JPEG White paper:

Towards a Standardized Framework for Media Blockchain and Distributed Ledger Technologies

An initiative exploring opportunities in media blockchain and distributed ledger technologies and impacts on JPEG standardization.

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Editors:
Frederik Temmermans, imec – Vrije Universiteit Brussel, Belgium
Deepayan Bhowmik - University of Stirling, United Kingdom

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Executive Summary

Fake news, copyright violation, media forensics, privacy and security are emerging challenges in digital media. JPEG has determined that blockchain and distributed ledger technologies (DLT) have great potential as a technology component to address these challenges in transparent and trustable media transactions. However, blockchain and DLT need to be integrated closely with a widely adopted standard to ensure broad interoperability of protected images. JPEG calls for industry participation to help define use cases and requirements that will drive the standardization process.

1. Introduction

JPEG (Rec. ITU T.81 | ISO/IEC 10918) is the most dominant still image format across the world[1] and the standardization committee continues to work on improving various components of the standard. This includes incorporation of new technologies addressing current challenges related to transparent and trustable media transactions such as JPEG Privacy and Security[2].

Blockchain, on the other hand, emerges to be a useful technology for many applications that require accountability of transactions [1]. Recently noticeable interests were observed in industries as well as in academia using blockchain as a solution to transparent multimedia distribution, copyright management and verification of media integrity for authentication [2], [3]. The main aim of this white paper is to explore opportunities in media blockchain and DLT to understand their impacts on JPEG standardization, for instance in addressing privacy and security issues.

During its 78th JPEG meeting (February 2018), the JPEG committee organized a special session on blockchain and its impact on JPEG standards. As a result, the committee decided to explore use cases and standardization needs related to blockchain technology in a multimedia context. JPEG is actively seeking inputs from experts to define these use cases and to explore eventual needs and advantages to support a standardization effort focused on the application of blockchain in media[3].

At its 81st JPEG meeting (October 2018), the first of a series of workshops was held with presentations from different stakeholders to start the dialog regarding the importance of blockchain and DLT in media applications and relevance to standardization. The proceedings of the workshop are accessible from the JPEG website (include the link here).

JPEG Privacy and Security aims at defining a new standard to increase the reliability of encoded images and associated metadata. Features of this standard are expected to enable applications and services that have better protection ability of image content on digital publishing, image sharing, and content distribution via the Internet. The features are classified into two basic categories: protection and authenticity which are achievable using tools such as encryption and watermarking technologies to protect parts of any type of JPEG images and/or associated metadata. Authenticity is an essential feature in many use cases to ensure and check the integrity of image data and/or embedded metadata to establish the rightful claim of all stakeholders of any digital asset. Together these features also enable trust among the users in the backdrop of emerging fake image/news related issues.

The realisation of those expected features could potentially be achieved using the emerging blockchain technology which can provide a tractable and scalable solution through a

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1 https://jpeg.org/jpeg/index.html
2 https://jpeg.org/items/20150910_privacy_security_summary.html
3 https://jpeg.org/items/20180213_press.html

distributed and tamper-proof media transaction framework. Use cases from industry as well academia are emerging that employ blockchain as the core platform for media distribution.

The main objectives of this white paper are: a) to discuss industrial needs based on existing usage cases, b) identifying relevant standardisation activities in blockchain and c) explore the role JPEG can play in standardisation of media blockchain. Additionally, this paper also provides background and generic description of relevant JPEG activities and blockchain as a distributed ledger technology.

2. Background: relevant JPEG activities

This section provides a generic overview of JPEG in general and a brief description of JPEG activities relevant to the aim and objectives of this white paper.

2.1 JPEG

JPEG is the image coding format of choice for applications as diverse as photography, web, medical imaging, and public records, named after the original International Standards Organization (ISO) / International Telegraph and Telephone Consultative Committee (CCITT) Joint Photographic Experts Group, established in November of 1986. The group developed the technique in the late 1980s and produced the international standard, formally known as Int'l Telecommunication Union (ITU)-TT.81, in the early 1990s [4].

The JPEG standard (ISO/IEC 10918) was created in 1992 (latest version, 1994) as the result of a process that started in 1986. Though this standard is generally considered as a single specification, in reality, it is composed of four separate parts and an amalgam of coding modes. Part 1 of JPEG (ISO/IEC 10918-1 | ITU-T Recommendation T.81) specifies the core coding technology and it incorporates many options for encoding photographic images. Part 2 defines the compliance testing. Part 3 defines a set of extensions to the coding technologies of Part 1, and via an amendment, the SPIFF file format was introduced. Part 4 focuses on the registration of JPEG profiles, SPIFF profiles, SPIFF tags, SPIFF color spaces, SPIFF compression types, and defines the Registration Authorities. And lastly, Part 5 specifies the JPEG File Interchange Format (JFIF). Without any doubt, it can be stated that JPEG has been one of the most successful multimedia standards defined so far. JPEG (Rec. ITU T.81 | ISO/IEC 10918) is still the most dominant still image format around[4].

2.2 JPEG Systems Layer

In addition to the original JPEG file format (ISO/IEC 10918-1), which recently celebrated its 25th anniversary, the JPEG committee has introduced several other image standards, such as JPEG 2000 (ISO/IEC 15444-1), which has been successful in several markets such as digital cinema, broadcasting (content distribution networks), medical imaging, remote sensing and archival.

[4] https://jpeg.org/jpeg/index.html

New initiatives for image coding are currently ongoing such as JPEG XS, JPEG Pleno and JPEG XL. While each format has its own purpose, there are still common features across these various formats. For this reason, JPEG initiated the JPEG Systems (ISO/IEC 19566) activity with the main aim to align system related features across JPEG standards.

The original JPEG file format supported APP marker segments to allow for new features or embed additional information into images. APP marker segments are used for example to embed EXIF metadata. JPEG 2000, on the other hand, uses a more modern box format. This is a flexible syntax where additional information or features can be encapsulated in a binary structure. The box format is also used by various other media formats such as JPEG XR (ISO/IEC 15444-2:2004/AMD3:2015) and MPEG-4 (ISO/IEC 14496-12).

To align the APP marker segment and box based approaches, the JPEG XT file format defines a structure to embed boxes into APP11 app marker segments. This allows to define system level boxes that can be used consistently in all formats. In addition, new functionalists and frameworks can be built on top of this generic notion of boxes.

In the past, several alternatives have been used to embed metadata in JPEG images. Unfortunately, not all have been standardized, leading to a fragmented scene that can lead to inconsistencies or metadata that is not retained when transferring images from one application to another.

While JPSearch introduced a uniform way to embed any type of metadata, it also imposes some additional restrictions. For example, it is required that an image should embed at least a JPSearch Metadata Schema instance. In addition, JPSearch was defined years before JPEG Systems and JPEG XT and uses APP3 marker segments with a custom format to embed metadata. Therefore, JPEG decided to define a JPEG Universal Metadata Box Format (JUMBF). JUMBF allows to embed any type of metadata in all box based JPEG file formats as well as the original JPEG format using the JPEG XT approach.

Many new image features (e.g. 360) are heavily metadata driven and often combine metadata and associated image data. Therefore, on top of an embedding syntax, JUMBF provides a mechanism to reference metadata via URLs. This allows to make references from textual metadata (such as XML) to associated image metadata.

2.3 JPEG Universal Metadata Box Format (JUMBF)

JUMBF defines a generic box that can encapsulate any type of metadata (textual or binary) and provides a mechanism for referencing via a URL schema. A JUMBF box provides additional information about the type of metadata that is embedded and can associate a label to be used for referencing.

The JUMBF specification defines how to embed common types of metadata such as XML, JSON, UUID boxes and image codestreams. In addition, other standards or third-party applications can define their own types for dedicated use cases. For example, JPEG 360 (ISO/IEC 19566-6) defines a custom type to embed 360 metadata as well as associated image data. The same approach is followed by JPEG Privacy and Security.

It is quite common that new extensions rely on a combination of textual metadata and binary image data. In these cases, there is a need for a way to reference the binary image data from the textual metadata. Therefore, JUMBF allows associating a text label to its content. JUMBF defines a URL schema that can then be used to make references from within the image or to make an external reference or request directly to the embedded metadata rather than to the encapsulating image. As an alternative to textual labels, JUMBF also supports binary IDs as a more efficient alternative for binary formats that need references.

2.4 JPEG Privacy and Security

JPEG Privacy & Security aims at developing a standard for realizing secure image information sharing, capable of ensuring privacy, maintaining data integrity and protecting intellectual property rights. This activity is not only intended to protect private information carried by images – *i.e.* in the image itself or its associated metadata – but also to provide degrees of trust while sharing image content and metadata based on individually set policies.

Every use case needs specific dedicated protection tools. For example, in some cases, invisible watermarks or fingerprints could be more suited than traditional encryption. However, it is important to note that JPEG does not intend to standardize any of the underlying technologies but rather aims to formalize the way these are signalled and applied to JPEG images. As such, users will have the flexibility to choose and adopt the tools best suited to their specific scenarios. When defining the signalling syntax, backward compatibility with the legacy JPEG and JPEG 2000 code streams will be provided as well as with other existing standards and frameworks (e.g. those by SC 27, SC 29, and W3C).

The features are classified into two basic categories: protection and authenticity. Protection features include:

- protection tools to protect parts of any type of JPEG images and/or associated metadata independently, while ensuring backward and forward compatibility with JPEG coding technologies;
- handling of hierarchical levels of access and multiple protection levels for metadata and image protection;
- file carving systems (e.g. resynchronisation points).

Authenticity features encompass:

- integrity check of image data and/or embedded metadata;
- avoidance of stripping off metadata, especially IPR information;

- versioning and/or tracking changes of an image and/or associated metadata and solutions to support embedding provenance information;
- embedding of traceable information to allow identification and assessment of the master image and identify derivatives or modified versions of the master image.

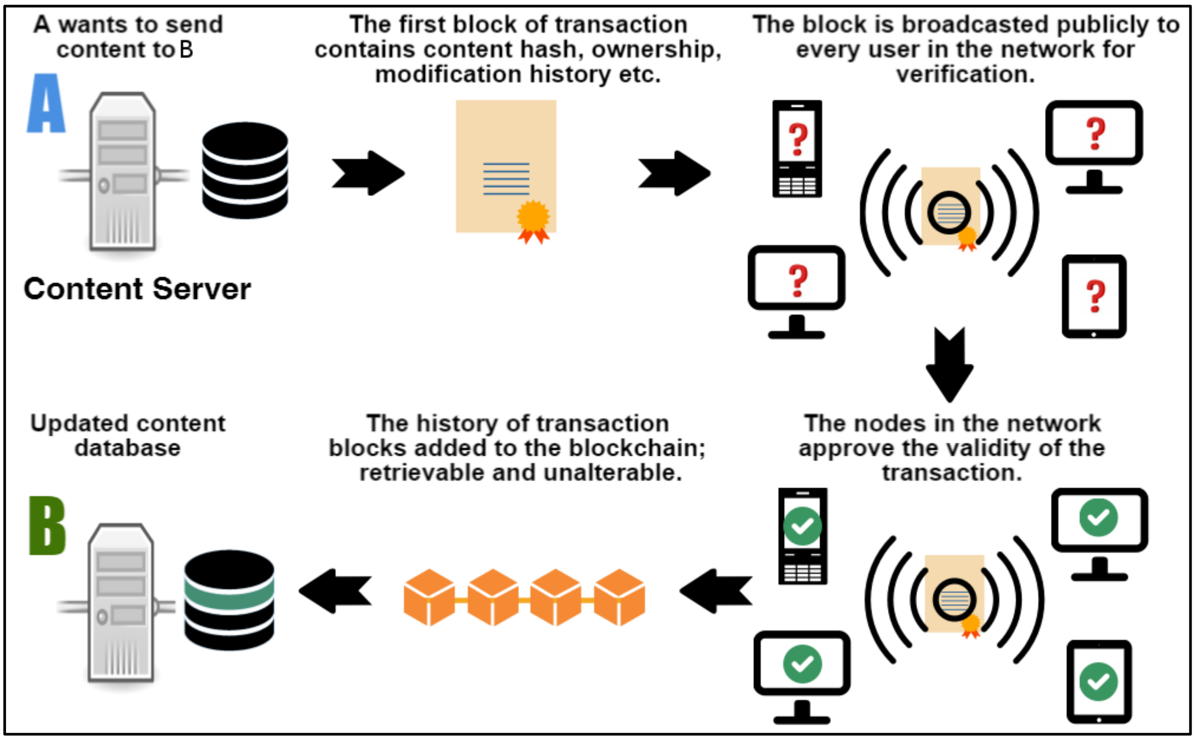

Figure 1: Overview of the blockchain working principle [2].

3. A brief overview of blockchain and DLT

This section presents a brief overview of blockchain and some of its applications related to imaging.

3.1 Blockchain and distributed ledger technology

Blockchain technology [1] is an open distributed ledger technology (**DLT**) that records details of all transactions in chained and signed 'blocks'. DLT provides a platform to record and share data in a distributed manner[5].

Blockchain is a subclass of DLT containing a particular type of data structure that allows storing and transmitting data in the form of ***blocks*** that are linked to each other in a digital ***chain***. A key component of blockchain is the use of cryptographic and algorithmic methods to record and synchronise data across all participating nodes in the network in an immutable manner. Therefore, one can conclude that all blockchains are DLTs, in fact, a specific type of

[5] http://www.worldbank.org/en/topic/financialsector/brief/blockchain-dlt

DLT. But not all DLTs are Blockchains. There are other DLTs for example, RadixDLT[6], Directed Acyclic Graph (DAG) - IOTA[7], NANO[8] etc.

Blockchain technology allows transactions to be verified without using a central organisation to process the transaction [5]. Conceptually it works by connecting or chaining blocks of information about the transactions and storing them together in a chronological order and hence called blockchain. Within a blockchain network, each record or block is timestamped, linked to a previous block and resilient to modification of the data. Therefore, blockchain is considered to be a trusted and secured mechanism for transactions between two or more entities in an efficient, verifiable and permanent way. An example is depicted in Figure 1. Increasing interests in this technology were noticed from various organisations, *e.g.,* Hyperledger[9] that intend to adopt the concept to provide a secure and publicly verifiable transaction mechanism.

3.2 Application areas

Blockchain technology is currently adopted in a number of application areas outside crypto-currency, such as, financial management (e.g., interbank payment, clearing and settlement, audit, etc.), healthcare (pharma, biotechnology and medicine), government and public sector (e.g., taxes, voting, land registry, intellectual property management etc.) and many others including manufacturing, energy, retail and supply chain management. Recently, emerging number of use cases are noticed in the multimedia domain that use blockchain for media distribution. Potential scenarios include multimedia transactions [2], hardware and software wallets, and transaction management [6]. Essentially blockchain is relevant to anything that requires transaction verification or a signature leading to authenticity and trust. Recent efforts were noticed in multimedia applications, for example by Fujimura et al. [7] where the copyright information was added as part of blockchain transaction. A multimedia blockchain framework was recently proposed [2] that keeps all records of the media transactions (e.g., ownership, licenses etc.) and offers a mechanism for tamper-proof verifiable integrity of the media enhancing trust among stakeholders.

3.3 Challenges and opportunities in media industries

Five emerging issues/challenges for creative industries that can be solved using blockchain are discussed in this subsection[10]. Particularly it indicates how the user and the small scale content creators can benefit from the new technology and recommends decentralisation of the current practice. A list of challenges and their potential solutions with the use of blockchain is paraphrased below with examples of relevant industrial products/services.

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[6] https://www.radixdlt.com/
[7] https://www.iota.org/
[8] https://nano.org/en
[9] https://www.hyperledger.org/
[10] https://thenextweb.com/contributors/2017/08/15/five-ways-blockchain-tech-going-rock-music-movie-industries/

3.3.1 Challenge 1: Access and distribution

The issue of ownership and access to digital assets is an ongoing issue and directly impacts the value of the assets and distribution of royalties to the right stakeholders. OPUS[11], a start-up powered by the Ethereum blockchain is positioning itself as the world's first decentralized music platform. With the use of Ethereum and decentralized interplanetary file system (IPFS), the platform intends to deliver thousands of tracks per second in a fully-decentralized manner. This allows storing of music tracks permanently while one can listen through smart contracts which also provides a way for end-users to compensate creators for their music.

3.3.2 Challenge 2: Global distribution

Cloud-based services such as Netflix or Spotify are often geographically restricted due to copyright restrictions/legal issues/censorship in different countries or regions. This is an issue and disadvantageous to content creators and consumers. However, the platform providers are bound by law of the land. This can potentially be solved by blockchain as proposed by DEC
ENT[12], a recently-launched platform that offers the ability for publishers to distribute their content globally through its decentralized, encrypted, secure and auditable platform.

3.3.3 Challenge 3: Commercial viability

Distribution of creative work is particularly challenging for independent or small artists who do not have full control in managing their works. Big platforms such as Spotify receive a sizable portion of the selling prices at the expense of right holders (the songwriter, in this case). While established artists may actually negotiate, independent artists often struggle in competition with everyone else in a big platform. With the help of blockchain the artists can be connected directly with fans and earn from revenues without cuts. In recent past, Imogen Heap collaborated with Ujo[13] to deliver tracks directly to fans and accepted payments in cryptocurrency.

3.3.4 Challenge 4: Managing assets and digital rights

The multi-billion dollar movie industry is currently highly-centralized and largely controlled by certain few Hollywood studios. A common issue emerged a number of times about other stakeholders not getting their fair share. The 21 Million Project[14], a startup, aims to decentralize film creation, enabling sourcing of talent, locations, and crew from across the globe, providing better transparency of the production and the distribution of box office earnings.

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[11] https://opus.audio/
[12] https://decent.ch/
[13] https://ujomusic.com/
[14] https://www.21million.co.uk/

3.3.5 Challenge 5: Combating piracy

Piracy plays a havoc on the creative industry and responsible for losses in billions every year. For movies, the copyright scenario is complex as it comprises of a collection of copyrights and titles, which span across screenplays, derivative works from books, designs, technical works, licensing from other works, merchandise etc. Blockchain can potentially address this challenge by creating an immutable record of transactions on any asset, idea, creative work etc. The transactions can be tracked during the lifetime of the assets during the ownership transfers, or assignment to players elsewhere, such as in music, television, etc. Custos Media[15], a startup, is an example that aims to keep track of digital assets like movies, eBooks and other media through blockchain technology using watermarking technology.

Payment Distribution	Digital Rights Management	Tracking of Assets	Asset Integrity Verification
• Use case #1	• Use case #1	• Use case #2	• Use case #2
• Use case #3	• Use case #2	• Use case #4	
• Use case #5	• Use case #4	• Use case #5	

Figure 2: Use case categories of multimedia distribution using blockchain

4. Example usage cases relevant to multimedia

In this white paper, we captured existing usage cases of ***Blockchain*** on multimedia and imaging applications acknowledging multiple dimensions such as payment distribution, digital rights management, asset tracking, media integration verification, etc. This section discusses five such usage cases related to multimedia blockchain. While all cases are focused on multimedia distribution as the primary application area, different challenges were attempted to be addressed leveraging blockchain technology. The challenges are categorised and depicted in Figure 2 and further discussed below.

4.1 Usage Case #1: KODAKOne and KODAKCoin

KODAKOne[16] image rights management platform and KODAKCoin, a photo-centric cryptocurrency to empower photographers and agencies are aiming to take greater control in image rights management using Blockchain technology. It intends to have a digital ledger of rights ownership for photographers to register both new and archive work that they can then license within the platform.

[15] https://custostech.com/
[16] https://kodakone.com/

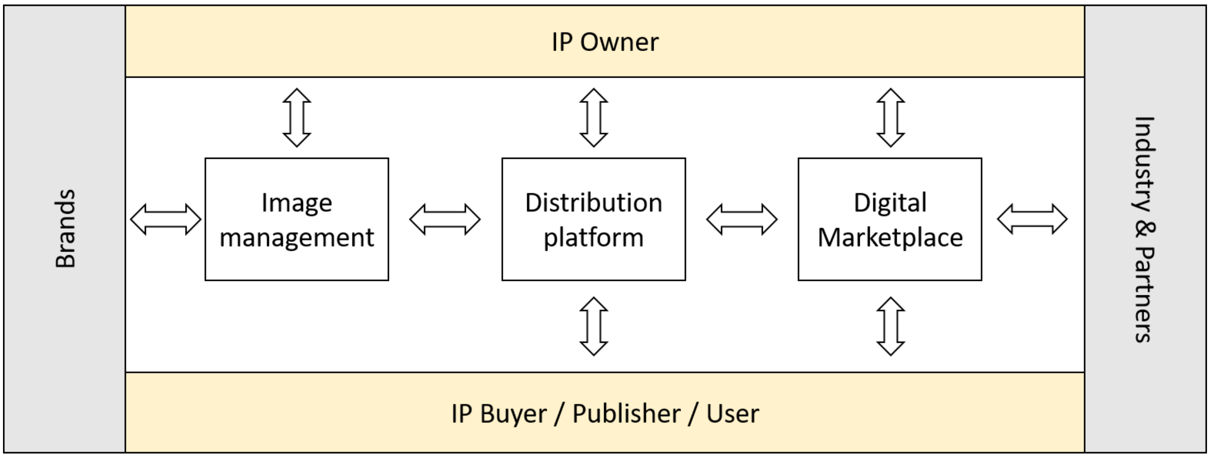

Figure 3: Overview of KODAKOne blockchain platform.

The main objective of KODAKOne is to provide a platform to the photographers for easily uploading of images to a cloud infrastructure and enable them blockchain-rights protected and commercially licensable. An overview of this platform is shown in Figure 3. This could potentially open up opportunities for photographers, image agencies and photo archive companies. With KODAKCoin, participating photographers can receive payment for licensing their work immediately upon sale. It also expects to continuously crawl the web to monitor and protect the IP of the registered images. KODAKOne Platform intends to enable WENN Digital to track licensing and illegal uses of the images.

This platform also pitched that there is an industry-wide lack of transparency means that photographers are not able to verify their royalty statements. Therefore this platform can address this issue by using the to-be-developed blockchain accounting and contracting system where every transaction and license agreement will be immutably stored in our decentralized registry.

4.2 Usage Case #2: The multimedia blockchain framework

A distributed and tamper proof media transaction framework is proposed based on the blockchain model [2]. The authors described a proof of concept where the blockchain contains copyright related information about the images and produces a cryptographic hash for every transaction. Current multimedia distribution does not preserve self-retrievable information of transaction trails or content modification histories. For example, digital copies of valuable artworks, creative media and digital archives (e.g., books) are distributed for various purposes including exhibitions, library archival or gallery collections. In another scenario, original media (document, image or video) is often edited for creative content preparation or tampered with to fabricate false propaganda over social media.

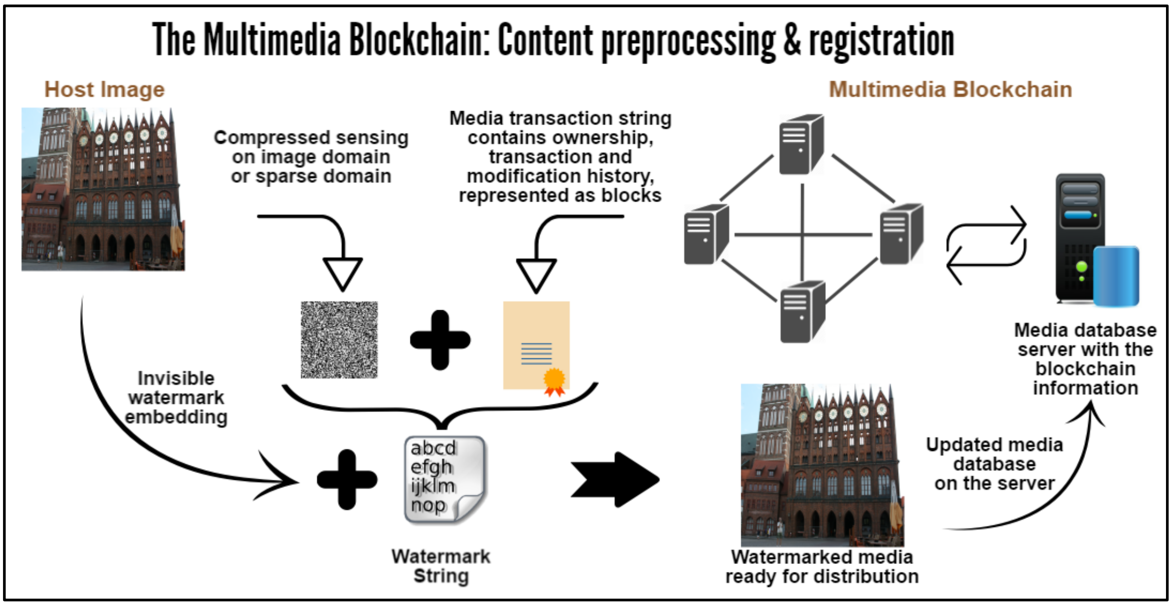

Figure 4: Overview of the multimedia blockchain framework [2].

There is no existing trusted mechanism available that can easily retrieve either the transaction trails or the modification histories. This work proposes a watermarking based Multimedia Blockchain framework that can address such issues. The unique watermark information contains two pieces of information: a) a hash containing transaction histories (blockchain transactions log) and b) an image signature preserving retrievable original media content. Once the watermark is extracted, the former segment is passed to a distributed ledger that can retrieve the historical trail and the latter part is used to locate and reconstruct the edited/tampered regions. The reconstruction of the original content is achieved by finding an optimal solution using a compressive sensing algorithm. The concept is shown in Figure 4. This work outlines the requirements, the challenges and demonstrates the proof of the concept.

4.3 Usage Case #3: *Current*: An incentivized, blockchain enabled multimedia ecosystem

Current[17], a blockchain (Ethereum) based platform, is creating a digital token that uniquely rewards a person's time, money spent, and data shared during the media streaming experience. It intends to consolidate popular media networks into one place which effectively allows users to purchase a broad range of products, services, and in-platform advertising. Current already provides more than 900,000 users with a more convenient search and discovery experience. This platform intends to combine and exploit behavioural data such as the types, times, and topics played by each person across multiple networks to serve up better recommendations.

The use of blockchain technology aimed at transparent accounting that is needed for the instant valuation of time, data, and attention. The platform claims that consumers get more

[17] https://cdn.current.us/whitepaper.pdf

choice in how they pay for media; creators and curators get a new form of compensation, and advertisers get more transparent accounting and audience information. The protocol interacts within the *Current* platform in addition to any other host media network. This introduces a new revenue stream and incentive mechanism for the host network giving it the ability to scale effectively. Over time, developers will leverage the identity profiles created for future blockchain based systems.

The main objective of the *Current* protocol is to facilitate transfers of value between media services by partnering with media networks. The blockchain will play a central role by capturing user activities at the conclusion of a track play, analyzing the play for legitimacy and fraud detection then, applying a series of network and individual influenced coefficients. This will derive a reward value using the credit system within *Current*'s platform.

4.4 Usage Case #4: Blockchain for JPEG images tracking

JPEG images may be traded for different commercial purposes. The most basic option is to sell an image to someone just for viewing or printing it, for instance when it comes to a high quality image. But one can also think about other commercial purposes, like modifying the original image to redistribute it later.

In any case, blockchain technology may be used to facilitate JPEG images tracking for different commercial purposes, like the ones already described. A blockchain may be created to follow the track of the different transactions taking place along the life cycle of an image.

This idea could be implemented by adding a new block when every transaction is done over a specific image, as shown in Figure 5. In the basic case, blocks are added for every new transaction in which the image is not changed. However, a transaction allowing the modification of an image may imply the creation of a new JPEG image, even though it is just a modification of the previous one. In this case, it is probably better to create a new branch of the original blockchain, separating at this moment the transactions on the original image to those on the newly created image, while maintaining their relationship.

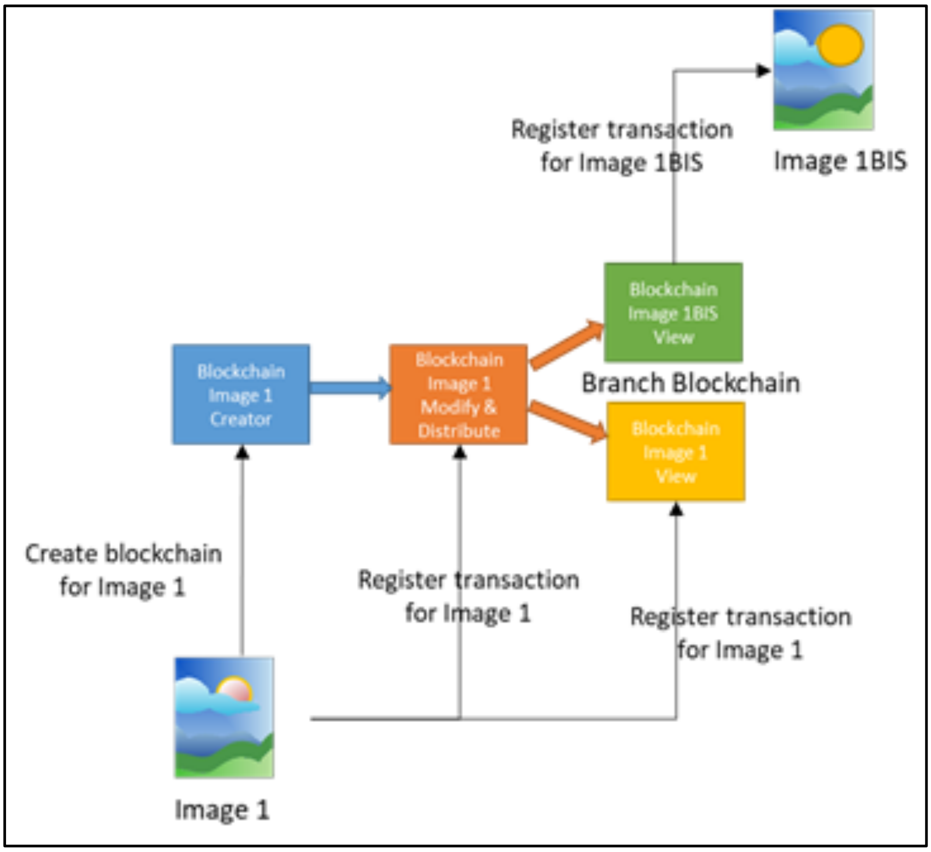

Figure 5. Blockchain for tracking JPEG images transactions

The tracking may be used for any transaction selling or transferring rights over the image. The representation of the "contract" associated to the transaction may be done by different means, like licenses or privacy rules, depending on how the image is managed. It is worth noting that the blockchain should store an immutable reference to the image (for instance, the hash of the image) and it can be easily detected if it has suffered any unauthorized modification. Of course, the blockchain should allow to certify if a specific transaction has been done.

4.5 Usage Case #5: OpenstreetVR: A blockchain based 360 image view for virtual reality (VR)

openstreetVR (OVR) is a geo-located street level WebVR based online community that relies on a custom designed blockchain and eco-power friendly, highly scalable, decentralized, merit based consensus engine for content identification, tracking and transfer of 360 panorama stills, videos and soon live streams XR media (Virtual, Augmented and Mixed Reality). Uploaded content is converted to JPEG2000 (J2K) format allowing real time Region of Interest (ROI) extraction and display of ultra high resolution (>8K) images to VR headsets ensuring a truly immersive experience. OVR is built using Babylon.js (a high performance, GPU enabled, open source WebVR gaming engine) allowing display of animated virtual objects integrated with 360 content directly in the Windows Edge browser without the need for a custom app. OVR rewards users with geoStreet tokens for capturing and uploading street level 360 views of the world's 39 million kilometres of roadways and paths.

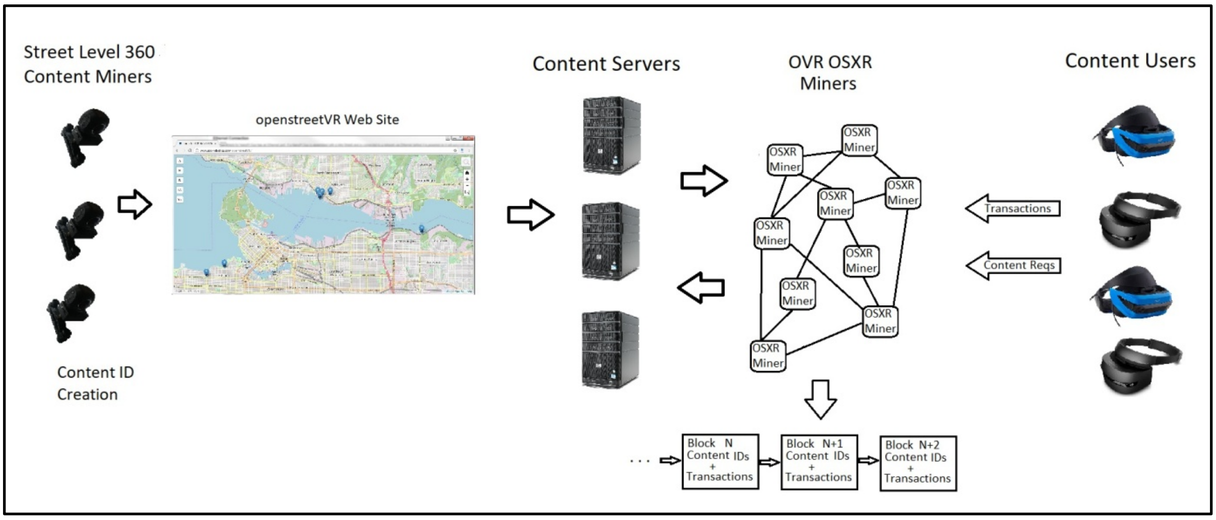

Figure 6: OVR geo-located VR content blockchain plant

OVR implements a blockchain to lock down and track all content transactions on the site and a cryptocurrency to incentivize users for creating the immersive 360 street level content. OVR blockchain miners are rewarded OSXR coin for maintaining the ledger of uploaded content and token transactions. A geoMarket token powers the e-commerce side of the site. The overall workflow is depicted in Figure 6.

5. Current blockchain standardisation efforts and initiatives

There are a few standardization efforts and initiatives carried out to provide internationally approved specifications for blockchain and distributed ledger technologies. However, none of them are particularly focusing on applications to media. This section briefly describes these standardisation activities and initiatives.

5.1 ISO TC 307 Blockchain and distributed ledger technologies

The ISO TC 307 on blockchain and DLT is the main technical committee that aims to set the future course of standardization in blockchain, DLT and related areas. This TC was created in 2017 by ISO and has its secretariat in Australia. The TC currently has 35 participating and 13 observing members. This consists of five key study groups for standard development including reference architecture, taxonomy and ontology, use cases, security and privacy, identity and smart contracts. The TC covers a relatively large scope of activities. Current SGs and WGs under TC307 are:

ISO/TC 307/CAG 1	Convenors coordination group
ISO/TC 307/JWG 4	Joint ISO/TC 307 - ISO/IEC JTC 1/SC 27 WG: Blockchain and distributed ledger technologies and IT Security techniques
ISO/TC 307/SG 2	Use cases
ISO/TC 307/SG 6	Governance of blockchain and distributed ledger technology systems
ISO/TC 307/SG 7	Interoperability of blockchain and distributed ledger technology systems
ISO/TC 307/WG 1	Foundations
ISO/TC 307/WG 2	Security, privacy and identity
ISO/TC 307/WG 3	Smart contracts and their applications

Currently, the objectives are to create the following specifications which are under development:

ISO/AWI 22739	Blockchain and distributed ledger technologies -- Terminology
ISO/NP TR 23244	Blockchain and distributed ledger technologies -- Overview of privacy and personally identifiable information (PII) protection
ISO/NP TR 23245	Blockchain and distributed ledger technologies -- Security risks and vulnerabilities
ISO/NP TR 23246	Blockchain and distributed ledger technologies -- Overview of identity management using blockchain and distributed ledger technologies
ISO/AWI 23257	Blockchain and distributed ledger technologies -- Reference architecture
ISO/AWI TS 23258	Blockchain and distributed ledger technologies -- Taxonomy and Ontology
ISO/AWI TS 23259	Blockchain and distributed ledger technologies -- Legally binding smart contracts
ISO/NP TR 23455	Blockchain and distributed ledger technologies -- Overview of and interactions between smart contracts in blockchain and distributed ledger technology systems
ISO/NP TR 23576	Blockchain and distributed ledger technologies -- Security of digital asset custodians
ISO/NP TR 23578	Blockchain and distributed ledger technologies -- Discovery issues related to interoperability

5.2 CEN-CENELEC Focus Group on blockchain and distributed ledger technologies

CEN and CENELEC have been supporting Europe's digital transformation for many years, producing European Standards and ICT standardization solutions in various sectors such as manufacturing, machinery, energy, health or transport. In light of this, and in order to contribute even more actively to our stakeholders' digital transformation, CEN and CENELEC have created a new CEN-CENELEC Focus Group on Blockchain and Distributed Ledger Technologies (DLT).

Blockchain and DLT's new developments in the field of ICT promise to make great contributions to the sharing of data and the managing of transactions in a controlled manner. Blockchain and DLT technologies have a large potential to transform business operating models in the long term and can be integrated in multiple areas, with applications in the finance, insurance, energy, health, manufacturing and e-government sectors. Blockchain and DLT have also great potential to provide an infrastructure for trusted, decentralised and disintermediated services beyond the financial sector.

The objectives of the Focus Group, among others, will be to identify potential specific European standardization needs, notably in support to the current standardization activities being developed in ISO/TC 307 'Blockchain and DLT'. CEN and CENELEC look forward to contributing to the further advancement of Europe's digital transformation. The Focus Group aim to address the needs of European businesses with a particular focus on SMEs and to encourage increasing European participation in ISO/TC 307. This focus group initiated work in line with the work items of ISO/TC 307 including reference architecture, security and privacy, identity, governance, and smart contracts.

5.3 ITU-T Focus Group on Application of Distributed Ledger Technology (FG DLT)

The ITU-T focus group on the application of DLT was established in May 2017 and it is chaired by Switzerland. Its objectives are to identify and analyse DLT-based applications and services, to draw up best practices and guidelines which support the implementation of those applications and services on a global scale; and to propose a way forward for related standardization work in ITU-T Study Groups.

FG DLT will develop a standardization roadmap for interoperable DLT-based services, taking into consideration the activities underway in ITU, other standards developing organizations, forums and groups.

5.3 IEEE Blockchain initiative

The IEEE Future Directions Committee, represented by the societies of the IEEE, has approved the formation of the IEEE Blockchain initiative (BCI) effective January 1, 2018. The BCI will be the hub for all IEEE blockchain projects and activities. The BCI encompasses a comprehensive set of projects and activities supported by the following core subcommittees: Pre/Standards, Education, Conferences and Events, Community Development and Outreach, Publications, and Special Projects.

6. Next steps

The current efforts in JPEG Privacy and Security are certainly relevant to blockchain and DLT. However, a larger scope of specifications in JPEG Systems currently under development as well as past standards such as JPSEC (Secure JPEG 2000) could be also impacted. Likewise, several future standards in coding but also search, retrieval and annotation can be relevant to both blockchain and DLT. A list of such standards should be identified along with their potential relevance.

Based on the analysis made on existing standardization efforts, it seems that there are no current activities in standardization of multimedia specifications to make them more efficient to be used in blockchain nor specific architectures and tools for multimedia applications.

As far as JPEG position regarding blockchain and DLT is concerned, three potential outcomes are possible:
1) Not-active
JPEG users would integrate JPEG standards with blockchain and DLT standards without any involvement from the JPEG Committee to facilitate such an effort.
2) Reactive
JPEG Committee would refer to blockchain and DLT standards developed by other standardization groups, e.g. ISO/TC307, and would develop additional JPEG mechanisms to make the ecosystem more integrated and powerful.
3) Pro-active
In addition to reactive, JPEG Committee attempts to influence the blockchain and DLT standards developed by other standardization groups, e.g. by bringing media related uses cases, in order for these standards to become more aware of media related applications and to better respond to media related specific needs

As media contents are increasingly managed on blockchain and DLT, the issue of interoperability, tracking and exchange of such contents become important and could be addressed by the JPEG Committee.

Moving forward, JPEG identified the following steps as future activities towards a standardised framework for media blockchain applications:

Inform and engage	JPEG intends to inform and engage all relevant stakeholders about its current activity on blockchain. JPEG also plans to organise one or more workshop(s) on multimedia blockchain in future meetings.
Collect additional use cases	JPEG calls for participation from industry and other standardization committees to help and define additional multimedia use cases and requirements that will drive the standardization process.
Assess use cases	A roadmap will be defined after an in-depth assessment of the collected use cases. The assessment aims to identify key features of the multimedia blockchain use cases from both business and technical perspectives.
Define requirements	The outcome of the use case assessments will be used to define the requirements. JPEG does not intend to define requirements for a blockchain framework. Rather it seeks to define a mechanism that can provide a common interoperable format/protocol.
A decision on issuing a call for proposal	A formal call for proposals will be issued if there are enough interests and requirements of a standard or protocol are identified.

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