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**Decentralised Music Rights Ecosystem**

# Motivation

Copyright legislation has continuously evolved so that fair, timely and transparent revenues are returned to artists and rights holders, e.g., US Music Modernization Act and EU Directive on Copyright in the Digital Single Market. Effective IP rights management in the digital environment is key to support the competitiveness of creative industries.  Creative companies and SMEs need to be empowered to make better decisions and deploy more advanced solutions based on insights gleaned from data. ISO/IEC 21000-23 Smart Contracts for Media supported by rich semantic copyright models can be handy when data-based decisions need to be derived by evidence and logic, leading to new business models that can be efficiently deployed on decentralised digital media platforms.

# Scope

This standard will provide the means (e.g., technologies and application programming interfaces) for a decentralised media rights ecosystem based on MPEG technologies (e.g., audio-visual codecs, file formats, streaming protocols, and smart contracts) and non-MPEG technologies (e.g., DLTs, content and creator IDs).

# Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>

- IEC Electropedia: available at <https://www.electropedia.org/>

**decentralised identifiers** **(DIDs)** are a type of identifier that enables verifiable, decentralised digital identity. A DID refers to any subject (e.g., a person, organisation, thing, data model, abstract entity, etc.) as determined by the controller of the DID.

**metadata** is information given to describe or help use other information.

In the case of copyright, one distinguishes between:

* Rights management information comprises identification metadata and rights metadata:
  + Identification metadata answering the questions: *what is what*, *who is who*
  + Rights metadata answering the questions: *who did what*, *who owns what*, *what can we do with that*
* Additional metadata as defined by industry practices:
  + Descriptive metadata for search and enjoyment of content
  + Usage metadata for a fair trade of content
  + Administrative metadata to trust all other metadata

**token** is an object stored in a DLT and managed through one or more smart contracts, representing unique tangible or intangible media assets, possessions, and accountable items

* fungible tokenis a token being changeable with other tokens
* non-fungible tokenis a token being non interchangeable with other tokens

**self-sovereign identity (SSI)** isa new way of thinking about digital identity. SSI is based on the principle of putting users in control of their digital identity and the related data.

# Use cases

Overview of use cases from the Smart Contracts for Media CfP [1], [2].

## Open Music Initiative (on-demand streaming, digital sale, and radio broadcast)

These use cases are about how the money flows back to songwriters, artists, publishers, and labels, when their music is webcast or streamed on interactive services, sold on digital platforms, and played on radio. For interactive streams and digital sales, the money flows depend on what entity negotiated the license (e.g., record labels having a direct deal with services, record labels represented by a digital aggregator/distributor and artists owning recording copyrights and using distribution services), while for radio and radio-like services, blanket licenses determine who gets paid and how much [3]. MPEG-21 CEL/MCO contracts are provided for each of these use cases in [4].

This use case has been concluded with ISO/IEC 21000-23 Smart Contracts for Media [5], [6].

Timeline

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**Figure 1: Selectable options provided by ISO/IEC 21000-23 Smart Contracts for Media reference software**

## **Music authoring tools**

Widespread adoption of interactive music services and applications (remixing, karaoke, and collaborative music creation) - thanks to IM AF (ISO/IEC 23000-12) [7], [8] aka STEMS [9] - raises the issue of intellectual property (IP) rights monitoring in such applications, for fair and transparent payment of royalties to artists and rights holders. The MVCO (ISO/IEC 21000-19) [10], [11], [12] facilitates rights tracking for such services by capturing user roles and their permissible actions on a particular IP asset. While the AVCO (ISO/IEC 21000-19/AMD1) [13], [14], [15] facilitates transparent IP rights management even when reuse of audio IP assets is involved, such as, tracks or even segments of them in new derivative works.

Furthermore, *Mixrights* is an on-line Javascript application based on IM AF (ISO/IEC 23000-12). It works entirely in the browser and operates much like a typical desktop document-editing application. IM AF files can be loaded by simply dropping them on the browser window. Then, tracks can either be removed or new tracks can be added by dropping audio files in the browser. Images and lyrics can also be added in the same way and mixing presets can be edited by playing the sequence and recording fader movements. *Mixrights* users can share their musical creations by uploading them to the server and sharing the links, e.g., in social networks. Users can also create new mixes or karaoke versions of existing songs (derivative works) and instantly share them. *Mixrights* keeps a count of the number of times a user-mix or karaoke version has been played helping users develop reputation. *Mixrights* software can be used for seamless integration with ISO/IEC 21000-23 Smart Contracts for Media for rights tracking towards fair payment of royalties.

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**Figure 2: *Mixrights* application based on IM AF (ISO/IEC 23000-12)**

## **Broadcasting operations**

The MCO (ISO/IEC 21000-21) [16], [17] provides the means to express the rights for exploiting media content, as it is typical among audio-visual production companies and broadcasters. In such a context, the most used commonly rights for media exploitation are public performance (e.g., where the public is present), fixation (e.g., when a performance is recorded on a tangible medium) and communication to the public (e.g., where the public is reached by means of a communication technology). As in narrative contracts, these exploitation rights might be associated with a wide set of conditions (e.g., number of broadcast transmissions, time periods, territories, languages, exclusivity, royalty percentages), modalities (e.g., linear/broadcast and non-linear/broadband) and access policies (e.g., free of charge, subscription, pay per view).

This use case is more suitable for production companies and broadcasters deploying technologies such as CMAF [18] & DASH [19].

# Exploration / Mandate

Conduct exploration activities on, e.g., technologies, architecture, and APIs towards a Decentralised Media Rights Ecosystem, including:

* Smart contracts and DLTs
* Rights metadata management
* Content and creator IDs
  + **Content IDs:** [**MPEG-21 DII**](https://www.iso.org/standard/35367.html)[**ISCC**](https://iscc.codes/)[**DIDs**](https://www.w3.org/TR/did-core/)[**NFTs**](https://eips.ethereum.org/EIPS/eip-721)
  + **Creator IDs:** [**Creative Passport**](https://www.creativepassport.net/)[**OpenID Connect**](https://openid.net/connect/)[**Self-Sovereign ID**](https://en.wikipedia.org/wiki/Self-sovereign_identity)[**ISNI**](https://isni.org/page/linked-data/)[**NFTs**](https://eips.ethereum.org/EIPS/eip-721)
* File formats and streaming protocols

# Architecture

This section gives a brief overview of the components needed for such a Decentralised Media Rights Ecosystem based on MPEG and non-MPEG standards. A starting point could be MPEG-M: Multimedia Services Platform Technologies (ISO/IEC 23006) as described in [34] and briefly explained in the Annex. In that case, MPEG-M will need to be adapted with respect to ISO/IEC 21000-23 Smart Contracts for Media and DLTs.

Diagram

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**Figure 3: Decentralised Media Rights Ecosystem Architecture**

## Smart contracts and DLTs

* Media Value Chain Ontology (MVCO) [10], [11], [12] facilitates the representation in a machine processable way, the life cycle (aka value chain) of Intellectual Property (IP) Entities. The relationship between a User and a particular IP Entity type (e.g., work, adaptation, product, copy) is specified through the concept of role. The Actions that a User takes on a given IP Entity determine the role of that User with respect to the IP Entity in question. Users get roles (e.g., creator, adaptor, producer, end-user) that attribute them rights over Actions (e.g., create work, make adaptation, produce, distribute, synchronise) that can be exercised on specific IP entities. Any given User may take on any number of roles within a given value chain. These relations are shown in Figure 4.

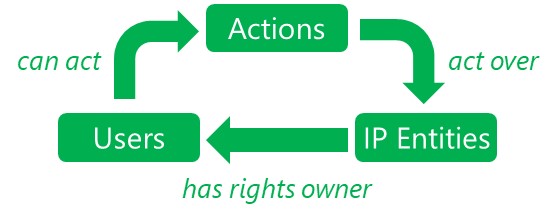


Figure 4: Relations between IP Entities, Users, and Actions

Thus, MVCO facilitates rights tracking for fair and transparent royalties’ payment by capturing User roles and their permissible actions on a particular IP Entity. Furthermore, it enables music navigation based on IP rights through their visualisation as co-author graphs revealing collaborations and influences among artists.

* Audio Value Chain Ontology (AVCO) [13], [14], [15] facilitates transparent IP rights management even when content reuse is involved. Widespread adoption of interactive music services (remixing, karaoke, and collaborative music creation) - thanks to IM AF/STEMS - raises the issue of rights monitoring when reuse of audio IP entities is involved, such as, tracks or even segments of them in new derivative works.

The Audio Value Chain Ontology addresses this issue by extending MVCO functionality related to description of composite IP entities in the audio domain, whereby the components of a given IP Entity can be located in time, and for the case of multi-track audio, associated with specific tracks. The introduction of an additional 'reuse' action enables querying and granting permissions for the reuse of existing IP entities in order to create new derivative composite IP entities.

* Media Contract Ontology (MCO) [16], [17] facilitates the conversion of narrative contracts to digital ones. It consists of a core model, which provides the elements for the creation of generic deontic statements encompassing the concepts of permission, prohibition, and obligation, and two extensions:
  + Exploitation of Intellectual Property Rights, e.g., licensing for broadcasting or public performance.
  + Payments and Notifications, e.g., royalties’ splits between rights holders and currency conversions.
* Contract Expression Language (CEL) [20] supports the same functionality as the Media Contract Ontology (MCO) but expressed by XML schemas instead of RDF ontologies.
* Smart Contracts for Media (MSC)[5], [6] provides the means (e.g., application programming interfaces) for converting MPEG-21 XML and RDF media contracts (ISO/IEC 21000-19 Media Value Chain Ontology, ISO/IEC 21000-19/AMD1 Audio Value Chain Ontology, ISO/IEC 21000-20 (2nd Ed) Contract Expression Language and ISO/IEC 21000-21 (2nd Ed) Media Contract Ontology) to smart contracts that can be executed on existing DLT environments.

This standard will assist the media industry in achieving effective interoperability for the exchange of verified contractual data between different DLTs. In this way, it will increase trust among the stakeholders for sharing high-value data (e.g., music rights) in the ecosystem. Another important feature of this standard is that it offers the possibility to persistently bind the clauses of a smart contract to their corresponding ones of a narrative contract. In this way, each party signing an ISO/IEC 21000-23 conforming smart contract will be able to know exactly what its clauses express.

## Rights and metadata management

The role of rights metadata management – based on MPEG-21 CEL/MCO [11], [14], [17], [20] schemas and ontologies – is to allow **rightsholders** to declare their rights and rights users to search for rights. **Rights users** will then license, distribute, and remunerate content. Therefore, one must be able to:

* **Store** identification metadata and rights metadata including machine-readable royalty splits, as well as standard terms and conditions. Identification metadata answering the questions: *what is what*, *who is who;* Rights metadata answering the questions: *who did what*, *who owns what*, *what can we do with that.*
* **Manage** the ex-ante (before distribution) machine-readable propagation of royalty splits (for remuneration) and terms and conditions (for licensing) throughout the dynamic and complex structure of contributions to a media end product. The data required for distribution and remuneration, i.e., the data required for a smart contract, is interlinked in the licensing statement: “Licensor (Partya) gives Licensee (Partyb) the Licencel to perform the Actions A1 to n over the IP Entities1 to n under the Terms T1 to n”.

Metadata management includes the **capture** of contributors and their contributions, the **ingestion** of rights data, the handling of ownership or availability **conflicts**, and the **query** of rights data [21], [22], [23]. In the following, these functionalities are briefly described:

* the **capture** of rights data to identify who did what as close as possible to the moment of creation, which may require forms of (semi-)automation such as plug-ins
* the **ingestion** of rights data whereby the attribution creator ABC created content XYZ should be attested, e.g., through verifiable credentials, and must be accompanied by rights management information on ownership splits and standard terms & conditions
* the handling of ownership or availability **conflicts**, whereby records must be reconciliated, matched and/or deduplicated, conflicts must be identified, parties must be notified, and resolution must be monitored
* the **query** of rights data allowing (a) a digital service provider to find the rights management information pertaining to content uploaded on its platform, and (b) potential rights users (e.g., filmmakers) to find content (e.g., music) relevant to their purpose as well as the related rights management information.

While rights metadata management is built around the DLT agnostic API of ISO/IEC 21000-23 Smart Contracts for Media, intuitive Graphic User Interfaces (GUI) need to be developed for an enhanced User Experience (UX).

## Content and creator IDs

* MPEG-21 Digital Item Identification (DII) Content identification is a fundamental component of any asset trade system. An asset identifier can be random so long as it can also be discovered by alternate IDs such as the International Standard Recording Code (ISRC) or the International Standard Work Code (ISWC) or other internal fields or keywords. These alternate IDs enable two or more organisations to discover and share a common identifier for an asset.

The MPEG-21 Digital Item Identification [24] provides a simple, extensible, and interoperable mechanism on how to integrate in music trade systems not only existing but even future alternate identification schemes by facilitating the elements: (i) *Identifier*; and (ii) *RelatedIdentifier*.

* International Standard Content Code (ISCC) identifiers are generated algorithmically from the content itself. Content files are processed to build the identifier. The ISCC does not have to be manually assigned, neither does it have to be carried around or embedded within the content. The content itself is the source and authority of the ISCC. The ISCC is a unique, hierarchically structured, composite identifier. It is built from a generic and balanced mix of content-derived, locality-sensitive, and similarity-preserving hashes generated from metadata and content [25], [26].

The ISCC has been accepted by ISO as a full work item ISO/AWI 24138 - International Standard Content Code and is currently being standardized at TC 46/SC 9/WG 18 - Digital-Content-Based Identification.

* Non-Fungible Tokens (NFTs)

A non-fungible token is a way of proving that a digital item is the only one of its kind in existence and therefore cannot be copied or reproduced without the owner's knowledge and consent. They can be thought of as a digital [certificate of authenticity](https://simple.wikipedia.org/w/index.php?title=Certificate_of_authenticity&action=edit&redlink=1). They're bought and sold online and represent digital proof of ownership of any given item. NFTs are securely recorded on a blockchain.However, the legal rights conveyed by an NFT can be uncertain. [ERC-721](https://eips.ethereum.org/EIPS/eip-721) was the first standard for representing non-fungible digital assets on the Ethereum blockchain.

With respect to MPEG-21 CEL/MCO schemas and ontologies, an *IP entity* is the representation of an asset, and the reference to this asset can be stored in a DLT. This representation of an asset may be serialized according to the concept of NFTs. Moreover, a *deontic expression* encompasses the properties of an agreed machine-readable contract clause regulating the actions of the parties, e.g., obligations, permissions, and prohibitions. This representation of a clause may also be connected to the concept of NFTs [5].

* Decentralised Identifiers (DIDs)are a type of globally unique identifier. They are designedto enable individuals and organizations to generate their own identifiers using systems they trust. These new identifiers enable entities to prove control over them by authenticating using cryptographic proofs such as digital signatures.

Since the generation and assertion of Decentralized Identifiers is entity-controlled, each entity can have as many DIDs as necessary to maintain their desired separation of identities, personas, and interactions. The use of these identifiers can be scoped appropriately to different contexts. They support interactions with other people, institutions, or systems that require entities to identify themselves, or things they control, while providing control over how much personal or private data should be revealed, all without depending on a central authority to guarantee the continued existence of the identifier [27].

* Creative Passport & OpenID Connect

The Creative Passport is a verified digital ID for music makers, where they can access, update, and manage verified information about themselves and their works, and share it with others. Born out of think-and do-tank Mycelia, driven by a community of creatives, technologists, and industry champions.

That is, having one decentralised hub where artists can upload and verify their data, while also connecting all of their existing external IDs in one place, will open up new opportunities and make the whole process of sourcing information and making payments much more controllable and transparent.

The long-term plan is for the Creative Passport to become a Self-Sovereign Identity, but a lot of research is still required in the field and there are challenges for immediate industry implementation [28].

OpenID Connect is a simple identity layer on top of the OAuth 2.0 protocol. It allows clients to verify the identity of the end-user based on the authentication performed by an authorization server, as well as to obtain basic profile information about the end-user in an interoperable and REST-like manner.

OpenID Connect allows clients of all types, including web-based, mobile, and javascript clients, to request and receive information about authenticated sessions and end-users. The specification suite is extensible, allowing participants to use optional features such as encryption of identity data, discovery of OpenID providers, and session management, when it makes sense for them [29].

* Self-Sovereign ID (SSI)is an approach to digital identity that gives individuals control of their digital identities. SSI addresses the difficulty of establishing trust in an interaction. In order to be trusted, one party in an interaction will present credentials to the other parties, and those relying parties can verify that the credentials came from an issuer that they trust. In this way, the verifier's trust in the issuer is transferred to the credential holder.

It is generally recognized that for an identity system to be self-sovereign, users control the verifiable credentials that they hold, and their consent is required to use those credentials. This reduces the unintended sharing of users' personal data. This is contrasted with the centralized identity paradigm where identity is provided by some outside entity. In an SSI system, holders generate, and control unique identifiers called decentralized identifiers. Most SSI systems are decentralized, where the credentials are managed using crypto wallets and verified using public-key cryptography anchored on a distributed ledger [30].

The European Union is creating an eIDAS compatible European Self-Sovereign Identity Framework (ESSIF). The ESSIF makes use of decentralized identifiers (DIDs) and the European Blockchain Services Infrastructure (EBSI).

* International Standard Name Identifier (ISNI)is in use by numerous libraries, publishers, databases, and rights management organizations around the world. It is used to uniquely identify persons and organizations involved in creative activities, as well as public personas of both, such as pseudonyms, stage names, record labels or publishing imprints. As an open standard, ISNI is not a proprietary "walled garden" - it is diffused widely on the open web and is a critical component in Linked Data and Semantic Web applications [31], [32].

Several mechanisms are available for interacting with the ISNI database, including manual interaction, batch processing and real-time API requests and responses. Two main APIs are currently deployed: an “[SRU Search](https://isni.oclc.org:2443/isni/docs/ISNI%20SRU%20search%20API%20guidelines.pdf)” API and an “[AtomPub Assignment Request](https://isni.oclc.org:2443/isni/docs/isni-atom-pub-api-guidelines.pdf)” API. Both are extensively documented in the Technical Documentation section of the ISNI website. ISNI supports a number of data formats, both for submission to the database and for outputs from the system.

For data input operations, primarily related to searches, to matching between source databases and ISNI, and to ISNI assignment requests, ISNI-XML is the preferred format. It is also possible to submit tab-delimited CSV information for batch assignment requests and matching. For data output from the ISNI system, ISNI-XML is again the preferred and richest format available. Additionally, as a product of ISNI’s work on Linked Data, it is also possible to access a subset of the data available in either RDF/XML or JSON-LD formats.

## File formats and streaming protocols

* ISO Base Media File Format (ISOBMFF) [33] is currently the most widely adopted multimedia file structure standard (.mp4 extension) facilitating storage, interchange, management, and editing.
  + MPEG-A: Interactive Music Application Format (IMAF)ISOBMFF derived MPEG-A: Interactive Music Application Format (IM AF) (ISO/IEC 23000-12) [7] (aka STEMS [9]) specifies how to combine multiple audio tracks with additional information, e.g., dynamic volume changes for DJ mixing and lyrics for karaoke applications.

For example, with IM AF various tracks can be remixed by users enabling them to share their remixes in social networks. Recipient users of the media can develop a reputation through music citations, similar to that of scientific citations [8].

* + MPEG-A: Common Media Application Format (CMAF) ISOBMFF derived MPEG-A: Common Media Application Format (CMAF) (ISO/IEC 23000-19) [18] specifies multimedia format, which contains segmented media objects optimized for streaming delivery and decoding on end user devices in adaptive multimedia presentations.

Moreover, CMAF specifies sets of tracks that share encoding and packaging constraints that enable the selection of multiple tracks to form a multimedia presentation and allow seamless switching of alternative encodings of the same content at different bit rates, frame rates and resolution.

* Dynamic Adaptive Streaming over HTTP (DASH) [19] is an adaptive bitrate streaming technique, universally deployed, that allows smart TVs and mobile phones to consume high quality multimedia content, while seamlessly adapt to variable network conditions.

Following the example of IM AF, DASH streaming enables radio producers and DJs to schedule playlists for streaming to their radio stations and clubs, respectively, and perform live mixing. In this case, artists could even be notified when their assets are scheduled for streaming, thus, enabling artists/fans interaction.

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**Annex**

**MPEG-M digital media services ecosystem** is described in [34]. In our context, of particular interest is the fact that MPEG-M facilitates easy creation of new services by combining service components (aka engines), such as the above-mentioned ones, as well as innovative business models because of the ease to design and implement interoperable media-handling value chains since they are all based on the same set of technologies, especially MPEG technologies. An MPEG-M architecture adapted for enabling interactive music applications with IP rights tracking, based on the above-mentioned components, is shown in Figure 5. MPEG-M Elementary Services classified by operations and entities are shown in Figure 6. That is, MPEG-M could consist a good starting point towards the Decentralised Media Rights Ecosystem.

A screenshot of a computer

Description automatically generated with medium confidence

Figure 5. MPEG-M architecture adapted for enabling interactive music applications and

services with IP rights tracking

Table, calendar

Description automatically generated with medium confidence

Figure 6: MPEG-M Elementary Services classified by operations and entities

**Rights Services**

* **Adaptr** What is Adaptr? Adaptr is an all-in-one platform to easily add hit music to apps and digital experiences. How does it work? Qualifying start-ups and developers can sign up, create playlists, integrate the SDK and configure their design, and then stream music for their users. Adaptr takes care of the rest, from paying the labels and publishers, to tracking use. Who is using Adaptr? Adaptr is for early-stage start-ups and app developers that do not have the resources to negotiate deals with multiple rightsholders. Companies include mobile gaming, digital fitness, social media, dating apps, wellness, dance and more. What rights are granted? On-demand, interactive transmissions of masters or underlying compositions. The right to create playlists for an end user's personal consumption only. The right to transmit and publicly display audio-only, and audio-visual content in timed relation with masters transmitted by Adaptr from authorised servers only. Source: <https://www.adaptr.com/faqs>
* **Data Explorer** is a 100% ID coverage searching tool powered by Quansic which allows to navigate through the global music repertoire. The user of Data Explorer can connect all artists with their releases and recordings, whether they are main artists or non-featured artists and know the linked IDs such as ISNI, IPI, IPN, ISRC, UPC etc. Every month 10,000 new IDs are added to the Data Explorer platform. The user can also have access to Data Explorer via an API. Source: <https://quansic.com/data-explorer/>

The AHG on Smart Contracts for Media would further work to invite such companies to present their standardization needs.