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Information technology — JPEG 2000 image coding system: Motion JPEG 2000 —

AMENDMENT 1: **Additional profiles for archiving applications**

Technologies de l'information — Système de codage d'images JPEG 2000: Images JPEG 2000 animées —

AMENDEMENT 1: Profils additionnels pour réaliser des applications

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Foreword

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The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

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INTERNATIONAL STANDARD
RECOMMENDATION ITU-T

Information technology – JPEG 2000 image coding system: Motion JPEG 2000

Amendment 1

Additional profiles for archiving applications

1) Clause 2 – Normative references

Add the following items to the list of the normative references:

– ISO/IEC 14496-3:2009, *Information technology – Coding of audio-visual objects – Part 3: Audio*.

– ISO/IEC 26428-1:2008, *Digital cinema (D-cinema) distribution master – Part 1: Image characteristics*.

2) Annex A

2.1) Clause A.1

In A.1, replace the following sentence:

This Recommendation | International Standard defines two profiles:

with

This Recommendation | International Standard defines four profiles:

In A.1, append the following numeration:

3) Motion Picture Archive Preservation Format. The brand 'mpap' indicates the Motion JPEG 2000 motion picture archive preservation format profile, as defined below.

4) Motion Picture Archive Access Format. The brand 'mpaa' indicates the Motion JPEG 2000 motion picture archive access format profile, as defined below.

2.2) New clauses A.3 and A.4

Add the following clauses:

A.3 Motion JPEG 2000 motion picture archive preservation format profile

For the preservation of motion picture content, the following profile is defined:

1) At least a single video track, using only JPEG 2000 visual samples is present.

2) Audio tracks may be present, as specified in Table A.1.

3) If more than one video track (e.g., different international versions or scenes) or more than one group of multi-channel audio tracks are present, the tracks shall be distinguished and selected by the `alternate_group` field. In addition, Edit Boxes (`edts`) and Edit List Boxes (`elst`) are permitted in order to create compositions of the different tracks.

4) The image codestream profile shall have `Rsiz`=7 (as specified in ITU-T T.800 | ISO/IEC 15444-1, clause A.10).

5) All color spaces are allowed, as long as they can be described with the metadata in the Colour Specification Box (`colr`) (as specified in ITU-T T.800 | ISO/IEC 15444-1, Annex I).

6) There is no restriction on frame rates.

7) The file shall be self-contained; no data references are used, and therefore all media data shall be contained within the single file.

8) The presentation shall be described by a single Movie Box (`moov`) only, i.e., fragments are disallowed.

9) The media data in the Media Data Box(es) shall be placed within the box(es) in temporal order.

10) If more than one track is present, the media data for the tracks shall be interleaved, with a granularity no greater than the greater of (a) the duration of a single 'sample' (in file format terms) or (b) one second.

11) The transformation matrices used are restricted to uniform scaling and rotation by multiples of 90°.

Table A.1 – Audio format specification for archive preservation format

Supported data format	'raw ' (optional MPEG-4 SLS).
Supported sample rates	Each Motion JPEG 2000 decoder shall support sample rates of 48 kHz, 44.1 kHz, 32 kHz and 96 kHz (as recommended in [2]). A Motion JPEG 2000 encoder can use any desired sample rate. However, without any further agreements outside the scope of this Recommendation | International Standard, correct decoding can be assumed only if the values recommended above are being used.
Supported word lengths	Each Motion JPEG 2000 decoder shall be able to correctly decode word lengths of 16 and 24 bits. A Motion JPEG 2000 encoder can use any desired word length. However, without any further agreements outside the scope of this Recommendation | International Standard, correct decoding can be assumed only if a word length of 16 or 24 bits is being used.
Channel format	Discrete (i.e., no matrix encoding).

Audio data shall be stored in a lossless manner. For this purpose the 'raw ' audio format shall be used.

All audio channels shall be organized as discrete channels. As an option, audio data can also be represented as MPEG-4 Scalable Lossless Coding (SLS) specified in ISO/IEC 14496-3 as a compressed but lossless audio format.

Metadata should be stored together with image and other media data in the same file. Metadata can consist of any combination of structural, descriptive and historical metadata. In all cases, there should be a minimum set of structural metadata stored. For image data this should consist of all information relevant to the employed JPEG 2000 encoding parameters and contain at least image size, frame rate, colour space, sub-sampling information, number and meaning of components and bit depth. For audio data this should consist at least of bit depth, sample rate, number and meaning of audio channels for each multi-channel audio representation and audio encoding standard.

Descriptive and historical metadata should be stored in an XML [9] representation.

A.4 Motion JPEG 2000 motion picture archive access format profile

The profile optimized for access to and exchange of archived motion picture content has the following characteristics:

1) At least a single video track, using only JPEG 2000 visual samples, shall be present.

2) Audio tracks may be present, as specified in Table A.2.

3) If more than one video track (e.g., different international versions or scenes) or more than one group of multi-channel audio tracks are present, the tracks shall be distinguished and selected by the `alternate_group` field. In addition, Edit Boxes (`edts`) and Edit List Boxes (`elst`) are permitted in order to create compositions of the different tracks.

4) The image codestream profile shall have `Rsiz=5` or `Rsiz=6` (as specified in ITU-T T.800 | ISO/IEC 15444-1, clause A.10).

5) The X'Y'Z' color space as defined in ISO/IEC 26428-1 shall be used and signalled in the Colour Specification Box (`colr`) (as specified in ITU-T T.800 | ISO/IEC 15444-1, Annex I).

6) There is no restriction on frame rates. If distribution to digital cinema is intended, then frame rates of 24 frames per second (fps) or 48 frames per second (fps) are recommended.

7) The file shall be self-contained; no data references are used, and therefore all media data shall be contained within the single file.

8) The presentation shall be described by a single Movie Box (`moov`) only, i.e., fragments are disallowed.

9) The media data in the Media Data Box(es) is placed within the box(es) in temporal order.

10) If more than one track is present, the media data for the tracks is interleaved, with a granularity no greater than the greater of (a) the duration of a single 'sample' (in file format terms) or (b) one second.

11) The transformation matrices used are restricted to uniform scaling and rotation by multiples of 90°.

Table A.2 – Audio format specification for archive access format

Supported data format	'raw ' (optional MPEG-4 SLS).
Supported sample rates	Either 48 kHz or 96 kHz.
Supported word lengths	Either 16 bits or 24 bits.
Channel format	Discrete (i.e., no matrix encoding), a maximum of 16 channels per multi-channel representation.

Audio data shall be stored in a lossless manner. For this purpose the 'raw ' audio format shall be used.

All audio channels shall be organized as discrete channels. As an option, audio data can also be represented as MPEG-4 Scalable Lossless Coding (SLS) specified in ISO/IEC 14496-3 as a compressed but lossless audio format.

NOTE – Metadata should be stored together with image and other media data in the same file. Metadata can consist of any combination of structural, descriptive and historical metadata. In all cases there should be a minimum set of structural metadata stored. For image data this should consist of all information relevant to the employed JPEG 2000 encoding parameters and contain at least image size, frame rate, colour space, sub-sampling information, number and meaning of components and bit depth. For audio data this should consist at least of bit depth, sample rate, number and meaning of audio channels for each multi-channel audio track and audio encoding standard. Descriptive and historical metadata should be stored in an XML [9] representation.

3) Annex B

Add the following clause:

B.4 Digital cinema archives

In this section practical guidelines for the use and application of motion picture archive formats are given. In the following paragraphs procedures are described that are meant to help in creating Archive Package files and how to use them to disseminate archived cinematic content to end users and to exchange archived materials between two or more archiving institutions. Implementations should be strict when writing, and tolerant when reading the described formats.

B.4.1 Ingesting into cinematic archives

Several ways exist to convert cinematic content to the motion picture archive formats. The content may come directly from various stages of an uncompressed digital production process or it can be a compressed digital distribution format, e.g., a Digital Cinema Package (DCP) [10].

It is also possible to ingest images originating from scanned film material as well as access copies that were created through transferring original film images to some other type of analogue or digital media, e.g., analogue or digital video tapes, digital versatile disk (DVD), etc.

a) Ingesting uncompressed digitally produced material:

Digitally produced material includes images that were recorded with an electronic camera and did not undergo any further processing, as well as the results of different processing steps during post-production to the final cinematic product. This also includes scanned films that were subject of a digital restoration process. Common formats for this type of imagery are DPX [3], TIFF [4] or TGA [5] sequences. This type of material may also have its origin on a digital video tape format that has been ingested into a computer system. This type of material should be compressed using the JPEG 2000 profile for long-term storage of cinematic content. To be able to preserve the material in its original quality, lossless compression with the 5-3 reversible filter should be used. The original colour space and bit depth should not be changed.

b) Ingesting compressed Digital Cinema Packages (DCPs):

The Digital Cinema Package as described in the different parts of SMPTE 429 [10] can be regarded as the digital equivalent to the release print on film material. Archival institutions in some cases may only be able to acquire a DCP of a certain production and not the uncompressed material originally used to create the DCP. The DCP should be converted without decoding and re-encoding of the contained JPEG 2000 images to the motion picture preservation storage format or the motion picture access format. All structural information of the DCP should be preserved in the metadata section to be able to exactly reconstruct the original DCP.

Direct archival of encrypted DCPs is discouraged because of the risks of loss of the encryption keys. Instead, the content of encrypted DCPs should be decrypted and stored as described above in order to ensure future accessibility. Security should be enforced by other means (e.g., physical security of storage media).

c) Ingesting scanned film material:

The formats standardized in this Recommendation | International Standard can also be used to store cinematic content that is scanned from original film material. However, the choice of format and profile will usually depend on the preservation strategy for the original film. For digital long-term preservation, the original film material should be scanned at the highest reasonable spatial resolution and bit depth. These digital images should then be stored using the motion picture preservation format with the 5-3 reversible transform. Image data should be stored in the colour space the film scanner used. All available technical data of the film scanner should be stored as metadata. It is also possible to store additional image components (colour channels), e.g., infrared for scratch removal. This package can then be also used as a starting point for digital restoration procedures. For ingesting digitally restored images originating from film material, see item a).

In many cases, it is desirable to keep the original film as long-term preservation element and to create digitized versions to facilitate access to the cinematic content. Depending on the requirements of the archival institutions there are two main routes. For lower requirements, the film should be scanned and encoded according to the specifications for the motion picture access format. For higher requirements, the specifications for the motion picture preservation format should be used with parameters appropriate for the prospective use.

B.4.2 Disseminating cinematic archives

In the context of this Recommendation | International Standard, dissemination means the delivery of archived cinematic content to end users. This does not necessarily mean that end users are required to have software and systems to decode and interpret the formats described in this Recommendation | International Standard. To create a format that can be utilized by end users, a conversion process is necessary. The details and target formats of this conversion process largely depend on the requirements of each user group. Possible user groups may be digital cinemas, television and movie production companies, schools and universities, scientists, and others.

There may be a number of dissemination formats in consideration of the end user's many different requirements, like, e.g.:

- Digital Cinema Package (DCP) format as specified in [10] and related documents;
- MPEG-4/Part-10 (H.264/AVC) as specified in ITU-T H.264 | ISO/IEC 14496-10;
- MPEG-2 as specified in ITU-T H.262 | ISO/IEC 13818-2;
- etc.

Usually the motion picture access format is used as a starting point for the dissemination process because the compressed image data can be directly converted into a Digital Cinema Package. It is also possible to create small-sized preview movies easily from this format by decoding only the lower resolution layers.

In special cases also the motion picture preservation format may be used as a starting point for the creation of a dissemination package. The high quality contained in this format is, e.g., needed to create uncompressed image sequences for digital restoration or re-mastering procedures.

B.4.3 Exchange of content between cinematic archives

To exchange cinematic content between different archival institutions, both motion picture formats specified in this Recommendation | International Standard can be used, depending on the requirements of the institutions. Generally, the motion picture access format should be preferred due to its stricter parameter set.

It is also possible to create new packages for exchange that, e.g., contain only a subset of the image, audio, metadata or other content of the source format.

B.4.4 General procedures and archive management

The archival system used to handle and store the formats described in this Recommendation | International Standard should adhere to the OAIS Reference model (ISO 14721:2003).