128th MPEG Geneva, Switzerland, 7 - 11 October 2019, Meeting Report

Panos Kudumakis
qMedia, Queen Mary University of London

Contents

1 SC29 scope & structure

AHG Establishment
SC29 establishes two ad hoc groups that have mandates to report to SC 29 by the next SC 29 meeting in March, 2020. These AHGs are open to P-member experts. NBs are requested to appoint their members to the AHGs to SC 29 Manager by October 26, 2019.

Establishment of AHG on SC29 Leadership
Based on offer by Japan National Body (SC29 N18405), SC29 believes that its work would be best served if the chair could be nominated as the best candidate from the international community, with the nomination formally being made, according to the Directives, by the national body holding the secretariat. SC29 establishes an ad-hoc group to study how that national body could be advised in making such a nomination.

AHG mandates
- Clarify leadership nomination and selection procedure
- Study how candidates present their role, vision and plan as leader
- Study leadership mechanism to sustain continuity

AHG convenor: Kohtaro Asai
Convenor Support Team: Leonardo Chiariglione, Touradj Ebrahimi

Re-establishment of AHG on Scope and Structure
AHG mandates
- Study 3 proposals
- Study and refine the "Areas of further study" from the JTC 1 Progress Report
- Study and refine the "Criteria for evaluating proposals" from the JTC 1 Progress Report
- Consider any guidance from JTC1
- Prepare the first report by Feb. 11
- Prepare the updated report by March 10

Convenor: Walt Husak
Convenor Support Team: Gary Sullivan and Pierre-Anthony Lemieux

Approval of Progress report to JTC1
SC 29 approves the progress report of the study on SC29 scope and structure as SC 29 N18443, and agree to submit to JTC1. SC29 also approves the revised scope in SC29 N18443 and agree to submit to JTC1.

Future Meetings
SC 29 approves the following meeting schedule:
34th SC 29 Plenary meeting in March 24, 25 and 26 (3 day meeting), Paris, France

End of the meeting: 20:25 Sat 12 Oct. 2019

Dr Panos Kudumakis
Head of UK Delegation, ISO/IEC JTC1/SC29 & Chair, BSI IST/37
at 33rd ISO/IEC JTC1/SC29 Meeting, Geneva (CH), 12 Oct. 2019.

SC29 UK National Body Resolution
UK ISO/IEC JTC1/SC29 mirror committee (aka BSI IST/37) unanimously approved that ISO/IEC JTC1/SC29/WG11 elevated to a new ISO/IEC JTC1/SC4x on 'MPEG compression and delivery of moving pictures, audio and other data' (SC29 N18165). The new SC4x will inherit the current terms of reference, work plan and organisational structure of ISO/IEC JTC1/SC29/WG11 and have a status compatible with its role (MPEG-enabled devices worth $2.8 trillion) and size (600 attendees). Further info at: MPEG Future

2 MPEG IPR Ontologies to Smart Contracts

Benefits of MPEG IPR Ontologies

- MPEG IPR ontologies can be used by music and media value chain stakeholders to **share and exchange all metadata and contractual information connected to creative works**, in a standardised and interoperable way, leading to transparent payment of royalties and reduced time spend searching for the right data.
- The latter is due to **inference and reasoning capabilities** inherently associated with ontologies. That is, **knowledge and data** can be derived by **evidence** (true facts) and **logic** based on rich **semantic copyright models** expressed by MPEG IPR ontologies. In such way, the data derived are **unambiguously interpretable** facilitating **efficient processing in B2C and B2B** music and media value chains.

The Challenge: From MPEG IPR Ontologies to Smart Contracts and Blockchains

How MPEG IPR standardised ontologies can be converted to smart contracts being executable on existing blockchain environments, thus

1. **enriching blockchain** environments with **inference and reasoning** capabilities inherently associated with ontologies, while
2. **increasing the trust level** among music and media value chain stakeholders **for sharing data** in the ecosystem, since the data will be cryptographically secured, and **its truth is verified by a blockchain**?

Towards a Semantic Music and Media Blockchain

- While lots of research literature deals with ontologies' semantic-level interoperability **(linking different ontologies)** and blockchains' protocol-level interoperability **(transferring verified data from one to another)**, the **interoperability gap** between them has not yet been sufficiently addressed.
- Towards this direction, MPEG is not going to develop any blockchain based technology or any new language for smart contracts.
- **MPEG aim is to develop the means (e.g., protocols and APIs**) for converting MPEG IPR ontologies to smart contracts being executable on existing blockchain environments.
- Such developments towards a ***semantic music and media blockchain*** have the potential to unlock both the semantic web and the creative economy.

Encoding semantic representations expressed by MPEG IPR Ontologies as metadata tags in smart contracts

MPEG IPR Ontologies

```
<NamedIndividual rdf:about="#XXX">
   <rdf:type rdf:resource="urn:mpeg:mpeg21:mco:pane:2015#Payment"/>
   <mco-pane:hasAmount>1.00</mco-pane:hasAmount>
   <mco-pane:hasCurrency>GBP</mco-pane:hasCurrency>
   <mvco:actedBy rdf:resource="#UserA"/>
   <mco-pane:hasBeneficiary rdf:resource="#UserB"/>
</NamedIndividual>
```

To

Move

Transfer UserA UserB £1

AHG Activities Overview

1. **Solicit industry participation in the area of smart contracts**

   28 members subscribed (covering both ontologies & blockchain communities)

2. **Dissemination of MPEG IPR Ontologies**
   - Panos Kudumakis, Thomas Wilmering, Mark Sandler, Víctor Rodríguez-Doncel, Laurent Boch and Jaime Delgado, "MPEG IPR Ontologies", ISO/IEC JTC1/SC29/WG11/N18500, Geneva, CH, Mar. 2019.
   - Panos Kudumakis, Thomas Wilmering, Mark Sandler and Jeremy Foss, "MPEG IPR Ontologies for Media Trading and Personalization", 1st International Workshop on Data-driven Personalization of Television (DataTV'19) at ACM International Conference on Interactive Experiences for Television and Online Video (TVX'19), Manchester, UK, 5-7 Jun. 2019.
   - Panos Kudumakis, Thomas Wilmering, Mark Sandler, Víctor Rodríguez-Doncel, Laurent Boch and Jaime Delgado, "The Challenge: From MPEG Intellectual Property Rights

Ontologies to Smart Contracts and Blockchains", IEEE Signal Processing Magazine, Revised Sept. 2019.

3. **Input documents**

M51376 - Some thoughts and resources on MPEG IPR ontologies based smart contracts

This contribution describes and clarifies 'The Challenge: From MPEG IPR Ontologies to Smart Contracts and Blockchains', that the AHG on 'MPEG-21 Contracts to Smart Contracts' is mandated to address. It also includes some resources (e.g., pointers to standards, content and software for experimentation) for the convenience of those interested in contributing to the activities of the AHG.

M51030 - CEL Contract Templates for OMI Use Cases

This contribution analyses Open Music Initiative use cases (e.g., on-demand streaming, digital sale and radio broadcast) and provides high level contracts. That is, for interactive streams and digital sales, how the money flows depends 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.

M51206 - The Tezos blockchain and its opportunities for media content tracking

This contribution briefly presents the 'Tezos' blockchain and the emerging opportunities for developing media-related decentralised applications. The main advantage of the 'Tezos' blockchain is its versatility, ensured by its properties, such as, reliability, upgrades, governance , self-amendment and proof-of-stake based consensus. Furthermore, 'Tezos' blockchain features four different smart contracts programming languages which can be interchanged. Thus, Tezos can serve as a testbed for the MPEG-21 smart contracts activity experimentations (as there is a need for independence wrt the platform). The weak point of 'Tezos' blockchain is related to the fact that its supporting community is yet rather small.

M51208 - Tools for converting MPEG21-CEL to Tezos smart contracts

This contribution relates to the automatic, bidirectional conversion between XML (as a representation for CEL) and JSON. It presents software tools developed in both Csharp and Python, for achieving such a conversion. As an example, the automatic conversion of the CEL contract, which is part of the MPEG-21 CEL standard, is provided. Furthermore, this contribution demonstrates that the automatic conversion XML ←→ JSON is possible. However, this study is expected to be completed with automatic conversion between the JSON corresponding to a CEL contract and a 'Tezos' smart contract.

4. **Output documents**

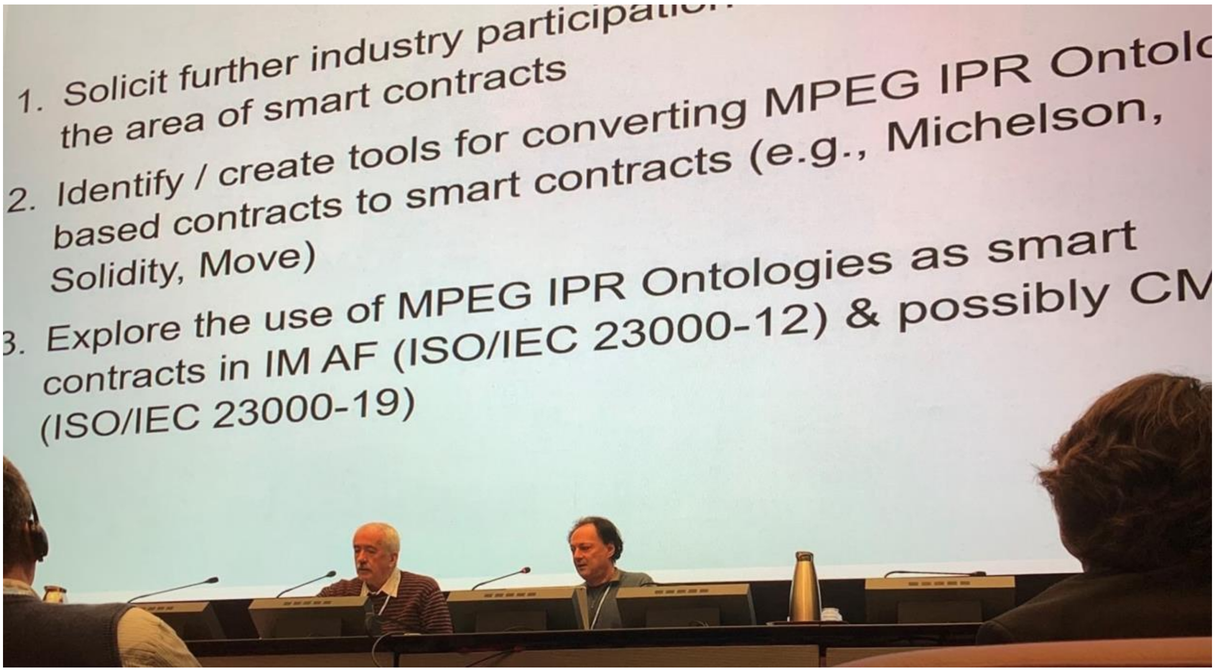
M18771 - Use cases for MPEG-21 smart contracts

This document approved by the Requirements group is based on the aforementioned contributions and, in particular, M51376 and M51030. Thus, presents the challenge the AHG is mandated to address, including use cases and related resources for further experimentation.

AHG Recommendations

1. Solicit further industry participation and contributions in the area of smart contracts (e.g., use cases & requirements)
2. Identify / create tools for converting MPEG IPR Ontology based contracts to smart contracts (e.g., Michelson, Solidity, Move)
3. Explore the use of MPEG IPR Ontologies as smart contracts in IM AF (ISO/IEC 23000-12) & possibly CMAF (ISO/IEC 23000-19)

Chairmen	Panos Kudumakis (QMUL) & Xin Wang (MediaTek)
Duration	Until next meeting
Reflector(s)	smart-contracts@lists.aau.at
Subscribe	https://lists.aau.at/mailman/listinfo/smart-contracts



‘MPEG IPR Ontologies to Smart Contracts’ ad hoc group report presented by Dr Panos Kudumakis at 128th MPEG Meeting, Geneva (CH), 7-11 Oct. 2019.

Use Cases

- **Open Music Initiative (on-demand streaming, digital sale and radio broadcast):** These use cases are about how the money flows back to song writers, artists, publishers and labels, when their music is web cast or streamed on interactive services, sold on the digital platforms and played on the radio. In particular, for interactive streams and digital sales, how the money flows depends 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. In Table 1, high level contracts are provided for each of the aforementioned use cases.

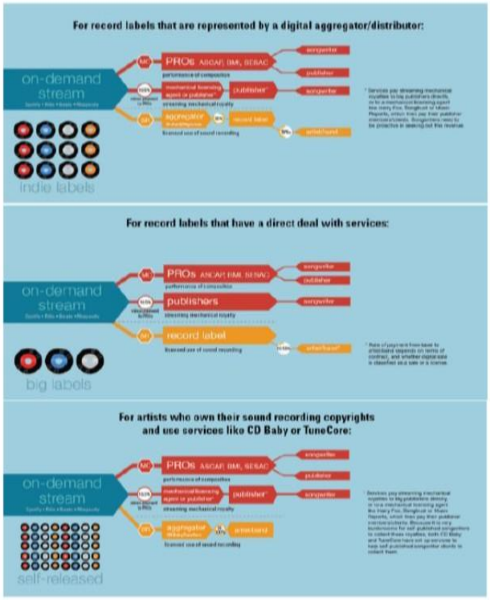
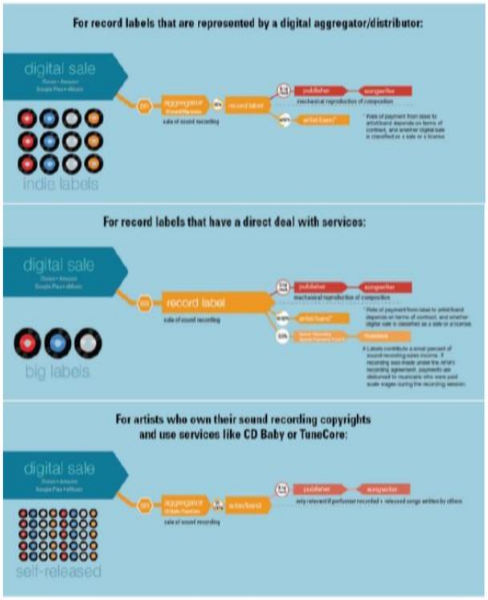
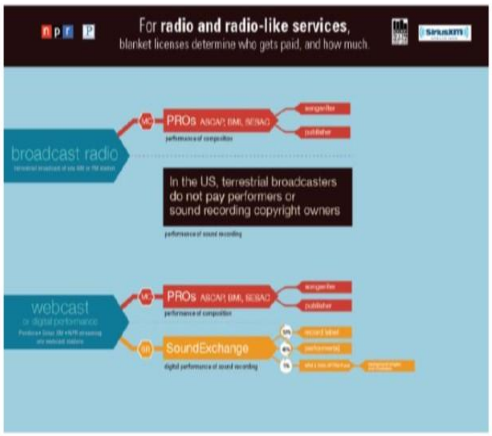
On demand streaming	Digital sale	Radio Broadcast
		
Contract For all P, C, W, S Party: Streaming Service Provider P Party: Streaming Service Consumer C Party: Digital Distributor D Statement 1 Subject: D Act: Provide Object: "Performance of Song" S Permission 1 Subject: P Act: Provide Recipient: C Object: "On demand Streaming Service" of S Permission 2 Subject: Consumer C Act: Pay Recipient: P Object: Subscription Fee X of "On demand Streaming Service" Permission 3 Pre-condition: ActionStatus{Permission 2}: ActionDone Subject: Consumer C Act: Consume Object: "On demand Streaming Service" of S Obligation Pre-condition: ActionStatus{Permission 2}: ActionDone Subject: P Act: Pay Recipient: D Object: 10.5% * $X	Contract For all D, C, L, S, X Party: Music Distributor D Party: Music Consumer C Party: Music Label L Statement 1 Subject: L Act: Provide Object: "Performance of Song" S Permission 1 Subject: D Act: Provide Recipient: C Object: S Permission 2 Subject: Consumer C Act: Pay Recipient: D Object: Purchase Fee X for S Permission 3 Pre-condition: ActionStatus{Permission 2}: ActionDone Subject: Consumer C Act: Consume Object: S Obligation Pre-condition: ActionStatus{Permission 2}: ActionDone Subject: D Act: Pay Recipient: L Object: 95% * $X	Contract For all D, C, L, S, X Party: Radio Broadcaster D Party: Music Label L Statement 1 Subject: L Act: Provide Object: "Performance of Song" S Permission 1 Subject: P Act: Provide Object: S Constraint: Region Obligation Subject: D Act: Pay Recipient: L Object: 95% * $X

Table 1 - Open Music Initiative use cases with high level contracts.

- **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) aka STEMS - 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) 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) 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.

- **Broadcasting operations:** The MCO (ISO/IEC 21000-21) 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 commonly used 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).

Resources

- **Standards and software**

Acronym	Standard	MPEG Document	Reference Software
MVCO	ISO/IEC 21000-19, '[Information technology -- Multimedia framework (MPEG-21) -- Part 19: Media value chain ontology]', June 2010.	[N11146] 91st Kyoto	N/A
	ISO/IEC 21000-8/AMD2, '[Information Technology -- Multimedia Framework (MPEG-21) -- Part 8: Reference software / AMD2 Reference software for media value chain ontology]', Nov. 2011.	[N12135] 97th Torino	https://tinyurl.com/y6tsr9as
AVCO	ISO/IEC 21000-19:2010/AMD1, '[Information Technology -- Multimedia Framework (MPEG-21) -- Part 19: Media Value Chain Ontology / AMD 1 Extensions on Time-Segments and Multi-Track Audio]', June 2018.	[N17170] 120th Macau	N/A
	ISO/IEC 21000-8:2008/AMD4, '[Information Technology -- Multimedia Framework (MPEG-21) -- Part 8: Reference Software / AMD 4 Media Value Chain Ontology Extensions on Time-Segments and Multi-Track Audio]', Oct. 2018.	[N17404] 121th Gwangju	https://standards.iso.org/iso-iec/21000/-8/ed-2/en/amd/4
MCO	ISO/IEC 21000-21 (**2nd Ed.**), '[Information technology -- Multimedia framework (MPEG-21) -- Part 21: Media Contract Ontology]', May 2017.	[N15940] 114th San Diego	https://standards.iso.org/iso-iec/21000/-21/ed-2
CEL	ISO/IEC 21000-20 (**2nd Ed.**), '[Information technology -- Multimedia framework (MPEG-21) -- Part 20: Contract Expression Language]', Dec. 2016.	[N15994] 114th San Diego	Included in N15994

- **MixRights software for experimentation**

Figure 1 - *Mixrights* application based on IM AF (ISO/IEC 23000-12).

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. The user can load IM AF files by simply dropping them on the browser window. Then, she can remove tracks, add new tracks by dropping audio files on the browser, add images and lyrics in the same way, or edit mix presets by playing the sequence and recording fader movements. Furthermore, *Mixrights* users can share their musical creations by uploading them to the server and sharing the links. Users can create new mixes of existing songs and instantly share them. *Mixrights* also keeps a count of the number of times a mix has been played. *Mixrights* software can be used for seamless integration with MPEG IPR ontologies based smart contracts for rights tracking towards fair payment of royalties. Those interested to work on this latter integration could get [*Mixrights*] software by contacting the author.

- **Content for experimentation**

A song by Imogen Heap called 'Tiny Human' with all of its resources is made of, for experimentation purposes, can be found at: http://imogenheap.com/home.php?article=2430

  - Tiny Human
  - Tiny Human (instrumental)
  - Tiny Human (7 stereo stems)

- Front cover image
- The music video
- Documentation about musicians, credits, lyrics, blockchain wallet address, and other useful info and links.

Output documents
M18771 - Use cases for MPEG-21 smart contracts

3 Immersive Media Access and Delivery

New, immersive services call for new ways of organizing, accessing, delivering and consuming media data. As a result, MPEG should assess what the implications are for its coding, encapsulation formats and content declaration technologies.

Background
MPEG-encoded media historically retrieved from storage media (e.g. CD-I, DVD) or delivered using broadcast (e.g. ARIB, ATSC, DVB). Nowadays streaming has become the dominant force in the video industry; video streaming services drive the technical innovation in the media industry. MPEG Technologies (ISO BMFF, DASH) find massive adoption for unicast for live and on-demand services augmenting, complementing and replacing broadcast (ATSC, DVB, HbbTV, SCTE). Immersive experiences (VR/360, 3DoF+, etc.) favour unicast-based technologies such as DASH to tailor the data stream to the exact needs of the consuming user in real time.

New Applications
The following are example of application bringing new challenges for streaming and accessing MPEG coded data:

- **Tiled 360 videos** in very high resolution
- Large **Point Clouds** that can be navigated in 6 DoF
- **Light fields** with lots and lots of small tiles
- A complicated **Scene Graph** with many objects to traverse
- Audio objects can be audible, or beyond the "**audio horizon**" in an immersive experience
- All likely retrieved from some sort of **cloud infrastructure**
- All of these can be available in **multiple quality/bitrate** variations
- All of those need to be **decoded and decrypted** with constrained devices at the receiver side.

Trends
Significant parts of the media data are **unique to the receiver**. Delivery shifts from sender-driven to **receiver-driven**. In addition, application requirements change dynamically in real-time, which makes **latency and a fast random access to the media** crucial aspects. However, at the same time, not all the components of an application have the same requirement in terms of end-to-end latency. In general, the amount of media elements contributing to a service is increasing and the user/application selects media according to user interaction and personalization in a dynamic fashion, and *therefore* the media data requires more **fine grain access**. Since mobile and wearable devices are core of the consumption of immersive media, the usage of **general purpose receiving platforms** (decoders, hardware decryptions, protocol stacks, renderers) should be leveraged to offer power and energy-efficient consumption.

Technical Challenges
Since the representation of the immersive experience constitutes a large amount of data (several TBs expected), it is desirable to allow client to flexibly retrieve **parts** of a large body of media data from a **cloud** resource to create a coherent user experience under **constrained resources**, where:

- **constraints** exist like bandwidth, access latency, decode resources (and where these can fluctuate dynamically)
- the client in charge of making **trade-offs** given such constraints
- fast **response times** and **efficiency** are crucial for the QoE
- inherently, data is accessed and retrieved in multiple **parallel streams**
- this data may need to be **protected** and/or encrypted
- this data may need to be **cached** close to the user for the best experience
- the data is stored in the **cloud** in a distributed manner

Media Access and Delivery Dimensions

Traditionally, data has been organized to allow temporal access. This dimension will remain but will merely be one of the dimensions:

- **Temporal** random access – "as usual"
  - Different timelines
  - Addition of non-timed media
- **Spatial** random access – retrieving only the relevant parts of the media
  - Depending on user orientation
- **Quality** access – retrieving the suitable quality
  - Making quality/bitrate trade-offs in switching between quality levels
  - Depending on what is visible/audible
  - Depending on retrieval/device and resource constraints, including bandwidth, latency, decoder capability, things like video and audio reproduction capabilities (e.g. screen resolution and colour space; speaker config)
- **Object** access – which objects to retrieve and possibly which parts of the objects
  - Descriptions, Nodes, etc.
  - Decoding capabilities, user preferences, etc.

Design Goals and Working Assumptions

To face the challenges of delivering immersive media, the media data stored on a cloud resource should offer a flexible, fast, timely and efficient **random access** where the media dimensions include: Spatial, Temporal, Quality, Bitrate, Objects. In conjunction, the **coding** and **encapsulation formats** of immersive media should by design factor in these dimensions such that the interface between the delivery and the coded data itself is lightweight and efficient. From an architecture point of view, there is a need to define a receiver model combining user interactions, decryption, decoding, and rendering along with a retrieval model that leverages these multiple random-access dimensions. These two models would help to better understand how a client could **dynamically** and **efficiently tailor** the experience for the user. Lastly, the conformance points between the cloud resource and the decoders to consume such experiences should be specified to ensure interoperability in the ecosystem.

Architectural View

Figure 2 below depicts an architectural view of an immersive media system.

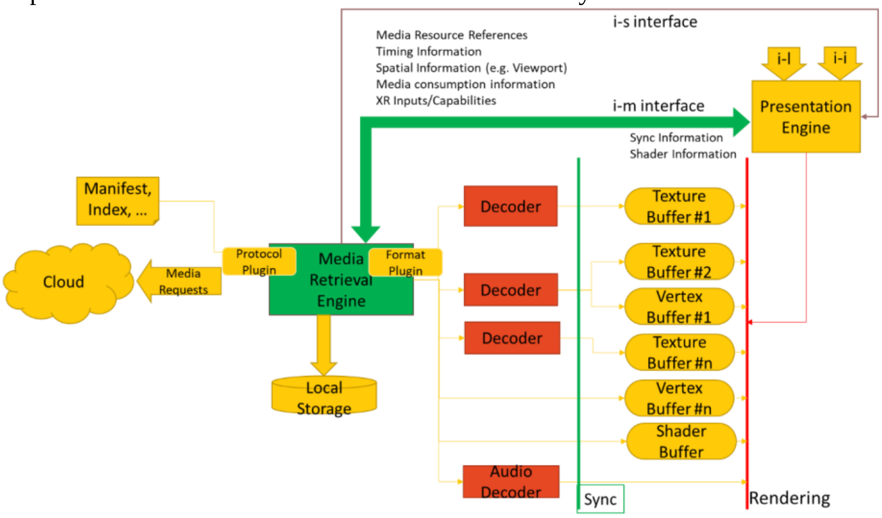


Figure 2 - Architectural View of an Immersive Media Client.

Output documents

M18767 - Requirements for Immersive Media Access and Delivery
M18769 - Overview of Immersive media standards (v9.0)
M18797 - Draft Definition of MPEG-I Phase 2a

4 MPEG-I Audio Evaluation Platform

The Moving Picture Experts Group (MPEG) is a working group developing standards to create coded representations of digital audio, video and 3D graphics. The MPEG-I Immersive Audio standard, ISO/IEC 23090-4, specifically addresses design and coding requirements in order to render audio content for presentation in virtual and/or augmented reality settings, in which user can move up to six degrees-of-freedom (6-DoF). Unlike traditional cinematic content, 6-DoF VR/AR allows movement in user orientation (pitch, yaw, roll) and translation (along the X, Y and Z axis in space) in the VR environment. Typical use cases for this technology could be a tour of a virtual museum, or presentation of a holiday destination before purchase. In addition, the technology includes the potential for users to interact and manipulate elements of their surroundings.

Purpose

In order to assess the performance of submitted proponent technologies, an audio evaluation platform (AEP) has been developed. Using the AEP, multiple proponent technologies can be evaluated in parallel, in real-time, whilst the user is free to fully explore the virtual and augmented reality environment.

The aim of the AEP is to allow assessors to capture <u>quantitative</u> subjective listening test data such that all aspects and experiences from a user can be considered when assessing quality for the next generation of audio coding for virtual and augmented reality.

Platform Overview

Figure 3 shows a general overview of all components necessary to conduct an evaluation. The figure is broken up into two stages of offline processing (left), and the real-time audio evaluation platform itself (right). The red line indicates the division between the two stages. The list below provides some information of all components and processing required to conduct a test. Short descriptions of each component is provided in Table 2.

Component	Description
Raw audio .WAV files.	Unprocessed audio files provided in demoAudioContent folder.
MPEG-H processing	This processing will be done by the MPEG Audio subgroup.
Config file	Configuration file to load into Max/MSP to conduct a test. This will be provided by the MPEG Audio subgroup.
PCM Data	MPEG-H decoded audio files to use within the test, provided in the decodedDemoAudioContent folder. The locations of these files are provided in the configuration file and loaded upon a new scene.
Directivity files	Directivity files for sources to be fed into each proponent renderer.
Model Files / Video data	Graphical data to be loaded into the Unity (VR) or Python (AR) software.
Scene EIFs	Encoder Input Format .xml files are a complete description of the AR/VR scene to be encoded into a bitstream.
Proponent MPEG-I encoders	Proponent dependent encoders.
Proponent Bitstreams	Proponent dependent bitstreams. These will be loaded by the respective renderers.
Max/MSP	The commercial Max/MSP software is used to run the main Max/MSP test patch provided within the GitLab repository. Start-up and operation of the correct Test patch is also discussed.
Unity (Virtual Reality)	The commercial Unity software is use to run the main Unity project. This Unity project is comprised of multiple test scenes and data. Start-up and operation of the correct start scene is also discussed.
Python controller Software (Augmented Reality)	Standalone Python software for facilitating communication between the AR headset and MaxMSP for conducting an AR test.

Table 2 - Audio Evaluation Platform Component Overview.

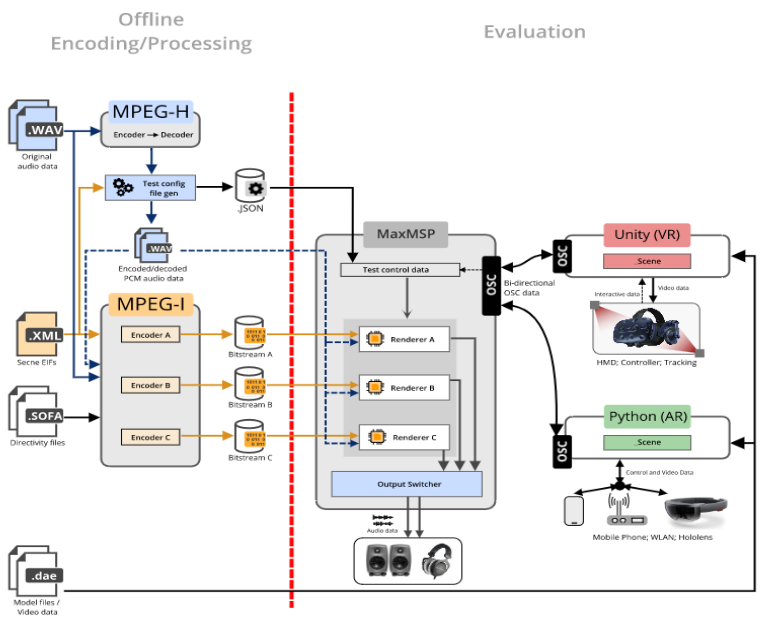


Figure 3 - Overview of Audio Evaluation Platform and Process

Output documents

N18807 - MPEG-I 6DoF Audio Encoder Input Format

N18808 - Draft Documentation for the MPEG-I Audio Evaluation Platform

N18809 - Workplan on MPEG-I Audio

N18811 - Draft MPEG-I Audio Test and Evaluation Procedures