



**ISO/IEC JTC 1/SC 29/WG 1  
(& ITU-T SG16)**

## **Coding of Still Pictures**

<b>JBIG</b> Joint Bi-level Image Experts Group	<b>JPEG</b> Joint Photographic Experts Group
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**EDITOR:** Deepayan Bhowmik, [d.bhowmik@ieee.org](mailto:d.bhowmik@ieee.org)  
Frederik Temmermans, [ftemmerm@etrovub.be](mailto:ftemmerm@etrovub.be)  
Fernando Pereira, [fp@lx.it.pt](mailto:fp@lx.it.pt)  
Touradj Ebrahimi, [touradj.ebrahimi@epfl.ch](mailto:touradj.ebrahimi@epfl.ch)

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Contact:  
ISO/IEC JTC 1/SC 29/WG 1 Convener – Prof. Touradj Ebrahimi  
EPFL/STI/IEL/GR-EB, Station 11, CH-1015 Lausanne, Switzerland  
Tel: +41 21 693 2606, Fax: +41 21 693 7600, E-mail: [Touradj.Ebrahimi@epfl.ch](mailto:Touradj.Ebrahimi@epfl.ch)

# Media Blockchain Use Cases and Requirements

## 1 Introduction

Digital rights management, privacy and security, integrity verification, authenticity, etc. are some of major challenges in the media content consumption chain. This impacts the society in several ways including the loss of income in creative sector due to piracy, spread of fake news, or evidence tampering for fraud purposes. Image data is even more susceptible as images can be easily shared in large volume, edited to distort fact or tampered to hide evidences, hindering forensic investigations. Therefore, there is a need for new standard technology to address such issues in coherent manner that is interoperable across various systems.

JPEG has determined that blockchain and distributed ledger technologies (DLT), referred as ‘blockchain’ in this document, have great potential as a technology component to address such challenges in digital media applications. However, to ensure seamless interoperability, blockchain need to be integrated with existing widely accepted standards such as JPEG. This can be achieved by introducing one or more new standard(s) related to blockchain and associated applications. Image coding and JPEG standards have certainly an important role to play when addressing media related applications.

In this context, the JPEG Committee has engaged industry, other standardisation bodies and academic experts through several workshops and an open discussion session to define use cases and requirements to identify and drive potential future standardization projects on blockchain for media related applications (referred as ‘media blockchain’ here). These requirements might be addressed inside or outside the scope of the JPEG Committee, depending on their focus.

## 2 Background

JPEG is the most dominant still image coding format across the world. The JPEG Committee continues to work on improving various aspects of the original JPEG coding standard as well as later standards such as JPEG 2000, JPEG XR, JPEG XT and JPEG XS. This includes incorporation of new technologies addressing current challenges in media applications.

Blockchain emerge as useful technologies for multiple application domains. Recently noticeable interests were observed in industries as well as in academia using blockchain as a solution to transparent media distribution, traceability, copyright management and verification of data integrity and authenticity among other key media applications.

Therefore, the JPEG Committee decided to identify and explore use cases and standardization needs related to blockchain technology in a multimedia context. This exploration included the organisation of several workshops and an open discussion session to engage with the industry:

- 1<sup>st</sup> JPEG Workshop on Media Blockchain Proceedings, ISO/IEC JTC1/SC29/WG1, Doc. WG1N81033, Vancouver, Canada, October 16<sup>th</sup>, 2018.  
[https://jpeg.org/items/20181023\\_blockchain\\_workshop\\_vancouver.html](https://jpeg.org/items/20181023_blockchain_workshop_vancouver.html)
- 2<sup>nd</sup> JPEG Workshop on Media Blockchain Proceedings, ISO/IEC JTC1/SC29/WG1, Doc. WG1N82017, Lisbon, Portugal, January 22<sup>nd</sup>, 2019.  
[https://jpeg.org/items/20190201\\_blockchain\\_workshop\\_lisbon.html](https://jpeg.org/items/20190201_blockchain_workshop_lisbon.html)
- 3<sup>rd</sup> JPEG Workshop on Media Blockchain Proceedings, ISO/IEC JTC1/SC29/WG1, Doc. WG1N83044, Geneva, Switzerland, March 20<sup>th</sup>, 2019.  
[https://jpeg.org/items/20190325\\_blockchain\\_workshop\\_geneva.html](https://jpeg.org/items/20190325_blockchain_workshop_geneva.html)
- 4<sup>th</sup> JPEG Workshop on Media Blockchain Proceedings, ISO/IEC JTC1/SC29/WG1, Doc. WG1N84024, Brussels, Belgium, July 16<sup>th</sup>, 2019.  
[https://jpeg.org/items/20190724\\_blockchain\\_workshop\\_brussels.html](https://jpeg.org/items/20190724_blockchain_workshop_brussels.html)

- Open discussion session on Media Blockchain Proceedings, ISO/IEC JTC1/SC29/WG1, WG1N86024, Sydney, Australia, January 21<sup>st</sup>, 2020.

[https://jpeg.org/items/20200130\\_blockchain\\_discussion\\_proceedings.html](https://jpeg.org/items/20200130_blockchain_discussion_proceedings.html)

A whitepaper, entitled “Towards a Standardized Framework for Media Blockchain”, was produced with the objective to: a) discuss industrial needs based on existing solutions; b) identify relevant standardisation activities in blockchain; c) define use cases and functionalities for media blockchain; and d) provide an outline for potential requirements in standardisation of media blockchain within and outside JPEG. Additionally, this paper also provides background and generic descriptions of relevant JPEG activities and blockchain as a distributed ledger technology. The whitepaper is available at <https://jpeg.org/static/whitepapers/jpeg-media-blockchain-whitepaper.pdf>

### 3 Use Cases

Based on the exploration activities of media blockchain and outcomes of the workshops, the JPEG Committee has identified two categories of use cases: a) enabling trust, privacy and security in the media consumption chain; and b) empowering transparent and trusted media distribution ecosystem in the creative sector. The first category advocates that the media blockchain can provide an efficient solution to issues related to trust, privacy and security in the consumption chain, while the latter advocates the media blockchain can provide a transparent and trusted media distribution ecosystem empowering creative content creators or publishers. Along with these two categories, four user groups have also been identified: a) content creators; b) publishers; c) consumers; and d) digital archives.

Example use cases are described below for further understanding of the required functionalities which help to develop the technological requirements. The use cases are selected to maximise the coverage. However, there is no intention to exclude other application scenarios that are not part of this document. In this document, a ‘functionality’ refers to a capability that is offered to a user in the context of an application, whereas a ‘requirement’ refers to the technical needs associated with the facilitation to users of the corresponding functionalities.

#### 3.1 Pictures without permissions

**Scenario:** Content creators such as commercial/amateur photographers, photo journalists, photo bloggers, or fashion photographers spend significant amount of time and money on creating valuable image content that has potential for monetization. A licensed version of the content appears online as part of a blog or an article. Once appeared online, several other users use those content for their own purposes (commercial or free posts) without acknowledging or paying any royalty to the original content creator.

##### **Required functionalities:**

1. Capability of automatically detecting unauthorized usage of media content.
2. Capability to establish copyright of an original content:
  - a. Is it copyrighted?
  - b. Who owns the copyright?

#### 3.2 Authentication and integrity verification for forensic evidences

**Scenario 1:** A crime scene is recorded through a series of pictures for investigation purposes. However, image editing tools are used to tamper the evidence.

**Scenario 2:** Spreading of fake news/rumor through doctored media has emerged in recent years due to availability of sophisticated photo editing tools as well as digital platforms with million user bases. This can be for a number of reasons, including spreading hatred, terrorism, scaremongering or gaining political advantages.

**Scenario 3:** Use of surveillance cameras in public and private space has increased considerably with the availability of cheaper hardware and higher bandwidth to transfer the content. In a number of occasions, surveillance footages are used in the court to prosecute criminals. Evidences can be tampered through editing software by deleting part of the footages or carefully removing part of the scene to cover up a crime.

**Required functionalities:**

1. Capability to easily verify the integrity of an image.
2. Capability to identify the original source (device or creator).

### **3.3 Advertisement fraud and advertisement copyright infringement**

**Scenario:** Advertisement frauds are one of the major concerns and, according to a report from Juniper Research, advertisement fraud will rise significantly, reaching USD 44 billion by 2022. There are two pathways envisaged in the advertisement fraud: 1) advertising platforms restrict advertisement performance data to advertisers and hence can falsify the data to their customer; and 2) fraudsters simulate clicks, mouse activity and fake social network accounts using bots to inflate the numbers.

**Required functionalities:**

1. Capability to share advertisement performance data in a transparent and trustable fashion.
2. Capability to correctly identify genuine users from bots.

### **3.4 Security of medical image content**

**Scenario:** Medical images are crucial and confidential assets for national health trusts or any clinic. Thus, security and reliability of such content at large scale is important for fundamental patients' needs, legal purposes and protection from cyber-attacks.

**Required functionalities:**

1. Capability to securely maintain medical images robust against system failure and cyber-attacks.
2. Capability to provide trust and transparency to various stakeholders who access medical image records.

### **3.5 Authenticity and copyright protection in GLAM sector**

**Scenario:** The GLAM (Galleries, Libraries, Archives and Museums) sector deals with a large amount of digital content. GLAM services face issues related to intellectual property rights (IPR) for access and usage control to authenticity including fake images and tampering.

**Required functionalities:**

1. Capability to facilitate privacy policies or rules and IPR conditions for controlled usage / access to the content.
2. Support for easy copyright transfer and licensing to various stakeholders.
3. Capability to identify copyright infringements.

### **3.6 Content ownership and monetization**

**Scenario 1:** Publishers have an archive of existing content and like to reach out to larger audience and monetize it automatically.

**Scenario 2:** Content creators are interested in registering copyright of their media content and make their work discoverable so that they reach easily to the end users or the publishers and hence monetize.

**Scenario 3:** Content creator and publishers like to manage their digital rights and licensing information in an easy and reliable way. They like to have very easy and flexible licensing agreement with the end user. They also want the DRM to be time stamped so that they cannot fall as a fraud victim.

**Required functionalities:**

1. Capability to claim copyright and license the content automatically / programmatically to new sources of buyers.
2. Capability to curate content from partners for resell in a transparent and trusted way.
3. Capability to record and share DRM information with other users.
4. Capability to time stamp copyright / ownership information in an immutable manner.

### **3.7 Privacy preserved incentivised media consumption chain**

**Scenario 1:** End users want to browse all media content from a single platform and pay once for each unique content from whatever sources they are coming from. They will save time and money by browsing through single platform.

**Scenario 2:** Publishers / content producers use a common platform (content aggregator) to reach out wider audience as the common platform might be known to end users compared to individual websites etc. However, they will need a transparent auditing system.

**Scenario 3:** Advertisers like to gather end user behavioural data (along with other attributes such as location, age, gender etc.) from a single source for targeted personalised advertisement.

**Scenario 4:** The end users like to be incentivised through micropayment or similar mean for sharing their behavioural data as opposed to current free data sharing model.

**Required functionalities:**

1. Capability to aggregate content from various sources transparently.
2. Capability to gather behavioural data (aggregation) such as information related to image category, metadata (e.g., through JPSearch) and privacy preserved statistic creation (e.g., person's anonymised attributes rather than identity) based on content browsing history, time, location etc.
3. Capability to incentivise users through micropayments / tokens (for controlled access to high resolution content) as a value for their behavioural profile in a transparent manner.

### **3.8 Provenance / Copyright verification**

**Scenario:** End user wants to verify the provenance, copyright or ownership before making a purchase / licensing.

**Required functionalities:**

1. Capability to verify the copyright information supplied by the seller.
2. Capability to verify the provenance of an asset.

### **3.9 Collaborative work environments / Stakeholder recognition**

**Scenario:** Commercial artworks or professional media content often involve a number of stakeholders including photographer, scene writer, models, makeup artists, designers, post processing experts, distributors, publishers, etc. Often their contributions are not recognised once the content is distributed. In this scenario the stakeholders want to claim royalty (pro rata) and / or get recognised.

**Required functionalities:**

1. Capability to record stakeholders' contribution.
2. Capability to distribute royalty earnings to the stakeholders according to their individual contribution in the form of micropayment in real time.
3. Capability to record post processed derived contents with version control in transparent and trustable manner.

## **4 Requirements**

Requirements for potential media blockchain standardization projects are drawn from the use cases as identified in the previous section and described in below. In this context, the expression "the standard" can imply a new or existing JPEG standard or a blockchain related standard existing or newly defined by another relevant standardisation committee. It is envisaged that some of the listed requirements may be satisfied by the components of an existing standard, JPEG or not; the remaining requirements may require the development of a new standard, JPEG or not. The following list of requirements is not necessarily complete and thus it is amenable to future extension.

### **4.1 Digital rights management**

- The standard shall provide mechanisms to create and manage rights of media assets through blockchain.
- The mechanism shall be globally accepted and seamlessly accessible in an inexpensive way.
- The mechanism shall ensure to generate and maintain digital rights of the asset at a global scale conforming laws of the land. This also includes certificate/license generation, distributions and management.

### **4.2 Copyright protection**

- The standard shall provide provisions to securely preserve copyrights information.
  - NOTE: Preservation should consider information within the media as well as trusted infrastructures from where the data can be retrieved easily.
- The mechanism shall provide means to preserve any historical copyright transfer information in an immutable way.

### **4.3 Integrity**

- The standard shall provide mechanisms to verify the integrity of the media content in question.
  - NOTE: Use case for this requirement include fake news and doctored media, where it is important to have a mechanism to verify the integrity of the media in question.

### **4.4 Authenticity**

- The standard shall provide means to support source verification and ownership authentication.
  - NOTE: The source verification may include camera sensor identification, time stamp information of capturing, processing or publishing.
  - NOTE: Ownership authentication should allow users to associate media content to its unique owner.

### **4.5 Traceability**

- The standard shall provide mechanism to trace the modifications and involved stake holders or identifying source of piracy.
  - NOTE: All historical record of each edit (e.g., for post-production purposes) should be available along with the information regarding responsible stake holders.

## 4.6 Privacy legislation compliance

- The standard shall provide means to comply with privacy laws.
  - NOTE: Recording assets meta information such as copyright, content signature or any other identifiable information within the blockchain can be challenging due to non-compliance of privacy regulations of different countries, e.g., GDPR in Europe.

## 4.7 Asset distribution and monetisation

- The standard shall provide provisions for protocols that can enable asset distribution and monetisation among various stakeholders.
  - NOTE: An appropriate infrastructure may enable creative content creators to distribute and monetize their assets without the need of centralised licensing organisations. Facilitation is required for a seamless creator to consumer distribution system that is transparent.
  - NOTE: The mechanism should include provisions to record information regarding contributions of each stakeholders in the process which can enable royalty distribution.

## 4.8 Contract management (smart contract)

- The standard shall provide means to support automatic contract management for media exchange without the need for involving a central authority.
  - NOTE: A tool (e.g., smart contract within blockchain) that enables automatic contract generation and exchange between the seller and the buyer.

## 4.9 Consensus model

- The standard shall provide means for consensus among the users of media blockchain for any transactions or operations to happen, e.g., media asset distribution, copyright transfer, etc.
  - NOTE: For example, a protocol that enables validation of media asset transactions across the participating stake holders in a decentralised way.

## 4.10 Content versioning

- The standard shall provide a mechanism for content versioning.
  - NOTE: A derived version of an asset should have reference to the original asset which itself can be a derived version from another content. This mechanism is useful to ensure traceability and management of the stakeholders.

## 4.11 Micropayments

- The standard shall provide tools for micropayment to all stakeholders within the asset creation and distribution chain.
  - NOTE: All stakeholders should be rewarded for their contribution. Functionality such as a scalable mechanism for micropayments is required for this purpose.

The mapping between use cases and requirements is shown in Table 1. This table is an example for illustrative purposes and does not exclude other use cases with the same requirements or additional requirements for these same use cases. This means this document and this table may be further completed in the future.

*Table 1 – Mapping between use cases and requirements.*

Use Cases ↓	Requirements →	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	4.10	4.11
Pictures without permissions		√	√			√						
Authentication and integrity verification for forensic evidences			√	√	√							
Advertisement fraud and advertisement copyright infringement		√	√			√		√	√	√		
Security of medical image content		√	√	√	√	√	√					
Authenticity and copyright protection in GLAM sector		√	√		√	√		√	√	√	√	√
Content ownership and monetization		√					√	√	√	√	√	√
Privacy preserved incentivised media consumption chain							√	√	√	√		√
Provenance / Copyright verification		√	√			√						
Collaborative work environments / Stakeholder recognition		√						√	√	√	√	√

## 5 Scoping the requirements

In terms of future standardization projects, the requirements identified above may be grouped into three main categories:

1. Requirements to be addressed by extending the existing JPEG standardization framework
2. Requirements to be addressed by a new JPEG standard
3. Requirements to be addressed outside the remit of JPEG by extending an existing standard or developing a new standard.

Further decomposition of the requirements might be necessary to identify their final scoping. However, the following sub-sections gave an initial indication where the requirements could be addressed according to the categories above.

### 5.1 Requirements extending existing JPEG standards

The requirements:

- Digital rights management (4.1)
- Integrity (4.3)
- Privacy legislation compliance (4.6)

can be satisfied (fully or partially) by the JPEG Privacy and Security standard. However, this does not exclude possibilities of future enhancements. The Privacy and Security standard may be extended with informative examples that illustrate how to use the standard to satisfy these use cases.

### 5.2 Requirements with potential for a new JPEG standard

The requirements:

- Authenticity (4.4)
- Traceability (4.5)
- Asset distribution (part of 4.7)
- Consensus model (4.9)

- Content versioning (4.10)

may justify a new JPEG specification. Additionally, requirements for digital rights management (4.1) and contract management (smart contract) (4.8) may need either extensions to existing standards or a new standard within the remit of JPEG media blockchain.

### **5.3 Requirements to be addressed outside JPEG**

The requirements

- Copyright information protection (4.2)
- Contract management (smart contract) (4.8)
- Monetisation (part or 4.7) and
- Micropayments (4.11)

need a blockchain architecture which can be agnostic to media assets and, therefore, have their main scope outside of JPEG standardization. Nonetheless, for seamless interoperability these requirements may need standardized interfaces particular to media applications that find their scope within JPEG.