain is a digital ledger in which transactions are recorded chronologically and publicly. For the world of digital content, that means licenses, Proof-of-Existence, and Proof-of-Ownership can be baked directly into the content itself. On the blockchain, anyone can track the ownership and movement of a piece of content with low overhead and almost no commission needed. When information is shared across a network of computers, there is no need for a central authority, leading to decentralization.

2.2 Decentralization

Blockchains are both politically and architecturally decentralized, meaning that no one individual, organization, or physical computer can control the system. While not foolproof, a decentralized system tends to have greater fault tolerance, as well as attack and collusion resistance. For digital content licensing, this creates a safer and more democratic space for Curators to build marketplaces. As opposed to competing in one giant marketplace like Getty, Curators could securely establish their own lists and reach the audiences that monopolies cannot. Decentralization solves the supply side of digital content by creating an infinite number of markets for Creators, Curators, and Buyers.

2.3 Proof-of-Ownership

With the rapid proliferation of digital media, protection of digital property has become paramount. Unfortunately, past efforts to detect infringement has been slow, elementary, and often very expensive. Most proposals apply watermarking techniques and focus on resolving disputes *after* a misuse has been detected. A third-party — often a judge — compares the ownership claim of disputing parties. This method of resolution is long, costly, and not precise. Moreover, one is often confronted with only a single claim of ownership. In digital marketplaces where Buyers intend to purchase digital content from hypothetical copyright holders, Proof-of-Owner is highly desirable. It deters Buyers from purchasing fraudulent work, and in turn, ensures that copyright holders are protected against the unauthorized reselling of their digital works. By using the publicly traceable and verifiable nature of blockchain and decentralization, Proof-of-Ownership can be proven through validation processes and consensus. It creates a frictionless buying process where lawyers and judges never need to be involved.

2.4 The Gallery Curation Model

As is often the case, the art world has been wrestling with many of these topics long before the technological sector. In considering the best way to empower Curators, celebrate Creators, and create a delightful experience for Buyers, PRM borrows heavily from the gallery curation model. For decades, real life photo and museum galleries have understood the importance of curating content. When someone walks into a gallery, they do not expect to see an endless sprawl of options. Instead, that person is served a thoughtful and considered collection. Where galleries struggle, is in scaling — expanding brick and mortar spaces is difficult and expensive. With the emergence of digital marketplaces, a Curator has the opportunity to expand their level of influence exponentially. Because of the low capital required, a digital Curator has the opportunity to create an economy of empowerment: high-quality content, an easy buying experience, and a way for Creators to build sustained credibility.

Section 3: Overview

3.1 PRM

PRM is a network of decentralized, evidence-based marketplaces called DCLs. Allowing anyone and everyone to create marketplaces will reach markets that monopolies can not. This includes modern-day organizations who need digital content but don't understand the traditional stock photography mechanics, professors who need material for presentations but aren't sure how to acquire the content they need, and individuals who want curated recommendations from trusted friends. PRM is composed of the PRM Token and the PRM Protocol.

3.2 Digital Content Objects

A Digital Content Object is the fundamental unit that is listed in a DCL. It is used to represent and hold the data for any type of content that can be stored or represented digitally. That could be a digital photo, or merely a digitally represented object, like a room for rent in an apartment. Digital Content Objects can be listed in DCLs, hold licenses that can be purchased, earn revenue for the Token holders, and validate copyright using Proof-of-Ownership processes in

the Validation Network. The same object can be listed in several DCLs by Curators and will hold different purchase prices which can be capped by the Creator.

3.3 Decentralized Curated Lists

DCLs are digital content marketplaces that are created and curated by anyone. Creators can apply to have their digital content featured on a DCL, or Curators may invite Creators directly. Both Creators and Curators can invest PRM Token in Digital Content Objects within a DCL, which is used with a multiplier to determine the final purchase price. Buyers can view DCLs for free and purchase digital content through DCL Licenses. The final purchase transaction price is then divided between the Curator(s) and Creator(s).

3.4 Margin Power and Evidence-Based Value

Margin Power is the core of all evidence-based value calculations. Taking into account PRM holdings, staked PRM, previous transactions, and copyright validations, it is an attempt to bring objectivity to the once-subjective world of pricing digital content. By using evidence-based value, like the Margin Power calculation, Creators have to prove their worth over time and thus are incentivized to create and license work that earns them this value. At the same time, Curators are given a vehicle to empower and celebrate the Creators they believe in. With undisputed evidence-based value from Margin Power, Buyers have confidence in purchase prices. There is nothing to negotiate and no possibility of being overpriced.

3.5 Validation Network

The Validation Network is made up of nodes on the Ethereum network running validations as specified by the PRM Protocol. The validations are used for copyright, ownership, and other types of checks for Digital Content Objects. When a copyright is deemed to be in violation through the validation process, all of the PRM Token staked in a piece of content will be taken from the stakeholders, serving as a deterrent for infringement. The validation processes are absolute, in that their results have total reliability in a result that cannot be refuted. Not only can PRM guarantee a fair price, but its system of validation ensures the credibility of what one is buying.

3.6 PRM Protocol Summary

The PRM Protocol is made up of smart contracts that run on the Ethereum blockchain. The main PRM smart contract will provide all initial functionality, creating unique smart contracts for individual items, such as DCLs and PRM Identities. Digital Content Object extensions are also considered as main smart contracts, and are used to extend the base Digital Content Object by defining specific Proof-of-Ownership rules and Digital Content Object features. For example, a digital photo would be one type of extension.

Storage is owned by the Creator and can be stored off of the PRM network, either off-chain in a cloud storage service (iCloud, Dropbox, home server), or even on-chain using IPFS and similar technologies. Storage is linked through the Digital Content Object, but not managed by PRM.

Ethereum nodes will run the processes of Margin Power calculations, as well as validations, as requested by the main PRM smart contract.

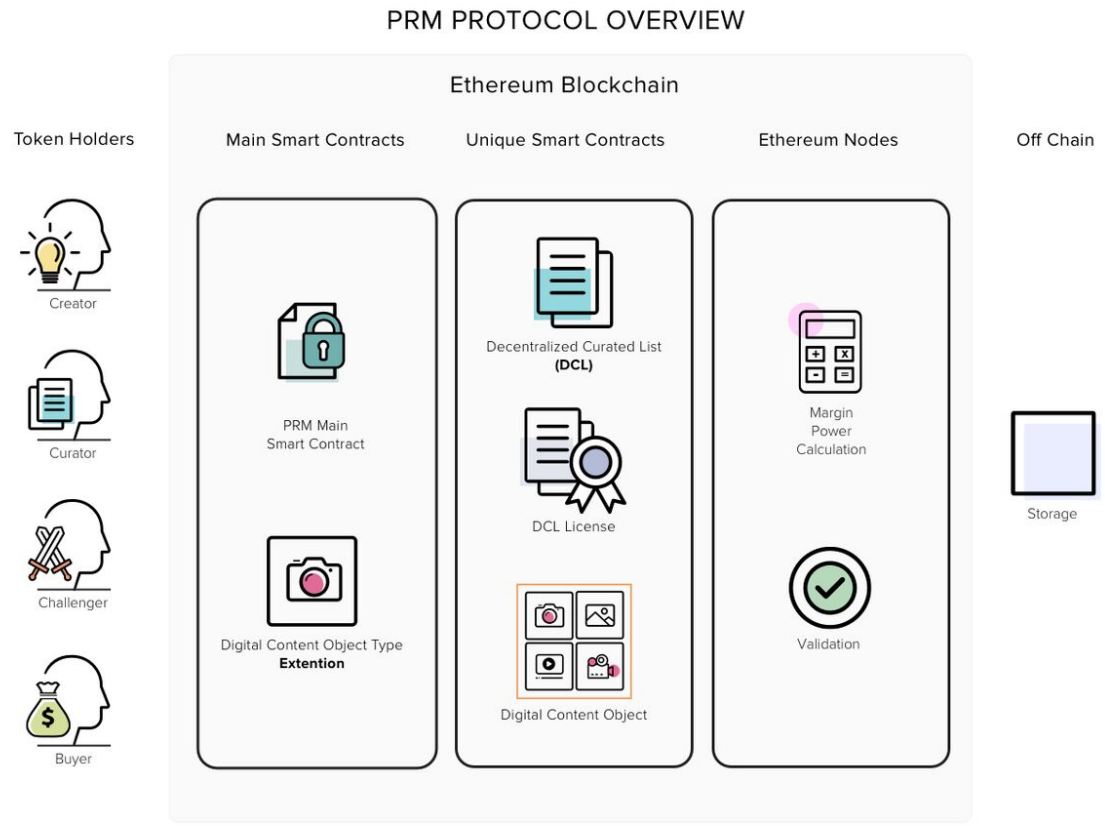

Figure 3.6: An overview of the components of PRM

Section 4: Protocol

4.1 Token

The PRM Token is an ERC20 crypto-economic Protocol Token that is used to apply evidence-based value to Digital Content Objects, by way of the mechanics of the PRM Protocol.

Token holders are defined by the following:

- Creators, who are the owners of Digital Content Objects
- Curators, who start and manage DCLs
- Buyers, who can purchase licenses of Digital Content Objects through DCLs
- Validators, who are rewarded for validating Digital Content Objects
- Challengers, who are rewarded for detecting unvalidated content

4.2 Digital Content Objects

Digital Content Objects (DCOs) are stored on the blockchain as an extension of the base DCO structure, and are created with a request to the main PRM Protocol smart contract. These different objects include digital photos, video, music, and more.

In this whitepaper, we will refer to an object in PRM, like a photo, as a Digital Content Object (DCO), and the specifications for the specific object is stored as a Digital Content Object Extension, or DCO Extension.

Table 4.2a: DCO Extension
The DCO Extension holds the data needed to represent any type of DCO. When the extension is created, a whole new type of DCO comes into existence on the blockchain.

Name	Data Type	Description
version	address	Address of the PRM smart contract.
title	string	A human readable title for the object type.
description	string	Short description of the object type.
fileFormats	string[ ]	Array of acceptable file formats that are supported by this digital object.
objectHashFormat	bytes32	This holds the format for generating the object's unique hash. For now, this will hold a JSON specification with the required inputs, the algorithm for generating the hash, and any other data required.
ownershipDataFormat	(string => bytes32)	JSON specification for how to create hash data for the pieces in the ownershipData. There is also a field whether each data is required or optional.
licenseTypes	address[]	Addresses of the licenses that this object can use. These licenses are also extended. An example is a Royalty-Free license for photos.
marginPowerWeights	(string => uint256)	A mapping of the customized weights from calculating Margin Power. Each input that's used in the Margin Power function has its own weight, and each must be specified when setting up the new Digital Content Object type. **See Section 4.5.**

validations	bool	Allows Digital Content Object types to require or not require validations. There are rare cases where some object types will not require the validation network.
validationPeriod	uint256	The period of time a challenge can be pending, in seconds. This is needed when a Creator needs to provide data for validation. They must provide it in the period specified for this object type, otherwise the validation state will change to incomplete. **See Section 4.63.**

Table 4.2b: Digital Content Object Creation Request Format

The request format to create a new Digital Content Object is detailed in this table.

Name	Data Type	Description
title	string	A human readable title for the object.
description	string	Short description or caption for the object.
objectVersion	address	Address of the “Digital Content Object type extension” smart contract that defines the specific function extensions for the object type (e.g. Priime’s photo extension).
assetLocation	string	URL string for the location of the asset. This gives Creators a choice of where and how they want their work hosted. Examples include iCloud, Dropbox, Amazon S3, IPSF, and Torrent services.
objectHash	bytes32	The unique hash for the object. For a photo, this would be the sha256 image hash unique to the photos pixels and EXIF data.
ownershipData	(string => bytes32)	Mapping of data used for Proof-of-Ownership. The structure is defined by the type extension that is referenced in the above objectVersion address. This data is used by the Validation Network to prove ownership. Examples include perceptive hashes for image matching, unique hashes for the camera’s serial number as a public key, and hashes for photo properties that were never publicly available.

Table 4.2c: DCO Extension Example for the Photograph Object

The objectHashFormat and ownershipDataFormat will specify the language, the uncompiled code for reference, and the binary that can be run. There will be continuous research on best practices on the delivery of these specifications. The goal is the binary can be run and can create the needed hashes and, if needed, the developer can use the algorithm code to develop their own tools.

Name	Data Type	Value
version	address	0x…
title	string	“Photograph”
description	string	“Digital licensable photograph by Priime”
fileFormats	string[ ]	[“jpg”, “jpeg”, “tiff”]
objectHashFormat	bytes32	[language: “python”, algorithm: “pycode…”, binary: “compiled binary…”]
ownershipDataFormat	(string => bytes32)	[“camera_serial”: [language: “python”, algorithm: “ pycode…”, binary: “compiled binary…”], “photo_key”: [language: “python”, algorithm: “pycode…”, binary: “compiled binary…”]]
marginPowerWeights	(string => uint256)	[“creation_period”: 5, “prm_holdings”: 0.005, “prm_staked_ratio”: 1000, “curator_prm_staked”: 0.008, “transaction_count”: 0.005, “transaction_price_average”: 0.001, “transaction_ratio”: 500, “validation_ratio”: 50000]
validations	bool	true
validationPeriod	uint256	604800

4.21 Licenses

DCL Licenses are smart contracts used as a relational reference between a Digital Content Object and a DCL. The DCL License is created through a Digital Content Object's smart contract. **See Section 4.32**. The DCL License holds data about the terms of use for the Digital Content Object and purchase price. It is also used in an invite-submission process for being added to a DCL. **See Section 4.3**.

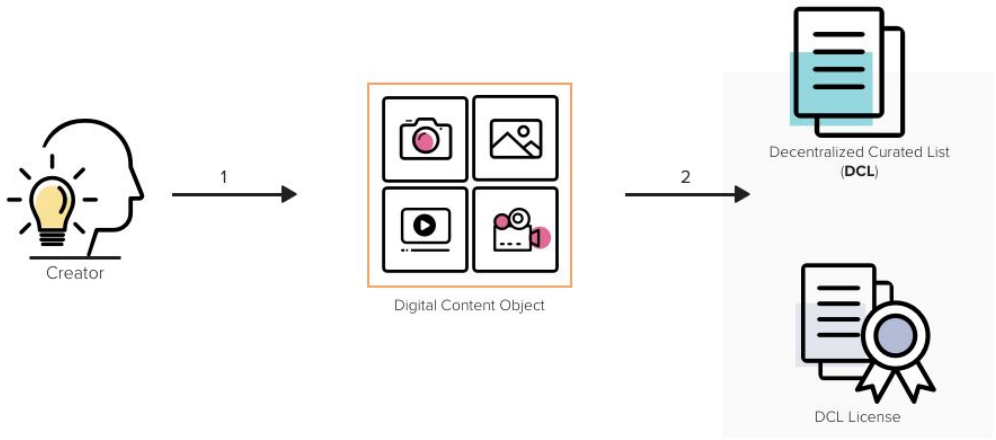

Figure 4.21: DCL License in relation to the Creator, Digital Content Object, and the DCL it is a part of

1. The Creator will call the Digital Content Object smart contract to create a DCL License. **See Sections 4.32 and 4.33**.
2. The Digital Content Object smart contract creates the DCL License that associates itself with the DCL.

4.3 Decentralized Curated Lists

4.31 Creation

Curators use the PRM protocol's main smart contract to create a new DCL. New DCLs that are created are themselves smart contracts. Once the DCL smart contract is created, the initial Curator can invite other Curators to join the list. All Curators joining must contribute a membership fee that is used directly to stake in existing and future objects listed in the DCL. The initial membership fee incentivizes active membership, staking, and deters stagnant or abandoned DCLs.

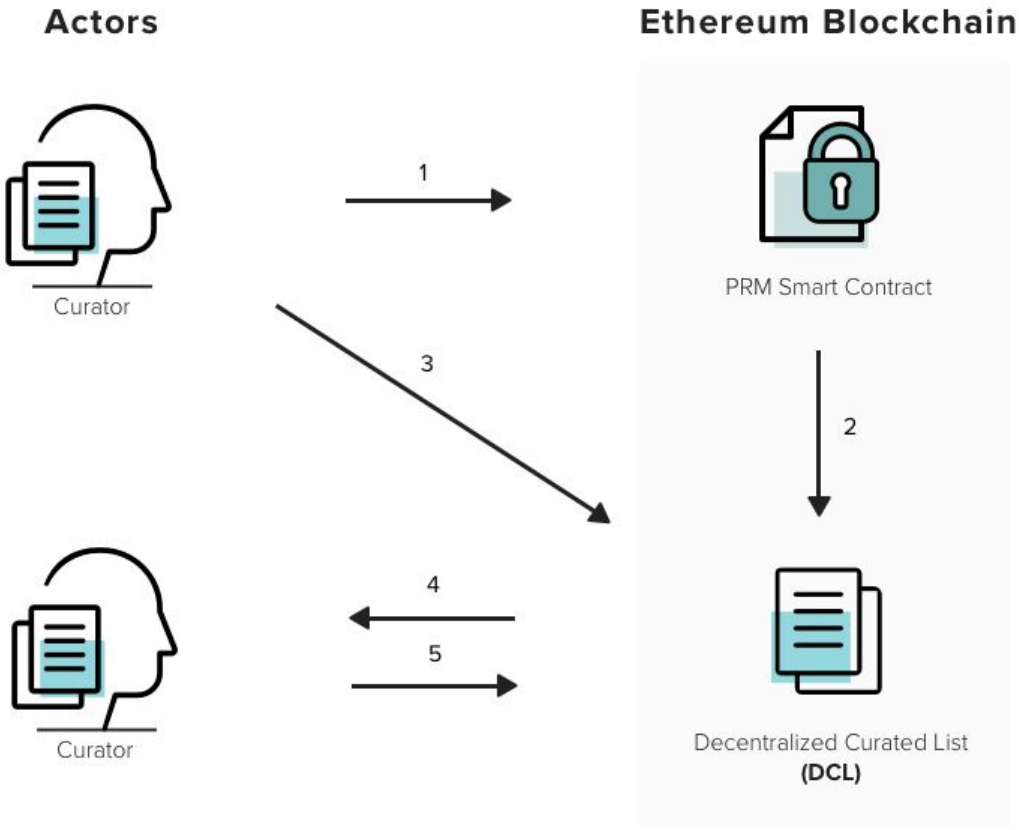

Figure 4.31: DCL creation and Curator invitations

1. Curator requests a new DCL smart contract to be created through the PRM smart contract. Included in the request is the computational and protocol fees, as well as the initial DCL Curator membership fee.
2. The DCL is created as a smart contract.
3. The Curator can now invite others to join the DCL as additional Curators by sending the invite request through the new DCL smart contract.
4. Other Curators receive the invite from the DCL smart contract through a call to their own Curator Identity smart contract.
5. Curators accept the invite and also approve of the transfer of the membership fee.

Table 4.31a: DCL Creation Request Format

Name	Data Type	Description
title	string	A human readable name for the DCL.

objectVersion	address	Address of the Digital Content Object type smart contract that defines the specific function extensions for the object type (e.g. Priime's photo extension).
curatorFee	uint256	Total units of PRM required to join the DCL as a Curator.
curatorAddress	address	Address for Curator's Identity smart contract, used to transfer the curatorFee amount of PRM (uses ERC20's approve( ) functionality).
submissionFee	uint256	Total units of PRM required to submit a Digital Content Object for consideration to be added to the DCL.

Table 4.31b: DCL Invite Request Format

Name	Data Type	Description
dcl	address	Address of the DCL smart contract being invited to.
invitee	address	Address of the invitee Curator's Identity smart contract.
inviter	address	Address of the inviter Curator's Identity smart contract.
curatorFee	uint256	Total unites of PRM required to join the DCL.
expiration	uint256	Time at which the request expires (seconds since unix epoch).

4.32 Submissions

Creators can submit their work to be considered to the DCL. Each submission includes a fee in PRM to apply for the DCL. Curators can accept or decline the submissions. If a Curator does not take any action, the submission expires, is declined automatically, and the PRM fee is refunded. Accepting or declining any submissions adds the PRM fee to the DCL's Staking Pool.

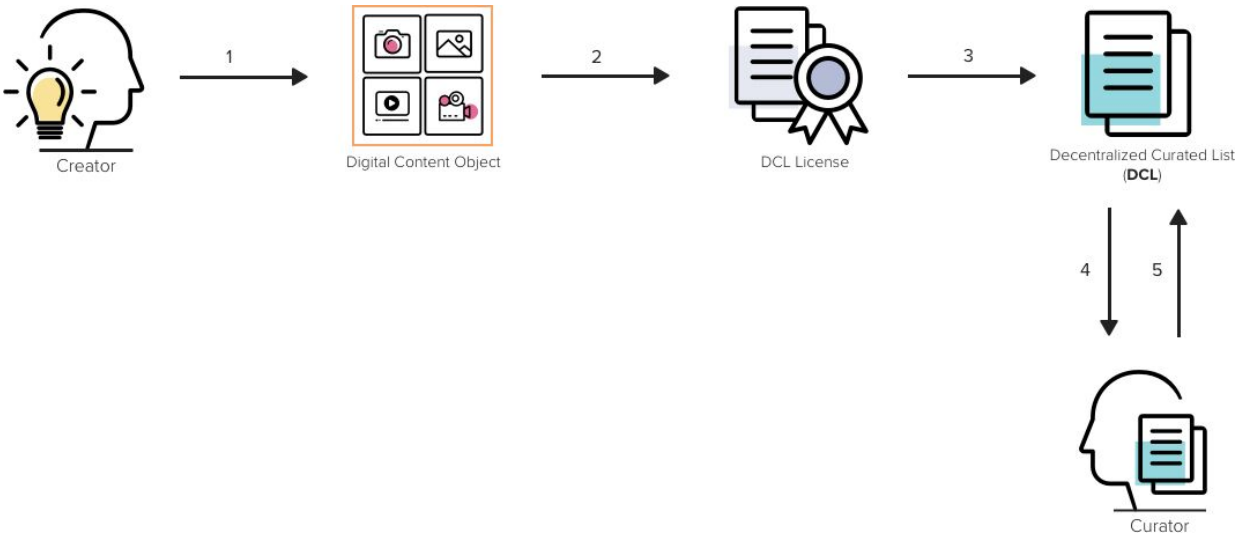

Figure 4.32: The flow for submitting a Digital Content Object into a DCL

1. Creator requests a DCL License through the Digital Content Object smart contract.
2. The DCL License is created as a submission and holds the submission PRM fee.
3. The DCL License enters the DCL's pending submissions pool.
4. Curator views all pending DCL Licenses.
5. Curator accepts the DCL License and it becomes active.

Table 4.32: Submission Request Format

Name	Data Type	Description
dcl	address	Address of the desired DCL smart contract.
object	address	Address of the Digital Content Object's smart contract.
objectVersion	address	Address of the Digital Content Object type smart contract that defines the specific function extensions for the object type (e.g. Priime's photo extension).
creator	address	Address of the Creator's Identity smart contract.
inviter	address	Address of the Curator's Identity who sent an invite. This is only used in the invite flow mentioned in **Section 4.33.**
terms	bytes32	The terms of the DCL License. This can be any structure defined by the Digital Content Object type smart contract.

stakingCap	uint256	The total amount of PRM allowed to be staked for the DCL License.
desiredMultiplier	uint256	The desired multiplier used to calculate purchase price, which is (total staked PRM) * (multiplier). The multiplier is set by checking Creator's Margin Power. **See Section 4.53.**

4.33 Invites

Curators can directly invite specific Digital Content Objects to be submitted to the DCL. If the Creator accepts, it is automatically added to the DCL and the PRM fee is staked into the content. For Creators, the PRM submission fee is resolved with the invite from a Curator, because the invite includes the fee. If the invite is not accepted in the period in which the invite is active, the invite PRM is refunded to the Curator. If the invite is declined, the PRM is refunded to the Curator.

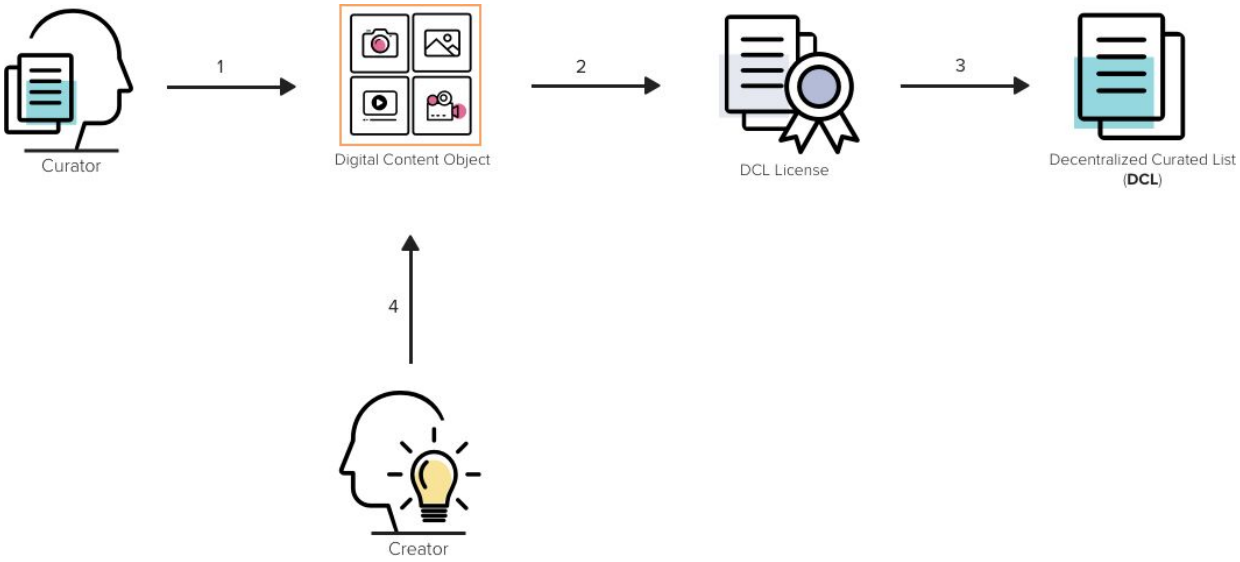

Figure 4.33: Flow for Curators inviting Creator's to submit their digital content to a DCL

1. Curator discovers the Digital Content Object and sends an invite through the Digital Content Object's smart contract. The invite process also has the Curator pre-approve the transfer of PRM required for the submission fee. Invitations cover the submission fee.
2. Creator accepts by requesting a DCL License through the Digital Content Object smart contract.
3. A DCL License is created.

4. Because it was an invite, Digital Content Object is accepted immediately and the submission fee will be automatically transferred from the inviting Curator and staked into the DCL License.

Table 4.33: Curator Invite Request Format

Name	Data Type	Description
dcl	address	Address of the desired DCL smart contract.
object	address	Address of the Digital Content Object's smart contract.
objectVersion	address	Address of the Digital Content Object type smart contract that defines the specific function extensions for the object type (e.g. Priime's photo extension).
curator	address	Address of the Curator's Identity smart contract. This is used for pre-approved PRM transfer from the Curator that covers the submission fee.
expiration	uint256	Time at which the request expires (seconds since unix epoch).

4.34 PRM Stake

Once accepted to a DCL, a Creator can invest Token as a stake into their content. Curators of the DCL can also invest their stake. The final price for the DCL License is a multiple of the PRM stake and the multiplier, which is defined by Margin Power. The Creator or Curator who staked the PRM is associated with their own staked amount. PRM stake can also be forfeited and awarded to Challengers if validation fails. The PRM stake is both used to set the DCL License purchase price, as well as signaling to the Buyers the confidence in copyright validity and overall value from Margin Power.

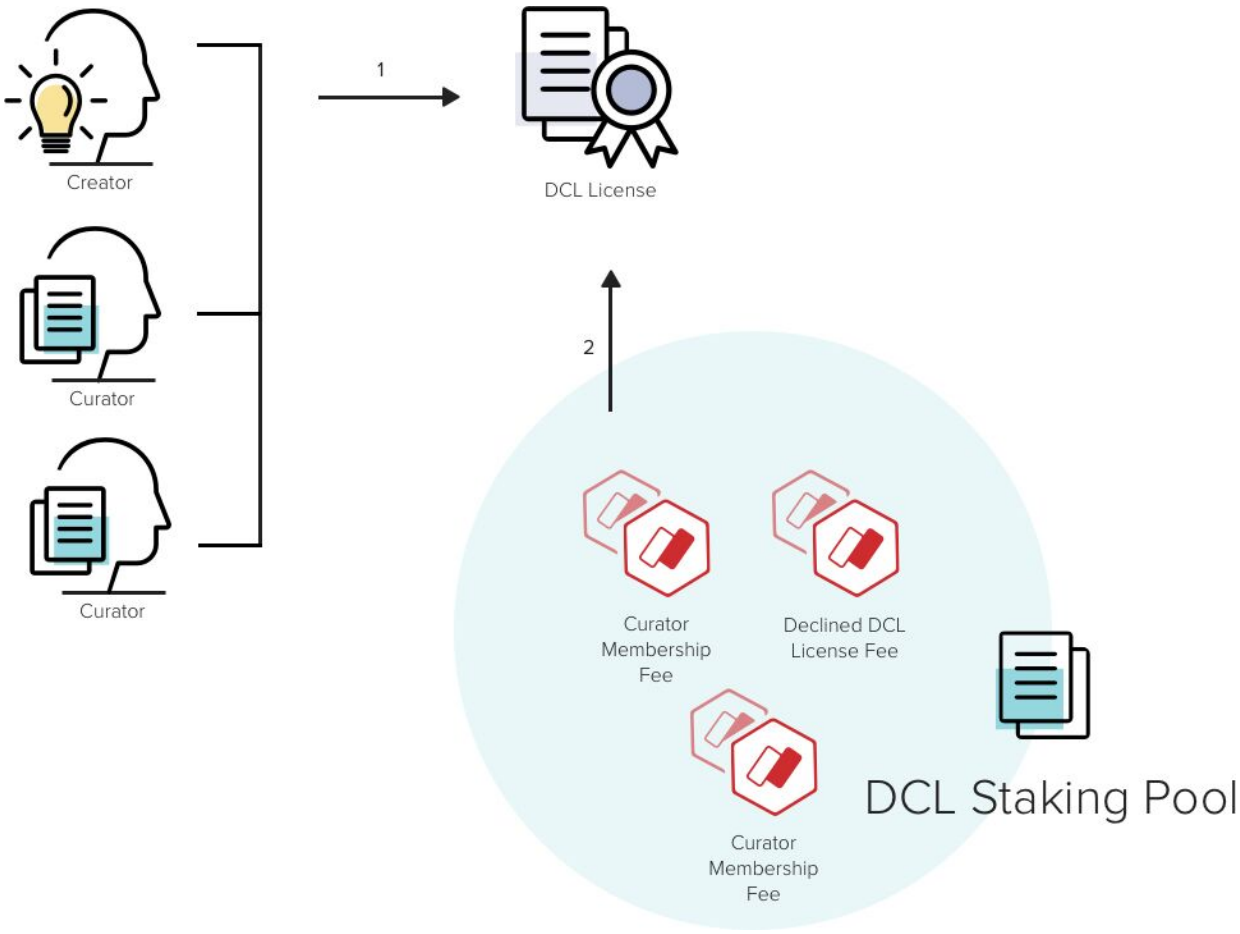

Figure 4.34a: Sources of PRM stake in a DCL License

1. The Creator and the DCL Curators can stake PRM into a DCL License to affect the purchase price.
2. Curators can also use any Staking Pool funds to stake in any DCL License

Table 4.34a: Staking Request Format

Name	Data Type	Description
dcl	address	Address of the desired DCL smart contract.
dclLicense	address	Address of the DCL License smart contract.
investor	address	Address of individual (Creator or Curator) that will be staking.

stakingPool	bool	Boolean specifying if the PRM will be drawn from the Staking Pool. **See Section 4.35.** This is ignored for Creators, as they are always staking from their own Identity smart contract. If set to true for Curators, this will fail if there are not enough funds in the Staking Pool.
value	uint256	The total amount to be staked.
expiration	uint256	Time at which the request expires (seconds since unix epoch).

The request will fail if any of the below are true:

1. Staking Pool does not have enough PRM for the requested value.
2. If the PRM staking cap has been reached, as defined in the DCL License by the Creator.

4.35 The Staking Pool

The Staking Pool is an accumulation of PRM Token that has been staked into the Digital Content Objects within a DCL. The Staking Pool is funded by Curators when first joining the DCL, as well as through DCL submission fees. The Staking Pool:

- Incentivizes active DCLs with proactive Curators
- Adds value by being only used for staking
- Acts as a signal for a desirable and valuable list
- Keeps Curators from using submissions as the form of revenue, rather than the licensing transactions. Staking Pool funds cannot be withdrawn for any use other than staking in a DCL License

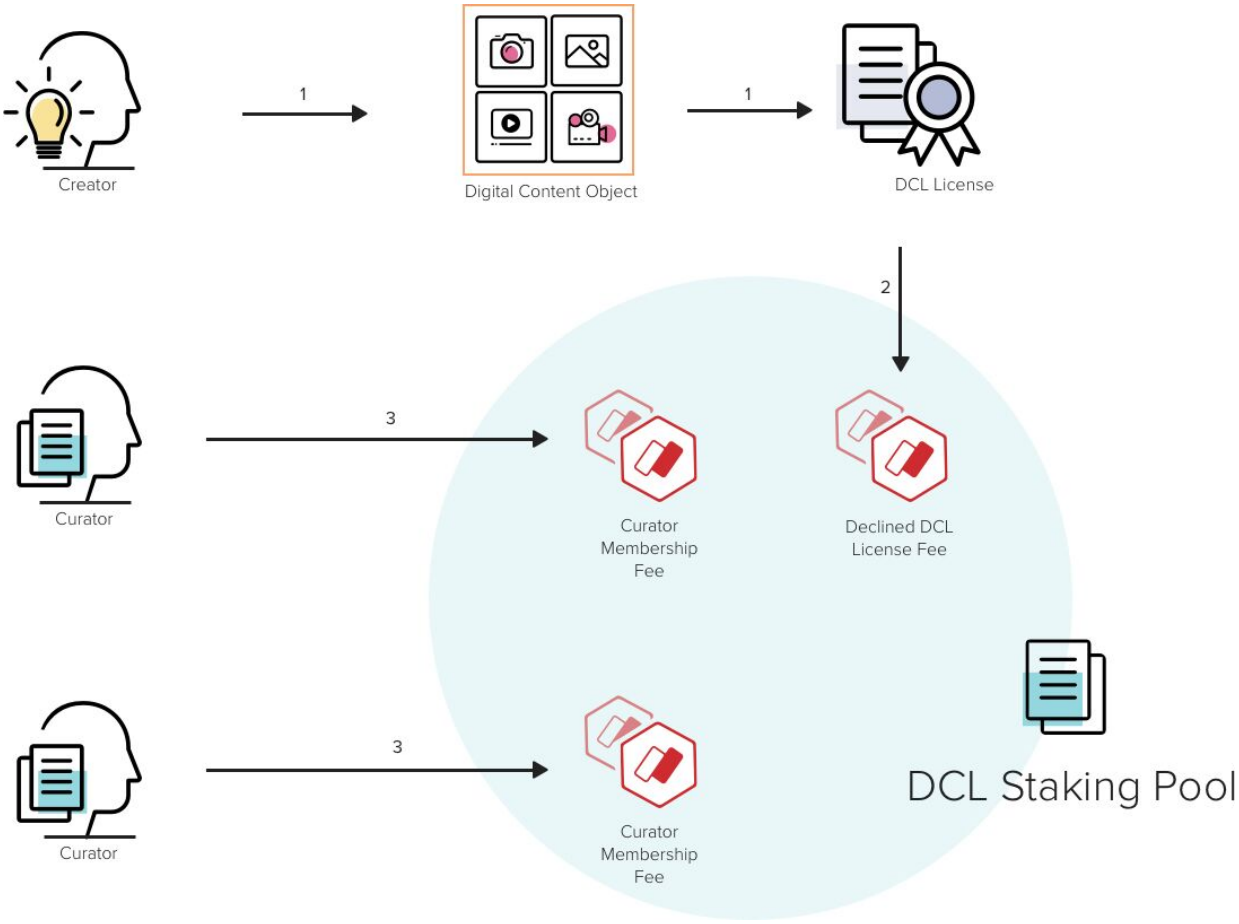

Figure 4.34b: Staking Pool sources

1. When a DCL License is created, the Creator sends the submission fee with the DCL License submission.
2. If a DCL License submission is declined, the application fee goes into the Staking Pool and can be used by Curators to stake in other DCL Licenses in the DCL.
3. When Curators join the DCL, they pay a fee that enters the Staking Pool.

When a DCL is destroyed, Curator's membership fees that are still remaining in the Staking Pool and not staked in a Digital Content Object are refunded to the Curator. PRM remaining in the Staking Pool from submission fees are awarded to the nodes that did the work of destroying the list. Staked PRM in Digital Content Objects is rewarded to the Creators.

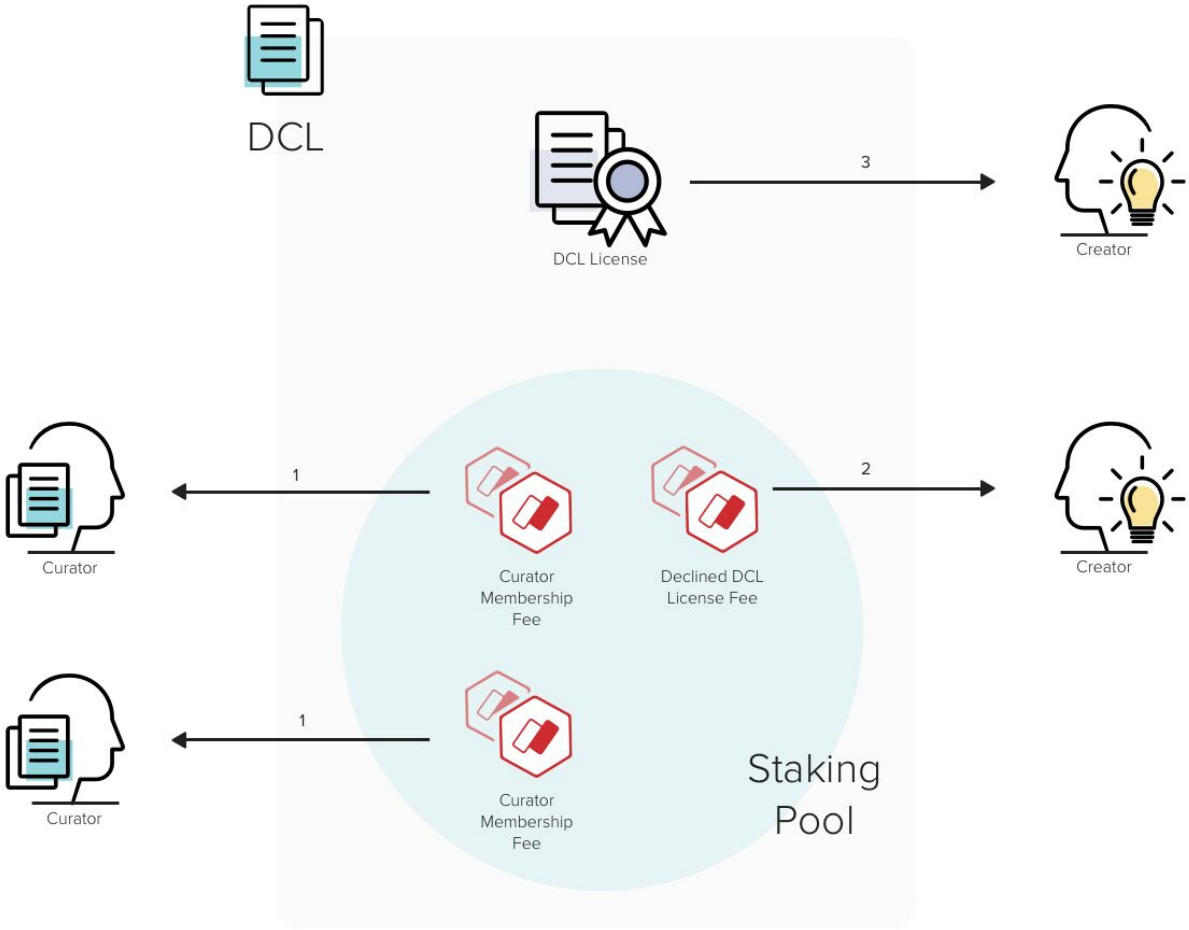

Figure 4.34c: PRM distribution on DCL destruction event

1. Un-staked PRM still in the Staking Pool at the time of destruction is refunded to Curators.
2. Un-staked PRM still in the Staking Pool at the time of destruction is refunded to Creators who had their submissions declined.
3. All PRM staked in DCL Licenses at the destruction time will be rewarded to the Creator who owns the DCL License.

The Staking Pool PRM is used to maintain the quality and quantity of DCLs created. Because it has a cost, DCLs must be created with intention to maintain, keep active, and earn revenue. It will deter DCLs that are created without any deliberation or planning. It will also deter creating DCLs with the intent to only make money on submission fees, unlike a Token Curated Registry model.

4.36 Revenue

When a Buyer purchases a Digital Content Object through a DCL License, the Creator and the Curator will split revenue based on their PRM stake upon completion of a transaction.

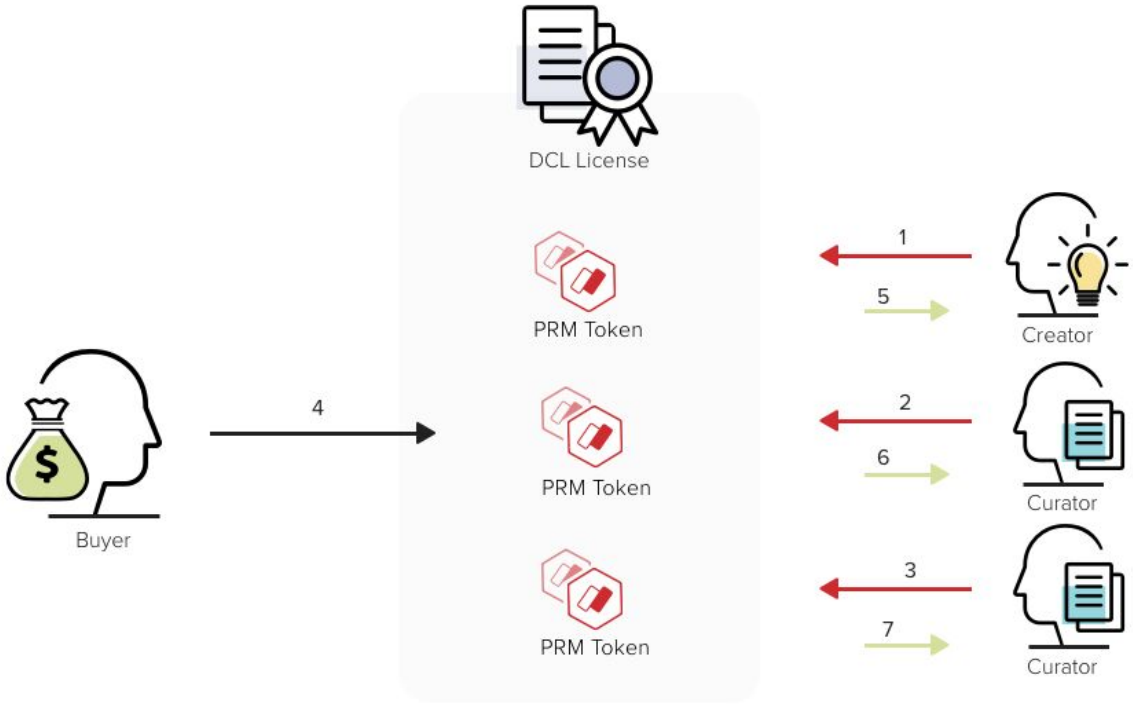

Figure 4.36: This is an example of a DCL License, with the Creator and Curators investing by staking their own PRM. The final purchase price is the total PRM staked multiplied by the multiplier, which was defined by the Creator when creating the DCL License. The multiplier in this example is two.

1. The Creator of the DCL License stakes his PRM, for this example he stakes 10 PRM.
2. First Curator of the DCL stakes 40 PRM.
3. Second Curator stakes 50 PRM.
4. The Buyer pays the purchase price of 200 PRM.
5. The DCL License distributes the earnings portion of 10% to the Creator: 20 PRM.
6. First Curator gets his 40%: 80 PRM.
7. Second Curator gets his 50%: 100 PRM.

The individual earning is calculated as below:

$$\text{Individual Earning} = \underbrace{\frac{\text{Individual Stake}}{\text{Total Staked}}}_{\text{Percentage}} \times \underbrace{\text{Total Staked} \times \text{Multiplier}}_{\text{Purchase Price}}$$

4.4 Identity

A PRM Identity is a smart contract that contains all the information and functions needed for all types of PRM holders. Types include Creators, who can also be Curators, Buyers, Challengers, or Validators. No role is mutually exclusive.

4.41 Universal Identity Features

Regardless of role, the Identity will have some universal features for all types of PRM holders.

Name	Data Type	Description
version	address	Address of the PRM smart contract.
prm	uint256	Un-staked PRM.
prmStaked	uint256	Staked PRM in all DCL Licenses.
creationDate	uint256	Time the Identity was created (seconds since unix epoch).

4.42 Creator Identity Features

In addition to the universal Identity features, Creators will have all the features required to protect their Digital Content Objects, participate in earning Margin Power, access and management of their digital content in DCLs, and send/receive ability for their PRM outside of DCLs.

Name	Data Type	Description
ownershipData	(string => bytes32)	A mapping of data used to prove ownership in the Validation Network. The data is in JSON format. For example, photographers will have unpublished camera serial numbers stored after being hashed into a public key.
marginPower	uint256	The core of all evidence-based value calculations. This value is recalculated when PRM, staked PRM, previous transactions, and copyright validations are updated. When Margin Power decreases, any multipliers on digital content that exceed current Margin Power levels will be adjusted.

digitalContentObjects	address[]	Array of addresses to the Digital Content Object smart contracts that contain the data for all owned work protected by PRM.
invites	address[]	Array of addresses for any DCL invites sent by a Curator. The invites will have references to the Digital Content Object that it is inviting.
transactions	address[]	Array of addresses to all purchase transactions made on any owned DCL License.
validations	address[]	Array of addresses of all the validation transactions that occurred for owned Digital Content Objects. **See Section 4.6.**

4.43 Curator Identity Features

The Identity for a Curator will include all the data required to maintain DCLs and join other DCLs with invites.

Name	Data Type	Description
dcls	address[]	Array of all DCLs the Curator is a member of.
invites	address[]	Array of invites to join a DCL. Each invite includes the Curator fee required, the inviter, invite expiration, and the DCL address. **See Table 4.31b.**
transactions	address[]	Array of addresses to all purchase transactions made on any DCL License that the Curator had a stake in.
prmStaked	uint256	Total amount of PRM staked in all DCL Licenses.

4.44 Buyer Identity Features

Buyers have a simple addition to the universal Identity that will give them access to all their licenses in order to manage their fulfilled transactions. For example, they will be able to access the licenses which can then point to the asset download locations.

Name	Data Type	Description
transactions	address[]	Array of addresses to all purchase transactions made.

licenses	address[]	Array of addresses to all licenses purchased and owned.

4.45 Challenger Identity Features

Challengers will have access to see their history of challenges made on the Validation Network.

Name	Data Type	Description
validations	address[]	References to all validation challenges, pending and complete.
passedValidations	uint256	Count of validations that passed.
failedValidations	uint256	Count of validations that failed.

4.46 Validator Identity Features

The Validators that run nodes for the Validation Network can see a history of their validations performed. This information can also be used by other nodes in the Validation Network to determine if a node is running rogue with a lot of false negatives. False negatives occur when the node is the minority of all validations in their results. This will only happen if a node is not running the required extension for the Digital Content Object that is being validated.

Name	Data Type	Description
validations	address[]	References to all validation transactions performed.
falseNegatives	address[]	References to any validations that were not confirmed by other nodes in the network. This can happen if the Validator runs nodes that are not in compliance to the agreed on validation processes.

4.5 Margin Power

Margin Power is used as the multiplier when setting purchases prices in a DCL License, and is designed to accurately reflect the natural progression of value by taking in all relevant evidence as inputs into the final calculation.

As a Creator, earning Margin Power takes time (experience), positive transactions (credibility), proving confidence in copyright ownership (PRM stake and successful validations), intent to continue with their work and selling through the network (PRM holdings), and recommendations

by other well regarded individuals (DCL Licenses and Curators). To calculate the Margin Power, the following table gives a summary of the inputs used.

Table 4.5: Inputs That Contribute Towards the Value of Margin Power

Name	Contribution	Description
Creation Date	Experience	The date that the Creator created their Identity smart contract contributes to the signal of experience through time.
Creator's PRM Holdings	Intent to continue	The total amount of PRM the Creator has to their name, including unused PRM held in their PRM Identity smart contract and PRM they have staked into their DCL Licenses.
Creator's PRM Staked	Price and copyright confidence	The total amount of PRM staked by the Creator into DCL Licenses. This is a subset of the PRM Holdings.
Curator's PRM Staked	Recommendations	This is the total amount of PRM staked by Curators of DCLs. This indicates others recommending and investing in the Creator's work as a signal of value.
Transaction count	Experience	The total amount of DCL License purchases by Buyers for work of the Creator.
Transaction price average	Quality of Experience	The average purchase price of all DCL License purchases.
Validation successes and attempts	Legitimacy and activeness in the network	Validations involve Creators providing data for the validation. Attempts are overall number of challenges to the validation, and successes are when the validation is completed. If the Creator does not provide the data such that the validations are left incomplete, or they are failures, this will affect their Margin Power.

These inputs are used in conjunction to different weights in the final Margin Power calculation. The weighting of each input is set when extending the Digital Content Object, and is specific to

that type of object. These inputs and their weights are calculated together in Priime's Margin Power Function, summarized below.

4.51 Margin Power Function

$$MP(\bar{x}) = \ln\left(\|\bar{x}\|_p\right)$$

Where $\|\cdot\|_p$ is a weighted ℓ_p norm so that if $\bar{x}$ is a vector of numerical inputs, we have

$$\|\bar{x}\|_p = \left(\sum_{k=1}^{N} a_i x_i\right)^{\frac{1}{p}}$$

Such that $\sum a_i = 1$ corresponds to the weights of importance to each of the inputs contribution to MP. Here N is the number of inputs we want to consider, and each x_i is a score standardized per each of its inputs. Further, we note that $p = 2$ simply just gives us the weighted Euclidean norm, however other values might be useful in testing what is appropriate to implement.

Table 4.51: We Consider the Following Standardized Metrics for the Above, Contributing to the Calculation

Standardized Metric	Description
Creation period (in years)	Time is standardized in a total amount of years since creation.
$\frac{\text{Creator's PRM Holdings}}{\text{Creator's PRM Staked}}$	This ratio is used to standardize the Creator's total PRM holdings vs. staked.
$\frac{\text{Successful Validations}}{\text{Validation Attempts}}$	This ratio is used for adding more to Margin Power depending on the successes of validations to attempts. The more successes per attempt, the better the Margin Power.

The weighting of each of these standardized metrics and inputs will indicate the influence of each, and can be understood in the following example.

4.52 Margin Power Calculation Example

A photographer selling her work can be used as an example. She holds 1,000 PRM and has staked 700 into DCL Licenses for her photography work. She has an average transaction price

of 50 PRM in over 1,000 transactions, and has been active for 2.18 years on the platform, gaining 30 successful validations out of 40 total validations along the way.

Let's assume further that this photography Digital Content Object extension weighs the ratio of transactions lightly (0.005 weighted), while validations are very important ($50{,}000$ weighted). All the weights for this example are listed in the table below.

Table 4.52: Input Summary

Input	Calculation	Value	Weight
Creation period (in years)	2.18	2.18	5
PRM Holdings	1,000	1,000	0.005
$\frac{\text{Creator's PRM Staked}}{\text{Creator's PRM Holdings}}$	$\frac{700}{1{,}000}$	0.7	1000
Curator's PRM Staked	4,000	4,000	0.008
Transactions count	1,000	1,000	0.005
Transaction price average	50	50	0.001
$\frac{\text{Successful Validations}}{\text{Validation Attempts}}$	$\frac{30}{40}$	0.75	50000

In this example, the photographer's Margin Power would be:

$$MP = \ln\left(\sqrt{5(2.18)^2 + 0.005(10000)^2 + 1000(0.7)^2 + 0.008(4000)^2 + 0.005(1000)^2 + 0.001(50)^2 + 50000(0.75)^2}\right)$$
$$= 5.372$$

4.53 Multiplier

Margin Power is the upper limit of a multiplier that the Creator sets on the purchase price of their DCL License. The multiplier is used to increase the purchase price of the license from the total amount of PRM staked in the photo. The multiplier can be set from zero to the maximum value of Margin Power. Zero would make the license free. If Margin Power decreases while the license is still available, the multiplier will also decrease automatically. This incentivizes Creators to keep the inputs of their Margin Power up at all times, such as holding PRM rather than exchanging it out.

4.53 Margin Power Extensibility

The Protocol for Margin Power allows for extensibility to specific types of digital content. Different weights on the various pieces of the calculation — PRM holdings, transactions, average transaction values, validations — all affect the total Margin Power. The extensibility is vital to a

diverse amount of digital content. For example, digital photography is priced differently than virtual reality model objects by a large margin.

4.54 Extension Crossover Avoidance
Because of the unpredictability of the types of Digital Content Objects and the nature of each type, inputs of Margin Power are sometimes specific to the type of Digital Content Object.

Table 4.54: Inputs that do not crossover to other Digital Content Object Types

Input	Description
Creator’s PRM Staked	The PRM Staked for a curator is only counted in the Margin Power for PRM Staked in the Digital Content Object Type.
Curator's PRM Staked	Like the Creator's PRM Staked, the same goes for Curator’s PRM Staked being counted only for the specific Digital Content Object Type.
Transactions count	Margin Power will only take into account transaction counts for transactions in the same Digital Content Object Type
Transaction price average	Margin Power will only take into account transaction price averages for transactions in the same Digital Content Object Type
Validation Attempts	Attempted validations will be specific to the Digital Content Object Type
Validation Successes	Validation successes will be specific to the Digital Content Object Type

4.6 Validation Network

The Validation Network are nodes on the Ethereum network that run the validation processes which are requested through the PRM Protocol’s smart contract.

4.61 Challenge to Validation
Challengers can request a validation to occur, using a challenge request. The goal of the challenge is to use Proof-of-Ownership to determine if the Digital Content Object is owned by the Creator and thus legal to be licensed by the Creator.

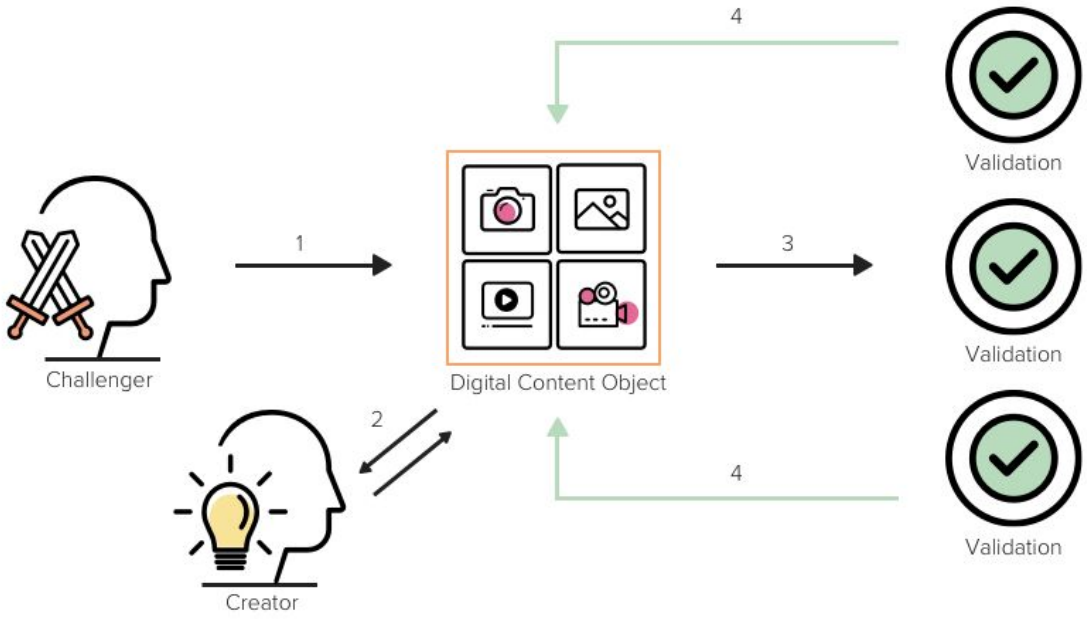

Figure 4.61: Typical challenge and validation flow for the Digital Content Object

1. The Challenger, who can be anyone (Curator, Creator, Buyer, or a very keen viewer), will request a challenge through the Digital Content Object's smart contract.
2. The Digital Content Object's smart contract will allow the Creator to supply the required data for a Proof-of-Ownership validation, and the Creator can provide that data within the challenge request period.
3. The challenge will be sent out to three-to-six Validators, each will run the PRM smart contract function that executes the Proof-of-Ownership processes.
4. When the validations are complete, the processes will report the result to the Digital Content Object. If they are all in consensus, the final result will be saved in the Digital Content Object. If the result is a failure of ownership, all PRM staked in any associated DCL License will be transferred to the challenger as a bounty reward, and an update to the Creator's Margin Power will be made to reflect the failed validation.

Table 4.61a: The Challenge Request Format Is Sent to the Digital Content Object Smart Contract

The challenge will also require the computational fee, which will be made by the Challenger. Once the request is made and fee is made available, the Digital Content Object will notify the PRM smart contract to broadcast the validation request to Validators.

Name	Data Type	Description
challenger	address	The Challenger's Identitty address.
object	address	Address of the Digital Content Object's smart contract.

objectVersion	address	Address of the Digital Content Object type smart contract that defines the specific function extensions for the object type (e.g. Priime's photo extension).

Table 4.61b: The Validation Broadcast Format

The broadcast is performed by the PRM smart contract, which will choose three-to-six Validators to run the validation processes. All PRM Validator addresses are stored in the PRM smart contract, and are picked at random and assigned a Validator identifier.

Name	Data Type	Description
challenger	address	The Challenger's Identity address.
object	address	Address of the Digital Content Object's smart contract.
objectVersion	address	Address of the Digital Content Object type smart contract that defines the specific function extensions for the object type (e.g. Priime's photo extension).
validatorNumber	uint256	Each Validator will get their own identifying number.

4.62 Creator Data

The Digital Content Object extension smart contracts specify the type of data that the Creator needs to supply. As part of the protocol, Creators will store this data privately until a challenge is requested. Applications that implement the Digital Content Object type specification, can securely store, notify Creators, and handle the transfer of the required data. The details of the data being sent is the responsibility of the Digital Content Object extension. **See Table 4.2b.**

4.63 Validation States

PRM Protocol specifies five validation states: unchallenged, data-requested, in-process, incomplete, and confirmed. These states are found within the Digital Content Object's smart contract. Each state affects the Creator's Margin Power.

Table 4.63: Descriptions and Margin Power Affects for Each Validation State

State	Description	Margin Power
Unchallenged	The object has never been challenged	No affect.
Data-requested	The object was challenged, and is awaiting data from the Creator	No affect.

In-process	The object was challenged, and validations are being processed	No affect.
Incomplete	The object was challenged, but the Creator failed to provide data in the challenge period	Creator's Margin Power is reduced.
Confirmed	The object completed a full validation and has received a final result.	Creator's Margin Power increases or decreases depending on whether the result was valid or invalid.

4.64 Validation Results

The validation results are stored in the Digital Content Object's smart contract. Once a validation is confirmed, it is protected within the smart contract and will never require another challenge. The outcome would essentially be the same.

The consensus of ownership will be made when all Validators report the same result. If the Validators do not, another random set will be chosen and the process will repeat until the results are the same. Inconsistent results will almost never happen, as the validations are absolute and will be running the same version of the Proof-of-Ownership processes. The consensus is only for the possibility of bad actors reporting false negatives.

The requirement for the PRM Validation process is that the results are absolute and cannot be refuted because it is backed by real Proof-of-Ownership.

4.65 Absolute validation

Absolute validation of ownership is a powerful tool in digital content licensing. Proving ownership of content with data and computations will deter copyright infringement, provide better Buyer confidence, and ensure overall fairness in the digital content licensing market. Users of any PRM Protocol extensions will need to be cautious of non-binary validations, since validations will take away PRM staked in the Digital Content Object if it fails. The absolute validation will ensure confidence in the signaling of value for Digital Content Objects listed in a DCL.

Concerning digital content, having absolute validation means:

- Preventing copyright infringement from occurring in the first place
- Saving time and money spent on registering with patent offices, such as the USPTO for work created in the U.S.
- Ensuring borderless protection
- Eliminating reliance on web crawlers to find copyright infringement

- Increasing Buyer confidence, as they have no risk of purchasing or using work that obtained unethically or illegally

Table 4.65: Example of Validations for the Digital Content Object Type of Photography

Name	Description
Camera Serial #	Cameras all have serial numbers and are used in the photography object type as a private key to generate a public hash key. This public key is then embedded into every photo's Digital Content Object smart contract as proof. When validation processes occur, it generates this public key with the serial number private key. The proof with the camera key is no longer needed once it is used in a validation, since every subsequent validation will have the same absolute result.
Digital Negative	The digital negative of a photograph can be a RAW file with data that is never published. It can also be the original .jpg that was saved by the camera when the photo was taken. As long as this "digital negative" is never published publicly, data from it can be used as a private / public key pair as Proof-of-Ownership. In the same way the camera data is used, the digital negative key will also be generated only if the private key exists. The private key won't ever be used again, since validation results are saved in the photo's smart contract forever.

4.66 Validation Research and Development

Digital Content Object types will have their own absolute validation processes. Priime, Inc., for example, is developing the first Proof-of-Ownership validation for digital photography. While the specifics of how validations can happen are not built into the PRM Protocol, it allows for future validation needs due to the flexibility of the data structures. Users of the Digital Content Object type specifications will have to understand and do their due diligence on the specifications for validations before entering into the smart contracts.

Section 5: The New PRM Economy

5.1 Incentives and Deterrents

The PRM Economy is a community-driven marketplace where all parties can participate in the formation of evidence-based value. Through a system of incentives and deterrents, the PRM Economy is more than just fairly priced — it is high-quality, selectively curated, and concise. At every touchpoint, Creators and Curators are encouraged to produce the work best possible. In turn, Buyers are continually presented with amazing content at price points they understand.

5.2 High-Quality DCLs

The creation of a DCL requires fees for computational power, Protocol use, and a Curator membership fee of PRM that is used as a stake in Digital Content Objects. The membership fee is used from the staking pool with the intent of the Curator putting a stake in at least one curated Digital Content Object. As long as the DCL exists, the membership fee of PRM cannot be withdrawn. This enforces only high-quality lists that are not stagnant. Numerous, useless, and stagnant lists will not be created because of the downside of locking up PRM in a DCL.

5.3 High-Quality Submissions

For a Creator's digital content to be accepted to a list, they must submit a DCL License along with PRM Token as a fee. The fee will only be returned if the Curator has not made any actions on the DCL within the application period, which would be the case in an abandoned DCL. The Creator will not be penalized for trying to enter into a DCL that is abandoned, but Creators will also be incentivized to use great care in choosing DCLs to apply to, because if the Curators reject the application, the fee is not returned until the DCL is destroyed, if ever.

5.4 High-Quality Digital Content

The PRM Protocol isn't designed to back up and dump every photo taken. Each Digital Content Object, when protected with the PRM Protocol, requires both computational and Protocol fees. The landscape of digital content will be filtered out to be the Creator's best work worth showcasing in a DCL.

5.5 Concise DCLs

Curators are incentivized to keep their lists manageable. First, having too many Digital Content Objects is intimidating and difficult for a Buyer — the exact reason they left Getty in the first place. Unmanageable lists will ultimately reduce a Curator's revenue opportunities. Second, the process of rejecting submissions will move the submission application fee to the DCL's Staking Pool. There is a big incentive to increase overall staking power to earn more revenue per license purchase, as opposed to using personal PRM holdings. Rejected submissions funding more staking power is a clear signal of higher value, since it can mean the DCL is more desirable and also more selective.

Section 6: Priime

6.1 Priime, Inc.

Priime is the developer and maintainer of the PRM Token and Protocol. Priime is developing the first apps on PRM by extending the Protocol for protecting, licensing, and selling photographs — a singular market that is estimated to be worth $4B alone. Priime's products on PRM will start with photography, but will expand as other types of assets are growing at a rapid pace.

Priime, Inc. was founded in 2014 with the mission of building the best tools and community in the world for photographers. The founders are a team of technical co-founders with a lifetime of

experience in engineering and design on end-to-end products, including a full suite of iOS and macOS photo editing applications, iOS and web photo publishing platforms, and more. The applications have over 5 million downloads, were featured by Apple as Editor's Choice, Best New App, and without any marketing spend has been on the top 10 paid apps in the U.S. App Store.

The team at Priime is no stranger to engineering elegant solutions to some of the most challenging technical and artistic problems. They have a long history of creating beautiful products their community, and they are proud to call users some of their best friends.

Priime has worked and created great relationships with creative agencies, stock photo/video agencies, journalists, and influential photographers — many in the top 100 in the world.

PRM and Priime products will continue the mission to create more tools for creatives in our ever-growing community.

6.2 Team

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Y Combinator (s10, w15), BS Comp Sci at UC Santa Barbara, Engineer of Secure Computing, Senior Engineer of Yardbarker, Developer and Co-Founder of Fanvibe, Lead Technical Architect of BeRecruited, Co-Founder and CEO of Priime

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6.3 Backing

6.31 PRM Advisors / Investors:

- Garry Tan
- Alexis Ohanian

6.32 Existing Priime Equity Investors:

- Ram Shriram
- Wei Guo
- Garry Tan
- Alexis Ohanian
- Waynn Lue
- Russell Cook
- Aaron Harris
- Krishna Bharat
- Initialized Capital
- Y Combinator
- Fusion Fund
- Amino Capital
- Sherpalo Ventures
- China Rock

You should not assume that any person, organization or entity identified as an existing investor of the company (publicly, privately or otherwise) is participating in, endorsing, promoting or affiliated in any way with this Token offering, or has vetted this Token offering. Each prospective purchaser of Tokens should make their decision to participate in this offering independent of any potential or actual involvement, in any form, by other investors.

Section 7: Research and Development Roadmap

2018

- PRM Token-Sale
- PRM Protocol Token released
- PRM Protocol v1.0 complete

2019

- Priime releases photography extension of the PRM Protocol as an open-source library
- Priime launches first photography suite of products built on the PRM Protocol using the new photography extension
- Partners launch DCLs and are featured on Priime's discovery pages

2020

- PRM Protocol v2.0 complete, allows all third-parties to begin development of their Digital Content Object extensions

Section 8: Additional Resources

Find all additional resources and recommended reading on the PRM website: https://priime.com/prm

Section 9: References, Acknowledgements, and Appendix

References

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- Jim Pickerell, photo industry analyst on licensing digital assets

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