

**126<sup>th</sup> MPEG Geneva, Switzerland, 25 - 29 March 2019, Meeting Report**  
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**Contents**

**1 Exploration activity on MPEG-21 Based Smart Contracts ..... 1**  
**2 White paper on MPEG Intellectual Property Rights Ontologies ..... 1**

**1 Exploration activity on MPEG-21 Based Smart Contracts**

Under the auspices of the Requirements subgroup an exploration activity and an Ad Hoc Group (AHG) have been established on MPEG-21 Based Smart Contracts with the following mandate:

Name	AHG on MPEG-21 Contracts to Smart Contracts
<b>Mandates</b>	1. Initiate in-depth study of use of MPEG-21 in blockchains and its operation 2. Investigate MPEG-21 CEL/REL XML conversion to blockchain smart contracts 3. Investigate MPEG-21 MCO/MVCO/AVCO ontologies conversion to blockchain smart contracts 4. Investigate how to add hooks between blockchains and MPEG-21 Intellectual Property Rights Ontologies for inference and reasoning capabilities 5. Solicit contributions towards the aforementioned objectives 6. Review ‘MPEG IPR Ontologies’ (N18500) white paper wrt the above findings
<b>Chairmen</b>	Panos Kudumakis (QMUL), Xin Wang (MediaTek)
<b>Reflector(s)</b>	<a href="mailto:smart-contracts@lists.aau.at">smart-contracts@lists.aau.at</a>
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**2 White paper on MPEG Intellectual Property Rights Ontologies**

A white paper on ‘MPEG Intellectual Property Rights Ontologies’ has been approved by the Communications subgroup to become publicly available on the MPEG web site ([N18500](#)). The latter is also attached to this report.

**Output Documents**

**N18537 - Use of MPEG-21 CEL in Blockchains**

**N18500 - White paper on MPEG Intellectual Property Rights Ontologies**

**INTERNATIONAL ORGANISATION FOR STANDARDISATION  
ORGANISATION INTERNATIONALE DE NORMALISATION  
ISO/IEC JTC 1/SC 29/WG 11  
CODING OF MOVING PICTURES AND AUDIO**

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**Contents**

1	Introduction .....	3
2	Media Value Chain Ontology .....	4
2.1	Main entities .....	4
2.2	Authorization model .....	5
3	Audio Value Chain Ontology.....	6
3.1	Relations for IP entity segments and tracks.....	6
4	Media Contract Ontology.....	7
4.1	Exploitation of intellectual property rights.....	8
4.2	Payments and notifications .....	8
5	Conclusions .....	9
6	References .....	9

# MPEG Intellectual Property Rights Ontologies

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**Abstract.** MPEG is a ISO/IEC working group developing media coding standards. This includes a set of standardized ontologies for the codification of intellectual property (IP) rights information related to media. The Media Value Chain Ontology (MVCO) facilitates rights tracking for fair, timely and transparent royalties payment by capturing user roles and their permissible actions on a particular IP entity. The Audio Value Chain Ontology (AVCO) extends MVCO functionality related to description of composite IP entities in the audio domain, e.g., multi-track audio and time-segments. The Media Contract Ontology (MCO) facilitates the conversion of narrative contracts to digital ones. These ontologies provide the elements for the creation of generic deontic statements encompassing the concepts of permission, prohibition and obligation. The joint use of MCO/MVCO/AVCO ontologies enables a number of applications where IP data is represented in a standard and structured manner. Furthermore, MCO/MVCO/AVCO ontologies can be executed in a controlled environment where transparency and interoperability is favoured towards fair trade of music and media.

**Keywords:** MPEG, Intellectual Property Rights, Semantic Web, Smart Contracts, Music, Media, Multimedia, MPEG-21, Rights Management, Rights Exploitation, Trade of Rights

## 3 Introduction

Computational ontologies are used for different purposes. Sometimes they are defined to substantiate a shared knowledge on a certain domain in a formal manner. Sometimes they are used to better ground data models, especially if data is to be serialized in the RDF form, favouring clarity and interoperability. And less frequently, they are used to drive computations in information systems where computer reasoning on formal models is necessary.

During the last few years, MPEG has published ontologies in the area of intellectual property rights which serve well for each of these objectives. First, the ontologies published by MPEG in this area are the result of wide consensus among different stakeholders and they are of value as a depiction of an agreement in a potentially conflictive subject matter such as intellectual property. Second, the MPEG ontologies define concepts and properties which can be used to represent actual entities, such as contracts, conforming to the best industry practices. Exchange of documents, even if privately, benefits from using a standard representation, acting as interlingua. If contracts, stakeholders and intellectual property entities in the media value chain are represented using RDF, they can be gracefully connected to other external entities or to additional knowledge on them, weaving *domain knowledge graphs*, which are becoming essential for the business operation of many technological companies. Finally, the deontic logic

structures featured by the MPEG ontologies on intellectual property, enable advanced reasoning on the obligations, permissions and prohibitions present in contracts and agreements.

Far from being academic merits, the combination of these achievements make ontologies unique compared to related technologies and have resulted in success cases in other enterprise applications [1].

The MPEG ontologies on intellectual property include the Media Value Chain Ontology (ISO/IEC 21000-19) to represent the intellectual property entities along the media value chain, its extension for the audio domain, known as, Audio Value Chain Ontology (ISO/IEC 21000-19/AMD1) and the Media Contract Ontology (ISO/IEC 21000-21) for the representation of contracts in the audio-visual domain. These ontologies are described in Sections 2, 3 and 4, respectively.

## 4 Media Value Chain Ontology

### 4.1 Main entities

The Media Value Chain Ontology (MVCO) [2, 3, 4] is an ontology that formalizes the media value chain. The MVCO was designed to satisfy a number of requirements, and the derived competency questions thereof led to defining three entities of top importance: *intellectual property entities*, as they are transformed along their life cycle, relevant *actions* that can be performed on them, and types of *users* whose actions are rights, obligations or otherwise foreseen by intellectual property law.

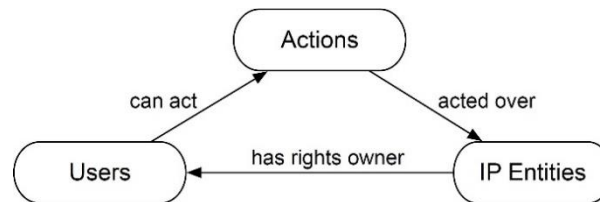
Intellectual property entities are entities protected by international intellectual property law. The very first entity in the chain is the abstract creation, the *work*, which is the result of any intellectual endeavour with enough creativity. Works are pure, abstract entities, with no material incarnation whatsoever. Derivative works are a special type of works, who have been derived from an existing work. Works are fixated into physical *manifestations*, which are the very first incarnation of works. Manifestations can be *instanced*, and *copied*, or they can be transformed into commercial *products*. Whereas the logical schema of IP entities resembles the Functional Requirements for Bibliographic Records (FRBR) chain [5], the source is somewhat different: MVCO takes the IP entities mentioned by copyright legislation (or its universal part, which is defined in universally agreed treaties such as the Berne Convention), whereas FRBR is inspired by the needs of librarians.

The types of roles a user can play revolve around the IP entities, e.g., a creator is defined as the user who creates a work, an adaptor is the user who adapts a work to produce an adaptation. These roles or very similar ones are also acknowledged by copyright legislation. Other roles include producer, distributor and, finally the end-user.

The types of actions that can be done also revolve around the IP entities. *Create work* is the action whose result is a new work, *produce* is the action whose result is a product and so forth. In addition, some other actions do not produce any new IP entity, such as, a public communication or an end-user action (e.g., play and print) but they are legal concepts with explicit mentions and provisions in copyright legislation.

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. Figure 1 illustrates these relations between actions, users and IP entities.



**Figure 1.** Relations between actions, users and IP entities.

## 4.2 Authorization model

The MVCO defined with users, actions and IP Entities would serve well to depict a static picture of the IP information. However, in real life rights are transferable and the representation of this was required to be supported in the MVCO.

Transfer of rights are born with the signature of agreements or contracts which grant *permissions*. A permission relates an IP entity with a right in transit between the original rights owner and the new rights owner. Permissions have an intrinsic dynamic nature: they are granted, invoked and revoked. Instances of a *user* class will probably be actual companies or persons; instances of *works* will be actual works. However, instances of permissions are far more interesting due to that they could refer either to the past or in the future.

That is, an instance permission will refer to one or two instances of user, but will also refer to the instance of an action. And what is the interpretation of an action instance? It might be an action effectively executed in the past, but it might be also an action to be done, mentioned by the permission as a mere possibility. This is commonly referred in the literature as *event factuality*, and suggests that action instances can be marked as executed acts or as possible acts.

Permissions can be also conditioned by the truth of certain *facts*, which must hold. Facts are simply defined as positive propositions with a binary truth value, suggesting MVCO users to extend as necessary, as long as, the alethic value (e.g., true or false) is maintained. As a result of basic deontic logic principle, the definition of a permission is sufficient to enable the representation of prohibitions (as negation of permissions) and obligations (the prohibition of not doing something).

Finally, the MVCO supports to some extent, the so called *copyright exceptions*; a notion present in IP law to enable the reasonable use of copyrighted assets in certain cases. For example, complete quotes are allowed for scientific purposes, and parody is also permitted. The MVCO provides mechanisms for specifying these copyright exceptions, although the exceptions themselves are not specified.

## 5 Audio Value Chain Ontology

The Audio Value Chain Ontology (AVCO) [6, 7] facilitates transparent IP rights management even when content reuse is involved. In particular, widespread adoption of interactive music services (remixing, karaoke and collaborative music creation) enabled by MPEG-A: Interactive Music Application Format (IM AF) [8] (STEMS [9] is a commercial implementation of IM AF) 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.

AVCO 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, as shown in Figure 2. 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.

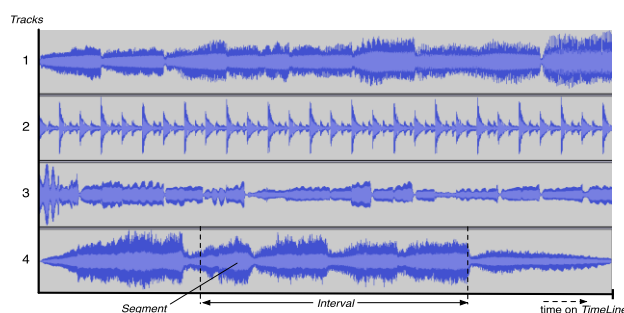


Figure 2. Visualized multi-track audio. Segment exist within an interval on a TimeLine.

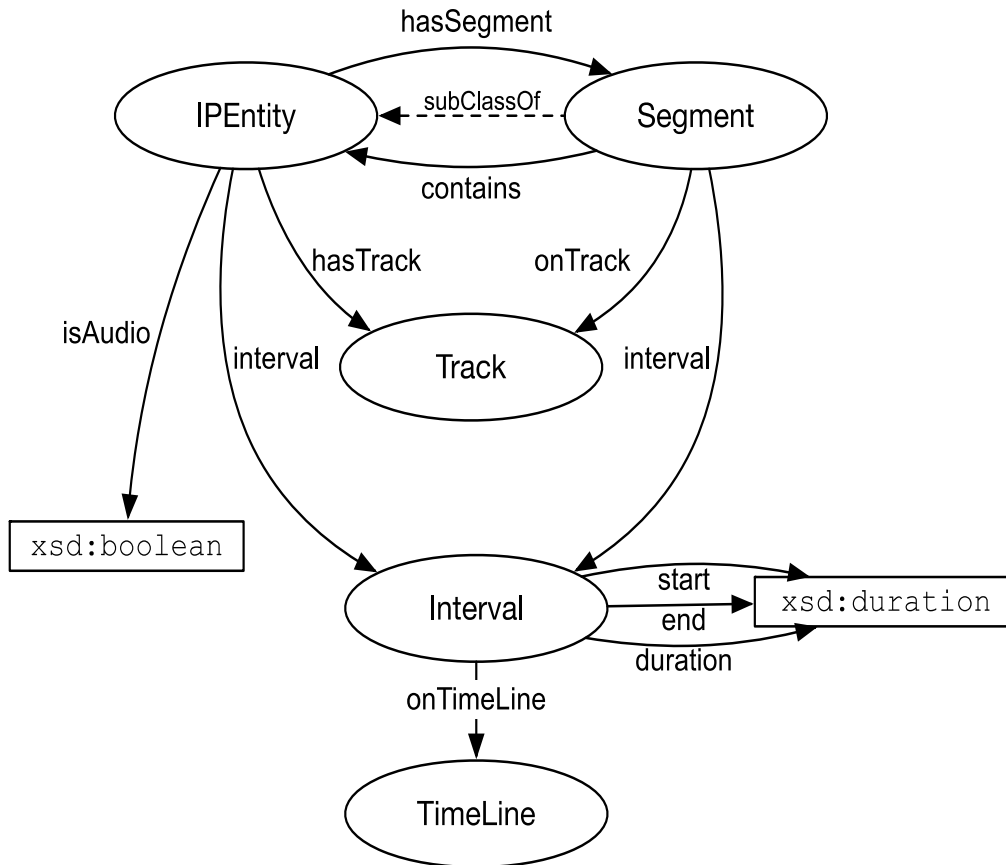
### 5.1 Relations for IP entity segments and tracks

The relations for the representation of composite IP entities in the audio domain are illustrated in Figure 3. Reused IP entities may exist in specified *segments* of existing IP entities and, in the case of multi-track audio IP entities, on specified *tracks*.

A segment is in a part-of relationship with the IP entity linked with the *hasSegment* property, and its class is subsumed by *IPEntity*. The segment, in turn, *contains* another IP entity, representing one of the components the composite IP entity is made-up-of.

Since we are dealing with IP entities in the audio domain a timeline can be associated with it. The timeline class is based on the timeline model of the Timeline Ontology [10]. The property *interval* links an IP entity to an *Interval*. An interval is defined as a temporal entity with extent. The duration of the audio resource is specified with the *duration* property linking to an explicit datatype. The property *onTimeLine* relates the interval with a timeline. In order to express that a segment exists within a certain interval on the same timeline, an interval is related to the segment in the same fashion using the *interval* property. The beginning and end of an interval is specified through an explicit datatype using the properties *start* and *end*, respectively.

For the case of multi-track audio resources, an IP entity is related to *tracks* with the *hasTrack* property. To express that a segment exists on a certain track, it is linked to the respective track using the *onTrack* property.



**Figure 3.** Classes and relationships for the representation of IP entities that contain other existing IP entities. Segments can also be associated with individual tracks of a multi-track audio IP entity.

## 6 Media Contract Ontology

The Media Contract Ontology (MCO) [11, 12] facilitates the conversion of narrative contracts to digital ones and permits the creation of new contracts in machine-readable electronic format. It consists of a core model (mco-core), as shown in Figure 4, which build on top of MVCO generic deontic statements (encompassing the concepts of *permission*, *prohibition* and *obligation*) by providing the elements for modelling the basic structure of media contracts (e.g., contract and parties identification and relationships with other contracts); and, two extensions: 1) Exploitation of Intellectual Property Rights; and, 2) Payments and Notifications.

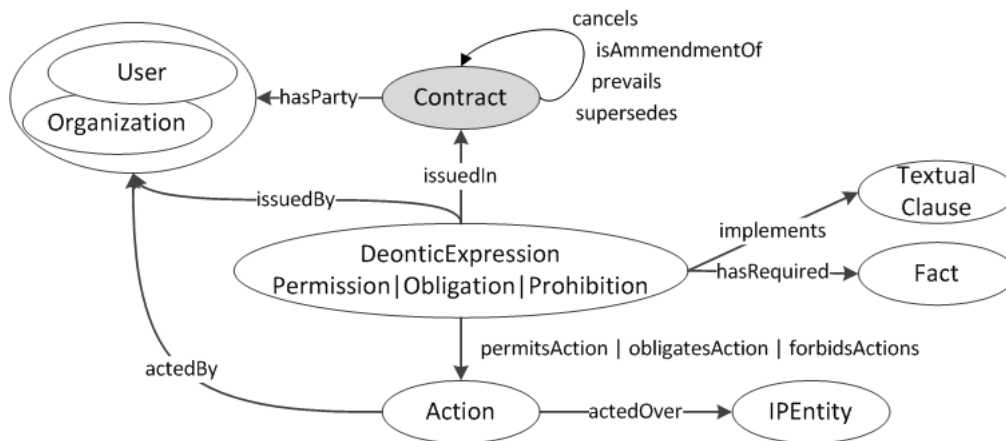


Figure 4. Main elements of MCO model.

## 6.1 Exploitation of intellectual property rights

The extension for the exploitation of intellectual property rights (mco-ipre) provides the means to express the rights for exploiting media content, as it is typical among audio-visual production companies and broadcasters. A wide set of conditions (facts) is supported related to the various aspects, modalities and policies of the communication to the public or public performances (e.g., number of runs, time periods, territories and languages). Concepts such as fixation, transformation and distribution, as well as, exclusivity, sublicensing, royalty percentages (e.g., splits) are just a few among those supported.

In the main model actions are permitted when the required conditions are met (e.g., the required *facts* are true). However it is also possible to specify relationships between different rights or actions, for which the occurrence of an action, for example the exploitation of a right, can trigger some condition on another action/right. This mechanism allows the specification of complex rights patterns, such as, for instance, the so called catch-up TV (a combination of both linear and non-linear communication to the public) for broadcasters.

## 6.2 Payments and notifications

The extension for payments and notifications (mco-pane) provides means to define specific obligations, for completing a media contract scenario. Both payments and notifications are typically obligated actions which can either be triggered by (as a consequence of) or required as pre-condition to rights exploitation.

Eventually MCO can be used from expressing rights within an organizational rights management system to creating full binding media electronic contracts, including digital signature of the parties. Information on rights purchased, sold and used, as defined by means of MCO is required to guide different workflows across media organizational processes, thereby granting business integration over electronic networks.

Another part of ISO/IEC 21000, namely part 20 [13], Contract Expression Language (CEL) provides an electronic format equivalent to MCO for XML technology environment.



## 7 Conclusions

MCO/MVCO/AVCO ontologies, which facilitate machine readable deontic expressions for permissions, obligations and prohibitions, could be used in conjunction with distributed ledgers (e.g., blockchains) enabling both transparency and interoperability towards fair trade of music and media [14, 15].

Such MPEG IPR ontology standards should convince music and media industry stakeholders to accept technology developments catering for the needs of music and media rights transparency build upon open standards.

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