Muzeum

A Blockchain-Based Open Protocol for Creative Industries

Version Beta 1.0.0

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August 2018

"He who receives an idea from me, receives instruction himself without lessening mine; as he who lights his taper at mine, receives light without darkening me."
- Thomas Jefferson, 1813

Background

On January 17, 2001, Professor Lawrence Lessig founded the Creative Commons, a true breakthrough that expanded the range of which creative works could be made available for others to share legally and build upon. Creative Commons licenses are based upon copyright but displaces individual negotiations for specific rights between a copyright holder and licensee with a "some rights reserved" policy employing standardized, front-loaded licenses for re-use cases where *no commercial compensation* is sought by the copyright owner. This reinvention of copyright management made the Creative Commons a light-overhead, low copyright management cost regime that benefits both copyright holders and licensees.

In 2017, inspired by Creative Commons's brilliant invention of generalizing re-use licensing cases into standardized licenses, we began to imagine if such practices could be extended further for copyright licenses use *with commercial compensation* while retaining the benefits of running a cost effective copyright management regime. In other words, if what Creative Commons does for copyright holders is facilitate "share legally + attribution", what we are attempting to accomplish and facilitate is "share legally + attribution + commercial compensation." We quickly realized that adding commercial compensation into the equation brings the entire copyright management scheme into a whole different level of complexity and suddenly, we had a new set of problems to solve. Among these problems, the most critical one was how to *record and track the change of copyright ownership* as it is the core of how commercial activities (for e.g., licensing and copyright transfer) and compensation (copyright royalty distribution) is carried out. We concluded that such a copyright ownership record and tracking framework should belong to a public domain database for the long-term benefit of the creative community. On top of such a public database, an open protocol should also be designed for its access and usage. As a result of the above, we propose *The Muzeum Protocol*.

Contents

Abstract

The Muzeum Protocol is a public-domain database and decentralized copyright tracking framework for creative industries. The goal is to facilitate the sharing of data and information (for e.g., history of contribution, copyright ownership, endorsement of work, etc.) of creators and content they produce, making peer-to-peer copyright licensing, transfer and royalty distribution much easier.

This white paper proposes an open protocol that integrates standardized linked-data, distributed file system, blockchain technology, smart contracts and digital property management to bridge all participants across creative industries for the joint creation of a new ecosystem friendly to accelerated cross-genre collaborations and emergence of new business models.

1. Obstacles Faced by the Creative Industries

With the rapid development of Internet technology, creative industries have undergone major changes in the past two decades. Although new digital distribution and media services have emerged during this period, the basic business infrastructure for content creators such as talent networking, copyright management, licensing procedures and copyright royalty distribution remain stagnant in terms of efficiency and transparency.

Difficulty in Connecting Creative Talents

Content is the foundation of creative industries and quality content comes from the collaboration of exceptional creative talents. Over the years, we have leveraged technology to develop new distribution, marketing, promotion and compensation models, but little has been done to aid developing, managing and connecting creative talents. With production and collaboration confined to word of mouth and existing partnerships, international collaborations remain scarce in a highly connected world. Muzuem hopes to correct and solve for the cost of these missed opportunities.

Lack of Standardization of Creators and Copyright Data

There has never been a decentralized yet universally agreeable depository of creator information, contribution history, and copyright ownership information at scale. However, with the advent of technology, there is a growing voice advocating this. Although large amounts of data are possessed by commercial platforms and organizations, they are neither comprehensive nor cohesive. Furthermore, there is no standardization of data, not to mention the competitive commercial and confidentiality issues that prohibit or conflict with the sharing of such data.

Inefficiencies in Processing Data

The lack of standardization and fragmentation of data sources create inefficiencies in data processing. Take music copyright for example, ownership information of songs are scattered among various music publishing companies and copyright organizations, usually in different data formats and varying degrees of completeness. Copyright data, hosted by different parties are asynchronous, causing essential information used in license clearance that should be publicly searchable (for e.g., songwriter names, copyright splits, licensing terms and conditions, etc.) to be done through labor-intensive manual fact checking, which results in discrepancy, duplication of effort and unnecessarily long delays. Also, as collaboration between multiple songwriters become the norm, songwriters need to go through multiple layers of "middleman" publishers, sub-publishers and collection societies. Songwriters are considered lucky to receive their royalties within six months of a release.

Difficulties in Innovation

The challenges listed above have hindered the emergence of new innovations and business models in the area of content and talent collaboration. The absence of a comprehensive infrastructure that facilitates efficiency, effectiveness, and precision in creative industries will not attract investment or growth in this sector. Further innovation is required to propel creative ecosystems further in the age of acceleration.

2. Muzeum's Mission

Allowing creative industries to foster innovation and the formation of new business models through the establishment of an open protocol and public database.

The Muzeum Protocol is proposed to solve the challenges stated in the previous section. Muzeum encompasses a public database and open protocol backed by blockchain and distributed technologies. We believe our efforts will lay the fundamental infrastructure for creative industries to foster an acceleration of collaboration and innovation.

A Public Database for Creative Talents and Contents

Muzeum leverages linked-data and distributed file system technologies to allow all industry participants to share a common database for the synchronized update of data ensuring consistency. The utilization of a distributed system means there will be no single centralized organization which controls the data, allowing records to be securely stored and more open. A public database of accumulated data and information lowers the barrier of entry held by incumbents, granting access to all and empowering innovations in new applications and business models.

An Open Platform for Collaboration, Copyright Licensing, and Transferring

Business transactions among the collaborating parties can be executed automatically in applications that utilize smart contracts on a blockchain. Therefore, the more participants in a blockchain, the more economical it will become for maintaining an industry-wide comprehensive platform. Creation and licensing of copyright can operate in a trust-free system which dramatically reduces cost of networking and verification. All participants in the creative industries can take advantage of this open platform and allow talent networking, collaboration, copyright licensing and royalty distribution to become more efficient that at present.

Under the premise of protecting trade secrets and personal privacy, openness for collaboration and transparency in copyrights are essential for creative industries to grow, which also complements the nature and characteristics of blockchain technology. The transaction records are retained in a distributed ledger for copyright holders to track content usage and royalty distribution.

Improved Copyright and Digital Assets Management

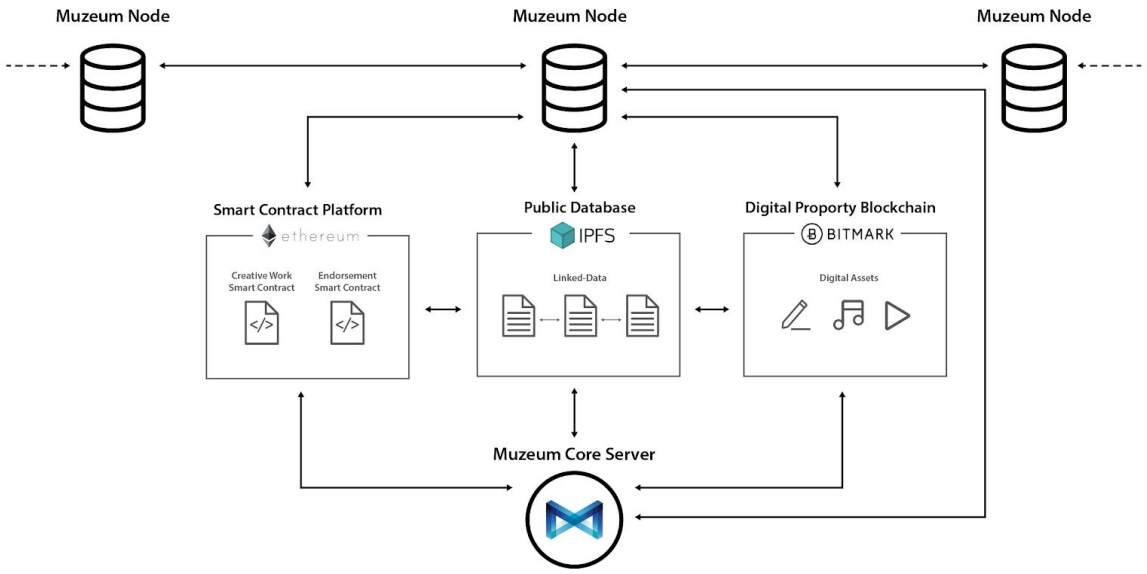
Blockchain technology uses permissionless systems with tamper-proof features which makes Muzeum ideal for proof of creation and ownership. Muzeum not only allows all licenses and uses to be easily traced, but also reinforces protection on copyright holders'

digital assets through property chains and encryption, encouraging creative industries to share digital assets while monitoring usage.

The Proliferation of New Applications and Businesses

Application services will be able to access data in the public domain under the Muzeum protocol, inviting all to utilize and contribute to the ecosystem. Most importantly, it renders innovation and new business models that were otherwise difficult to achieve possible. When creative talents, copyright ownership, licensing and transfer of content such as music, video, design, text, and photography are all available on an open platform, everyone is granted the opportunity to design and create new application services, accelerating value creation among creative industries.

3. Technical Architecture



(Figure) Muzeum Architecture

3.0 Architecture Overview

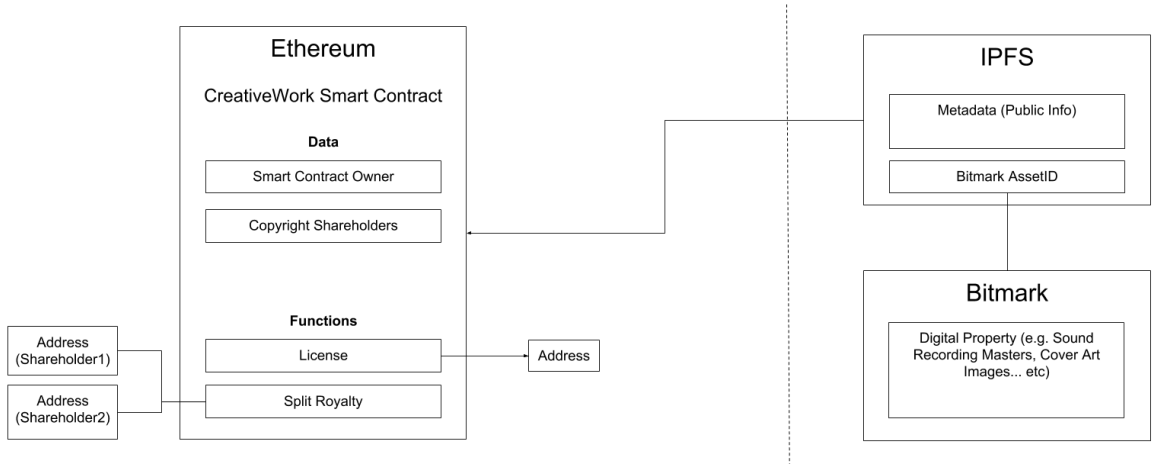
- Smart Contract Platform
    - Ethereum
- Digital Property Blockchain
    - Bitmark
- Public Database (Distributed File System and Linked-Data)
    - IPFS Interplanetary File System
    - LCC Framework
    - JSON-LD
    - Schema.org
    - Coala IP

3.1 Smart Contract Platform: Ethereum

CreativeWork Smart Contract

In The Muzeum Protocol, with the registration of each creation, a smart contract will be established. Which includes:

1. Information:
    a. Smart Contract Owner's Ethereum address
    b. Metadata IPFS address
    c. Copyright Shareholders' (Co-Creators) Ethereum address and royalty split (ownership) percentage
2. Function:
    a. License: Authorizes a licensing transaction.
    b. Royalty Split: This function will automatically perform royalty split when there is royalty transferred to this smart contract.



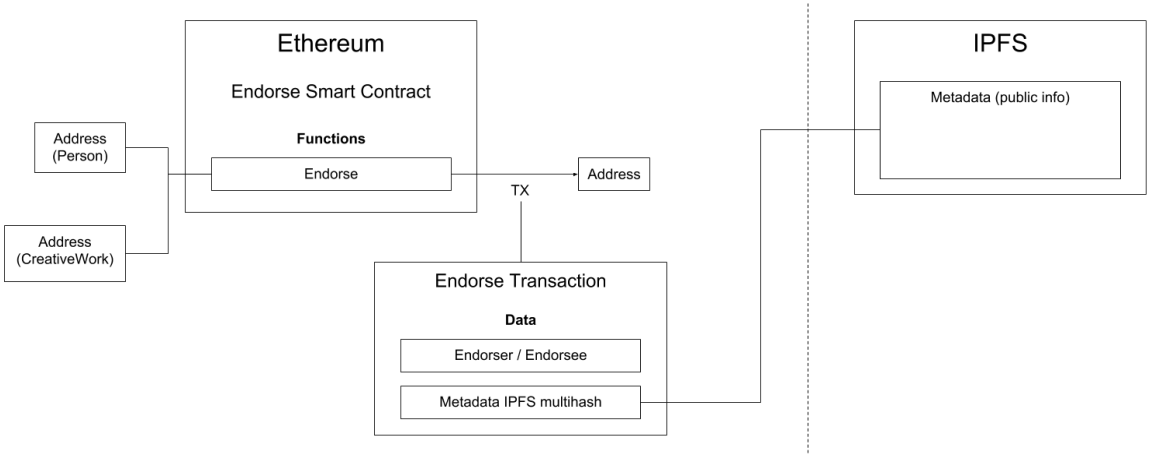
(Figure) CreativeWork Smart Contract Architecture

Copyright Share Token Smart Contract

Advanced applications include allowing groups of copyright shareholders to create Copyright Share Token Smart Contracts, an Ethereum ERC20 token contract with a variable which records the token distribution (Ethereum address and token amount). The CreativeWork Smart Contract's split_royalty() function can then split the received royalty based on the specified token distribution records. Copyright shareholders can also transfer the tokens as a proof of copyright transfer.

Endorsement Smart Contract

Each creator can utilize the Endorsement Smart Contract to endorse other creators, and an owner of the CreativeWork Smart Contract can also endorse contributors (for e.g., graphic designers, video producers, photographers, etc.) to his/her project. Educational institutions and certifying agencies can also utilize it to issue and document certifications. Endorsement information will be stored in IPFS as linked-data and its IPFS address will be recorded in Endorsement Transaction as an immutable record on the blockchain.



(Figure) Endorsement smart contract architecture

3.2 Digital Property Blockchain: Bitmark

Muzeum uses Bitmark blockchain to manage ownership and the encryption of files.

BITMARK

The Bitmark blockchain records ownership and transaction history of digital assets. Each digital asset has a unique fingerprint on the Bitmark blockchain, and each digital asset can be republished with multiple Bitmarks with each having a unique Bitmark ID. In the Muzeum Protocol, each creative work is treated as an asset and will be recorded on the Bitmark blockchain. Each time a license is issued, a new Bitmark will be issued, and the ownership of the Bitmark will be transferred to the authorized person. After receiving the Bitmark, the authorized person will have access to the asset file. (The transfer here represents the transfer of digital assets and has nothing to do with the transfer of copyright.)

3.3 IPFS Distributed File System and Linked-Data

Muzeum uses the Interplanetary File System (IPFS) as the protocol for a distributed file system. IPFS is an open protocol that allows files to be distributed and stored across all

nodes of the network, thus data will not be lost due to hosting server failures, providing a robust storage infrastructure. IPFS's openness is ideal as an open database in conjunction with blockchain-based applications.

Muzeum adopts part of the Coala IP protocol concept, using the Rights Reference Model (RRM) proposed by the Linked Content Coalition (LCC) and implements JSON-LD as well as the semantic definitions of schema.org for the purpose of establishing an open semantic network.

Use in Conjunction with the Blockchain

1. **Publishing IPFS Content to the IPNS Namespace**
   Muzeum publishes IPFS content to the IPNS namespace so metadata can be adjusted. The latest version of metadata on IPFS can be accessed with the same IPNS URL. This preserves flexibility for change of data while maintaining the requirements of data openness.

2. **CreativeWork Smart Contract**
   In The Muzeum Protocol, each creative work creates an Ethereum smart contract upon registration, which records the following:
   a. Smart contract owner's Ethereum address
   b. Copyright holders' Ethereum address and royalty split (ownership) percentage

   Only the smart contract owner can modify such information. This ensures the owner has control over data but also grants flexibility for changes in the future. The only constant that remains unchanged is the Ethereum smart contract address of the creative work itself.

3. **Recognition of the Creative Work Smart Contract licensing transaction record as the Rights Assignment**
   The Muzeum Protocol recognizes the licensing transaction record of the CreativeWork Smart Contract on the blockchain as proof of licensing between the parties, which is the RightsAssignment. This approach allows RightsAssignment to identify the copyright holder and the licensee based on the Ethereum addresses of both parties.

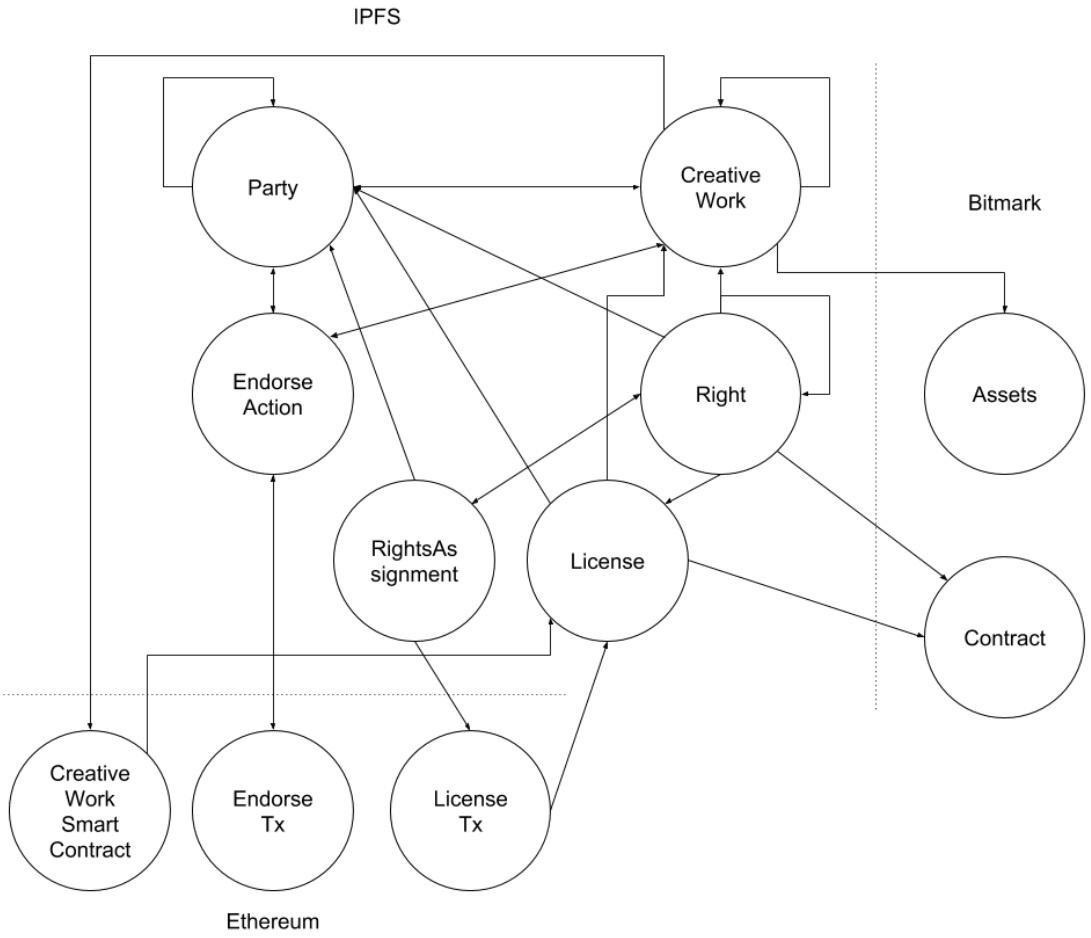
The Muzeum Linked-Data Model

Based on technology integrated into the Muzeum protocol. The following data needs to be added:

1. Ethereum address and transaction related information.
2. Bitmark account and assets related information.
3. IPNS URL as a link.
4. Talent collaboration and endorsement information.

Muzeum Entity and Semantic Reference Table

Muzeum Entity	LCC Entity	Schema	New Properties
Party	LCC Party	• schema.org/Organization • schema.org/Person	ethereumAddress bitmarkAccount
CreativeWork	LCC Creation	• schema.org/CreativeWork • schema.org/Article • schema.org/Blog • schema.org/Book • schema.org/Clip • schema.org/Dataset • schema.org/Game • schema.org/MediaObject • schema.org/Movie • schema.org/MusicAlbum • schema.org/MusicComposition • schema.org/MusicRecording • schema.org/Painting • schema.org/Photograph • schema.org/SoftwareApplication • schema.org/Thesis • schema.org/VisualArtwork	ethereumAddress fingerprints: [<bitmarkFingerprint>,]
Right	LCC Right LCC RightsAssignment	coalaip.schema/Right coalaip.schema/RightsAssignment	contract: <bitmarkID>
EndorseAction	N/A	schema.org/EndorseAction	



(Figure) Muzeum linked-data relationship

Muzeum Party Entity

Example: MusicGroup

Property	Expected Type	Description
Properties from MusicGroup		
album	MusicAlbum	A music album. Supersedes albums.
genre	Text or URL	Genre of the creative work, broadcast channel or group.
track	ItemList or MusicRecording	A music recording (track) - usually a single song. If an ItemList is given, the list should contain items of type MusicRecording. Supersedes tracks.
Properties from Organization		
award	Text	An award won by or for this item. Supersedes awards.
logo	ImageObject or URL	An associated logo.

member	Organization or Person	A member of an Organization or a ProgramMembership. Organizations can be members of organizations; ProgramMembership is typically for individuals. Supersedes members, musicGroupMember. Inverse property: memberOf.
memberOf	Organization or ProgramMembership	An Organization (or ProgramMembership) to which this Person or Organization belongs. Inverse property: member.
Properties from Thing		
alternateName	Text	An alias for the item.
description	Text	A description of the item.
identifier	PropertyValue or Text or URL	The identifier property represents any kind of identifier for any kind of Thing, such as ISBNs, GTIN codes, UUIDs, etc. Schema.org provides dedicated properties for representing many of these, either as textual strings or as URL (URI) links. See background notes for more details.
image	ImageObject or URL	An image of the item. This can be a URL or a fully described ImageObject.
name	Text	The name of the item.
sameAs	URL	URL of a reference Web page that unambiguously indicates the item's identity. E.g., the URL of the item's Wikipedia page, Wikidata entry, or official website.
url	URL	URL of the item.
Properties from Muzeum		
ethereumAddress	Text	An ethereum address of the person
bimarkAccount	Text	A Bitmark account of the person
endorsement	EndorseAction	An agent approves/certifies/likes/supports/sanction an object.

Reference: http://schema.org/MusicGroup

MusicGroup JSON-LD

```
{
	"@context": "http://schema.org",
	"@type": "MusicGroup",
	"@id": "<MusicGroup's did>",
	"name": "David Bowie",
	"album": [
		{
			"@type": "MusicAlbum",
			"@id": "<Album's did.>",
			"name": "Space Oddity",
			"url": "<IPNS URL of linked-data.>"
		}
	],
	"track": [
		{
			"@type": "MusicRecording",
			"@id": "<Track's did.>",
			"name": "Space Oddity",
```

```
                        "url": "<IPNS URL of linked-data.>"
                }
        ],
        "image": "<URL of music group's image>",
        "url": "http://www.davidbowie.com",
        "ethereumAddress": "<Ethereum address of the music group.>",
        "bitmarkAccount": "<Bitmark account of the music group.>"
}
```

Muzeum CreativeWork Entity

Example: MusicRecording

Property	Expected Type	Description
Properties from MusicRecording		
byArtist	MusicGroup	The artist that performed this album or recording.
duration	Duration	The duration of the item (movie, audio recording, event, etc.) in ISO 8601 date format.
inAlbum	MusicAlbum	The album to which this recording belongs.
inPlaylist	MusicPlaylist	The playlist to which this recording belongs.
isrcCode	Text	The International Standard Recording Code for the recording.
recordingOf	MusicComposition	The composition this track is a recording of. Inverse property: recordedAs.
Properties from CreativeWork		
audio	AudioObject	An embedded audio object.
author	Organization or Person	The author of this content or rating. Please note that author is special in that HTML 5 provides a special mechanism for indicating authorship via the rel tag. That is equivalent to this and may be used interchangeably.
contributor	Organization or Person	A secondary contributor to the CreativeWork or Event.
copyrightHolder	Organization or Person	The party holding the legal copyright to the CreativeWork.
publisher	Organization or Person	The publisher of the creative work.
thumbnailUrl	URL	A thumbnail image relevant to the Thing.
Properties from Thing		
description	Text	A description of the item.
identifier	PropertyValue or Text or URL	The identifier property represents any kind of identifier for any kind of Thing, such as ISBNs, GTIN codes, UUIDs, etc. Schema.org provides dedicated properties for representing many of these, either as textual strings or as URL (URI) links. See background notes for more details.
image	ImageObject or URL	An image of the item. This can be a URL or a fully described ImageObject.
name	Text	The name of the item.
url	URL	URL of the item.

Properties from Muzeum		
explicity	Boolean	Indicates whether this content is explicity.
ethereumAddress	Text	An ethereum address of the person
bimarkAssetID	Text	A Bitmark asset ID of the creative work.

Reference: http://schema.org/MusicRecording

MusicRecording JSON-LD

```
{
	"@context": "http://schema.org",
	"@type": "MusicRecording",
	"@id": "<MusicRecording's did>",
	"name": "Space Oddity",
	"author": "David Bowie",
	"byArtist": [
		{
			"@type": "MusicGroup",
			"@id": "<Music group's did.>",
			"name": "David Bowie",
			"url": "<IPNS URL of linked-data.>"
		}
	],
	"copyrightHolder": "",
	"duration": "PT0H5M15S",
	"inAlbum": [
		{
			"@type": "MusicAlbum",
			"@id": "<Music album's did.>",
			"name": "Space Oddity",
			"url": "<IPNS URL of linked-data.>"
		}
	],
	"recordingOf": [
		{
			"@type": "MusicComposition",
			"@id": "<Music composition's did.>",
			"name": "Space Oddity",
			"url": "<IPNS URL of linked-data.>"
		}
	],
	"isrcCode": "<ISRC of the music recording.>",
	"audio": [
		{
			"@type": "audioObject",
			"bitrate": 1411200,
			"uploadDate": "2069-11-04"
		}
	],
	"datePublished": "1969-11-04",
	"genre": "Rock",
```

```
        "position": 1,
        "publisher": "",
        "thumbnailUrl": "",
        "image": "<URL of music recording's cover image>",
        "explicity": false,
        "ethereumAddress": "<Ethereum smart contract address of the recording.>",
        "bitmarkAssetID": "<Bitmark asset ID of the recording.>"
}
```

Muzeum Right Entity

Property	Expected Type	Description
Properties from CoalaIP Right		
usages	Text	The usages of the right (all, copy, play, stream, etc.).
territory	Place	The territory of the right.
context	Text	The context of the right (inflight, in public, commercial use, etc.).
exclusive	Boolean	Whether it is an exclusive right.
numberOfUses	Integer	Number of uses of the right.
validFrom	Date	The date which the right is valid from.
validTo	Date	The date which the right is valid to.
source	creativeWork	Source copyright of the right.
license	URL	URI pointing to a license in an immutable data store, e.g., IPFS
contract	Text	A Bitmark ID of the right license contract.
Properties from Muzeum		
rightOf	CreativeWork	The creative work which the right points to.
rightsholder	Party (Person or Organization)	Holder of the right.
rightsAssignment	rightsAssignment	The assignment record of the right.

Reference: Coala IP

Right JSON-LD

```
{
        "@context": "http://coalaip.schema/",
        "@type": "Right",
        "@id": "<Right's did>",
        "usages": "all|copy|play|stream|...",
        "territory": "<URI pointing to a Place>",
        "context": "inflight|inpublic|commercialuse...",
        "exclusive": true|false,
        "numberOfUses": "1, 2, 3, ...",
        "validFrom": {
                "@type": "Date",
                "@value": "2016-01-01"
        },
```

```
        "validTo": {
                "@type": "Date",
                "@value": "2017-01-01"
        },
        rightOf: {
                "@type": "CreativeWork",
                "@id": "<CreativeWork's did>",
                "name": "",
                "url": "<IPNS URL of linked-data.>"
        },
        "source": {
                "@type": "Right",
                "@id": "<Right's did>",
                "url": "<IPNS URL of linked-data.>"
        },
        "contract": "<BitmarkID of the license contract.>",
        "license": "<URI pointing to a license in an immutable data store, e.g. IPFS.>",
        "rightsholder": {
                "@type": "Party",
                "@id": "<Rightsholder's did>",
                "url": "<IPNS URL of linked-data.>"
        }
        "rightsAssignment":
        {
                "@type": "rightsAssignment",
                "@id": "<RightsAssignment's did>",
                "url": "<IPNS URL of linked-data.>"
        }
}
```

Muzeum RightAssignment Entity

Property	Expected Type	Description
Properties from Muzeum		
assigner	Party (Person or Organization)	The assigner of the right assignment.
assignee	Party (Person or Organization)	The assignee of the right assignment.
right	Right	The right of the assignment.
transaction	Text	The transaction hash of the right assignment on Ethereum blockchian.

RightsAssignment JSON-LD

```
{
        "@context": "http://muzeum.schema/",
        "@type": "RightsAssignment",
        "@id": "<RightsAssignment's did>",
        "assigner": {
                "@type": "Party",
                "@id": "<Assigner's did>",
```

```
                "url": "<IPNS URL of linked-data.>"
        },
        "assignee": {
                "@type": "Party",
                "@id": "<Assignee's did>",
                "url": "<IPNS URL of linked-data.>"
        },
        "right": {
                "@type": "right",
                "@id": "<Right's did>",
                "url": "<IPNS URL of linked-data.>"
        },
        "transaction": "<Transaction hash on Ethereum blockchain>"
}
```

License JSON-LD

```
{
        "@context": "http://coalaip.schema/",
        "@type": "License",
        "@id": "<License's did>",
        "usages": "all|copy|play|stream|...",
        "territory": "<URI pointing to a Place>",
        "context": "inflight|inpublic|commercialuse...",
        "exclusive": true|false,
        "numberOfUses": "1, 2, 3, ...",
        "duration": {
                "@type": "duration",
                "@value": "<ISO 8601 durations format>"
        },
        "source": {
                "@type": "Right",
                "@id": "<Right's did>",
                "name": ""
        },
        "contract": "<Bitmark ID of the license contract.>",
        "rightsholder": {
                "@type": "Party",
                "@id": "<Rightsholder's did>",
                "url": "<IPNS URL of linked-data.>"
        }
}
```

Muzeum EndorseAction Entity

Property	Expected Type	Description
Properties from EndorseAction		
endorsee	Organization or	A sub property of participant. The person/organization being supported.

	Person	
Properties from Action		
agent	Organization or Person	The direct performer or driver of the action (animate or inanimate). E.g. John wrote a book.
result	Thing	The result produced in the action. E.g. John wrote a book.
Properties from Thing		
description	Text	A description of the item.
identifier	PropertyValue or Text or URL	The identifier property represents any kind of identifier for any kind of Thing, such as ISBNs, GTIN codes, UUIDs, etc. Schema.org provides dedicated properties for representing many of these, either as textual strings or as URL (URI) links. See background notes for more details.
url	URL	URL of the item.
Properties from Muzeum		
type	Text	The type of the endorseAction. (E.g. verification, contribution, endorsement ,certificate.)

Reference: http://schema.org/EndorseAction
Schema are licensed under the Creative Commons Attribution-ShareAlike License (version 3.0).

EndorseAction JSON-LD

```
{
        "@context": "http://schema.org/",
        "@type": "EndorseAction",
        "@id": "<EndorseAction's did>",
        "endorsee": {
                "@type": "Person",
                "@id": "<Person's did>",
                "name": "",
                "url": ""
        },
        "agent":  {
                "@type": "Person",
                "@id": "<Person's did>",
                "name": "",
                "url": ""
        },
        "result": {
                "@type": "CreativeWork",
                "@id": "<Creative work's did>",
                "name": "",
                "url": ""
        },
        "type": "verification | contribution | endorsement | certificate",
        "description":"",
        "url": ""
}
```

3.4 Muzeum Core Server

Muzeum Core Server contains:

1. Index database
2. Generation of linked-data
3. Transfer of licensed asset ownership
4. Notification service

Public data on DApps (for e.g., party, creative work information, endorsement records, licenses, etc.) will be sent to the Core Server via API for indexing.

Index Database and Generation of Linked-Data

The Data registered on DApps will be transferred through API to Core Server for generating index and linked-data.

Transfer of Licensed Asset Ownership and Notification Service

After the licensing transaction on Ethereum is completed, DApps notify the Core Server to proceed with the transfer of licensed asset ownership on the Bitmark blockchain. Licensees will have the access to encrypted asset files once they receive the bitmarks. Furthermore, the Core Server can also be a notification and asset-transferring delegate to facilitate the automation of the licensing process. Licensors can execute these procedures on their own as well.

During the licensing process, DApp should encrypt the personal data for privacy protection before creating it as a bitmark and transferring to the licensor. The Core Server does not and should not deal with personal data.

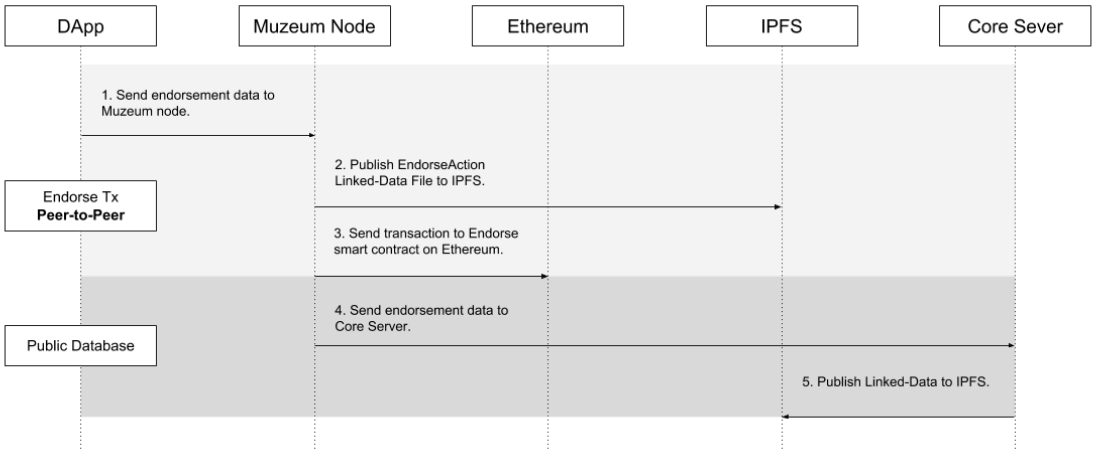
3.5 Integration Process Flows

With the above, the actual process of how the Muzeum Protocol operates is as follows:

Party (for e.g., creator, copyright holder, etc.) registration process:

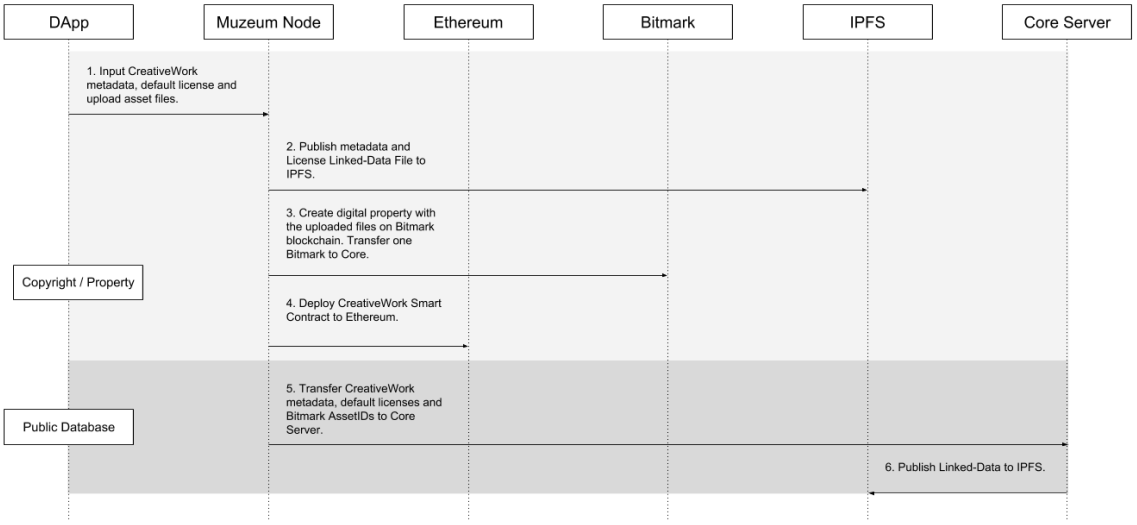
1. Create a profile on any DApp.
2. Transfer to the Muzeum Core Server via API and indexing in the database.
3. Publish metadata to IPFS.

The endorsement process:



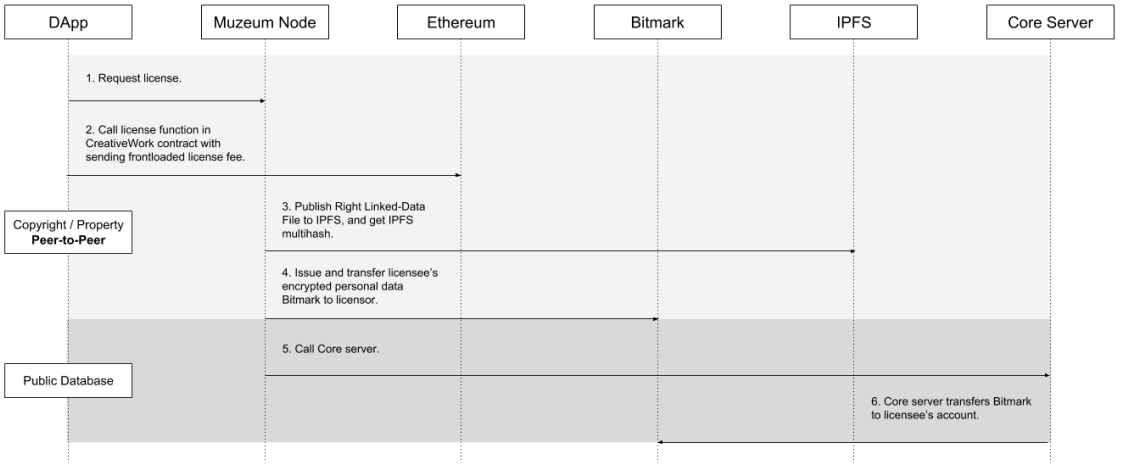
1. Registered parties input endorsement data on DApps.
2. Muzeum Node generates endorsement linked-data and publishes to IPFS.
3. Registered parties execute the endorse function in endorsement smart contract and processes the transaction on Ethereum.
4. Muzeum Node creates new data on Muzeum Core Server via API.
5. Muzeum Core Server generates and publishes the up-to-date linked-data to IPFS.

Creative work registration process:



1. Copyright holder inputs CreativeWork metadata, default license and uploads asset files on the DApp.
2. Muzeum Node publishes the linked-data of default license to IPFS.
3. Muzeum Node creates digital property with the uploaded files on Bitmark blockchain, and transfers one Bitmark to Muzeum Core's Bitmark account.
4. Muzeum Node deploys CreativeWork Smart Contract to Ethereum.
5. Muzeum Node transfers CreativeWork metadata and default license to Muzeum Core Server.
6. Muzeum Core Server generates and publishes the latest linked-data to IPFS.

Licensing process (unidirectional):



Scenario

Copyright holders can automate with front-loaded licensing terms in advance. As long as licensees agree to the set conditions, they can obtain the license after the transaction is complete without additional approval from the copyright holder.

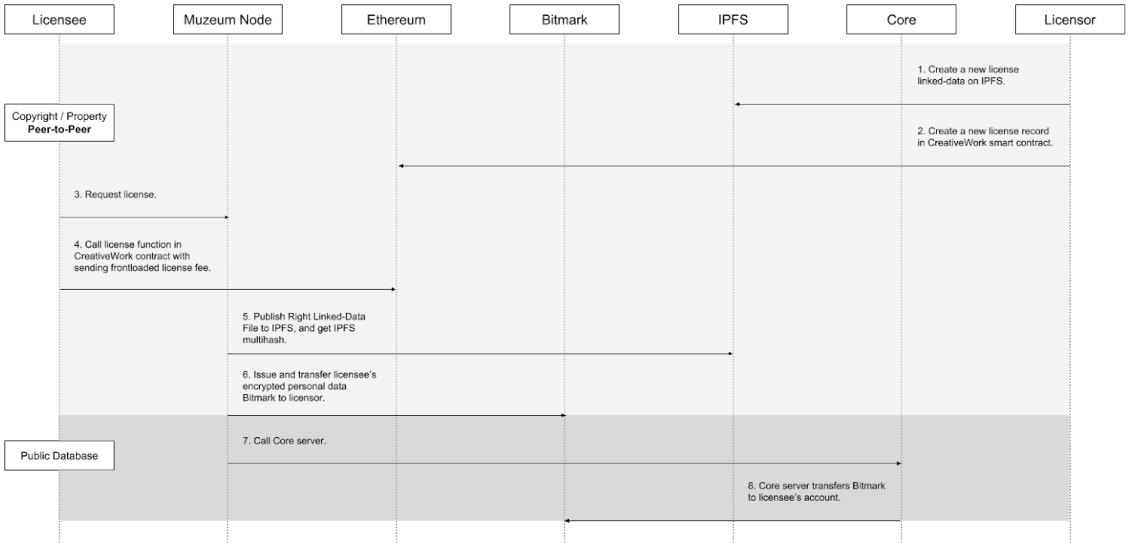
Initiate a licensing transaction
Licensees can submit personal data, select a licensing item, preferred terms and initiate a transaction. If the transaction details match the front-loaded terms and conditions, the smart contract will process the transaction and save this transaction record. The record includes the transaction amount, the licensee's Ethereum address, the BitmarkID of the licensee's personal privacy information, the licenses' linked-data IPFS hash, and the transaction time.

Transfer of digital assets
After the transaction is completed on Ethereum, Muzeum Node will verify its legality, then notify the Muzeum Core Server via API to transfer the digital asset bitmark of the licensed item to the licensee. Bitmark's AssetID is available in license linked-data.

Personal Privacy Information
The licensee's information will be transmitted to the copyright holder through encryption to protect privacy. Muzeum Node encrypt personal data, creates bitmark, and transfers it to the copyright holder's Bitmark account. The BitmarkID of the personal data will also be recorded in the licensing record of the smart contract.

Notification
After Muzeum Node informs the Muzeum Core Server via API that the licensing transaction is completed, the Muzeum Core Server will send an email to notify the copyright holder.

Licensing process (bidirectional):



Scenario

After the copyright owner and the licensee reach an agreement, the copyright holder establishes a customized license, which includes: transaction amount, licensee's Ethereum address, license linked-data IPFS hash, and requested payment deadline. The licensee must use the pre-agreed Ethereum address to conduct the transaction and submit personal data, which then receives the license after the transaction is complete.

4. Features

Based on Muzeum's technical framework, the following features serve as the basis for developing new application services.

Public Database

Based on the linked-data stored in IPFS in the above integration process flow, the Muzeum Node will automatically synchronize and create an Elasticsearch index so that developers can quickly create search functions in the application.

Data Validation

In a decentralized world, the credibility of an individual's identity will be based on an accumulation of endorsements and transactions, which is the so-called "Online Reputation."

Data validation is done by DApp. For example:

- If a copyright holder Alice performs identity authentication via a DApp *MuzeAuth* with Facebook Connect, the DApp can make an endorsement "Alice is verified via *MuzeAuth* as Alice on Facebook".
- If Alice conducts the real-name authentication through *MuzeAuth*, then the endorsement will be "Alice is verified with real-identity as Alice (with link URL) via *MuzeAuth*".

Verification of creative work information and copyright ownership is also done by DApp. Results of the verification are shown as endorsement records on Ethereum and referencing linked-data on IPFS. For example: "Album ABC is released by *Soundscape*" or "Copyright XYZ's copyright registration data is verified by *MuzeAuth*."

The verification endorsement establishes index data on the Core Server through the API. There may be more than one unit at the same time in the verification endorsement, thus, users must judge the credibility of the endorsement unit themselves.

Talent Endorsement

Endorsement allows creative talents and teams to display past achievements such as work experience and technical skills qualitatively in two ways: first, through the participation of creative works to validate their contribution; second, through the recognition of professional institutions for their relevant certification records.

The Registration, Management, and Inquiry of Creative Works

Copyright holders can generate and manage registration records for the copyrights and its related information. Both subsequent licensing or transfer of ownership can be traced on the blockchain. Information can also be made available to the public.

The Transfer of Copyright Ownership

The transfer of copyright ownership, whether in whole or in part, may be recorded and executed through smart contracts. Tokenization of copyright share can also make the ownership records immutable, clearer and more precise.

Licensing of Creative Work

The act of licensing will be registered on the blockchain, which can be used as a proof of transaction. In the future, a copyright with collective ownership by multiple parties can also use Multiple Signature to ensure the licensing is done under an unanimous agreement.

Royalty Split of Copyright

The copyright royalty split scheme can also be created and executed through smart contracts. In certain circumstances, copyright owners may agree to share royalty with contributors of the creative works. For example, a label who owns the copyright of a recording may decide to split copyright royalty to other contributors of said recording such as its producer, vocalist or session musicians.

5. Examples of possible application services

Muzeum's infrastructure and platform mechanisms facilitates the creation of application services and new business models:

Talent Resources and Networking Services

Decentralized creative talent resource services can be established by utilizing endorsement records on the blockchain. The creator's capabilities and experience can be verified through the connections of creative works, copyright ownership, as well as endorsements, making it more convenient for creative talents to find collaborators.

As food and drug industries explore the possibility of using blockchains to log and track production records, the blockchain can also be used to increase transparency for the creation and tracking of copyright ownership. Blockchain’s proof-of-existence nature can also be used for creative talents or industry practitioners' experience and professional certification. In combination with the history of creation and talent endorsement, various types of human resources and talent networking related applications may emerge.

Copyright Management, Transaction and Licensing Platforms

Creators and copyright holders can register their own copyrights, set licensing terms and conditions, and execute licensing activities automatically on decentralized copyright management platforms. Licensees can accept the pre-set terms and conditions front-loaded by the copyright holders, or negotiate customized licensing terms e-managed through smart contracts.

Issuance of Token

Application developers can create their own tokens on the blockchain. For example, musicians can issue their own fan club tokens to loyal fans as a proof of membership. Different tokens can represent various types of access to exclusive contents online and offline live events. Information and special conditions such as membership expiration date, membership fee, conditions for transfer can also be managed by smart contracts.

Smart Crowdfunding

Creators can tokenize and sell part of the copyright of their creative works by leveraging token issuance and smart contracts. Fans can purchase copyright shares to support the creators, allowing them to share a part of the copyright’s future revenue while the creators receive funding for production and marketing. This is applicable for music and filmmaking projects, as it provides extra incentive for fans, and creates additional sources of funding for the creators. Copyright royalty splits may be automatically carried out through smart contracts without middlemen intervention.

Advanced Digital Content Distribution Services

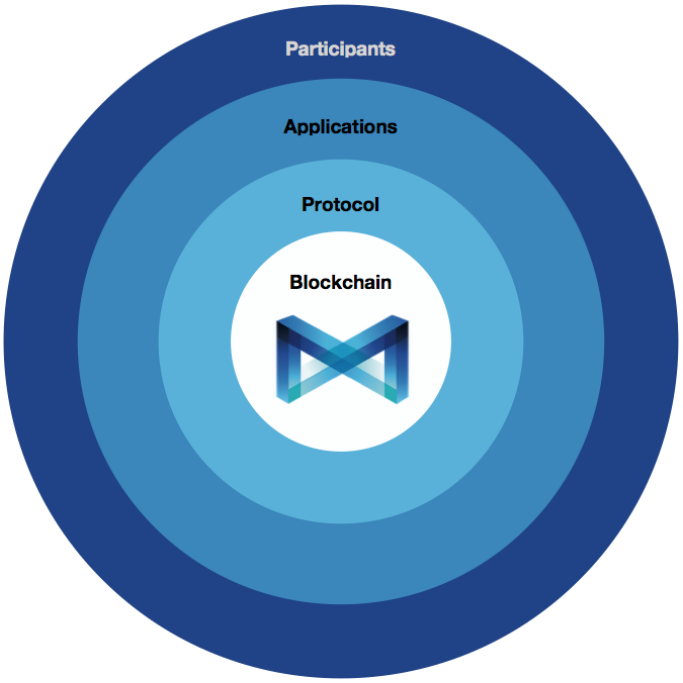
Muzeum presents new possibilities for digital content distribution and media applications. Developers with application services which utilize Muzeum can access content in the public domain database, search and license creative works with front-loaded licensing terms and conditions that meet the application's business model and functional requirements. This allows application developers to focus on product development, while creators and copyright holders possess the liberty of setting, adjusting and managing the licensing of their creative works.

6. Summary: The Future of Creative Industries

The future should have more cooperation, participation, connection, and openness.

Similar to swarm behaviour in nature, large decentralized groups can emerge from the scattered individuals and exhibit collaborative lives through individual interconnections through the invisible common protocol of the species. The future of creative industries must empower interconnections among individual creators, as well as ensuring collaborations run smoothly through the introduction of a common protocol.

The birth of the blockchain provides an excellent foundation to realize the future. Our vision of creative industries is categorized into four layers as shown in the following figure: blockchain, protocol, applications, and participants.



(Figure) The Future of Creative Industries

- Blockchain and distributed systems are the fundamental layer, namely the public database and the open computing platform.
- The second layer "protocol layer" is the industry protocol running on the blockchain and distributed systems such as standardized data formats, licensing and royalty distribution procedures, etc.
- The third layer "application layer" is where application services are constructed by leveraging the protocols and blockchains.
- The fourth layer of "participants", representing all of the industry's participants in the future, will strengthen their mutual cooperation and allow creative Industries to act as a living organism under this structure.

In addition to increasing connectivity and trust, cooperation and co-creation, greater transparency and efficiency, the emergence of new business models will also increase the demand of talent, content, and copyrights.

List of Participants

Creators	Copyright holders	Brokers / Agents	Exploiters
Musicians / Bands Video Production Team Designers Photographers Writers Artists	Content Creators Music Labels / Film Studios Game Developers / Publishers Arts Groups / Companies Media Owners / Investors	Talent Agencies Copyright Agents Publishing / Publishers	Digital Content Distribution Platforms for Audio-Visual Media Audio and Video Production Studios Live event organizers Retail stores Individual users and more
Related Parties	**Developers**	**Collection Societies**	**Authorities**
Performers / Groups Production Team Members Copyright Management Companies Other Copyright Related Parties	Core System Development Team Application Service Providers Academic Research Units Other Independent Developers	Collection Societies for Sound Recording Rights Collection Societies for Music Composition Rights	Copyright Administration Office Cultural and Creative Industry Authorities

Team

Joint Development Team

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Acknowledgements

Rongrong Song, Sean Moss-Pultz, Yue Li, Yijie Lin.
Republic of China (Taiwan) Ministry of Culture.