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Information technology — JPEG XS low-latency lightweight image coding system —

Part 3: Transport and container formats

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives or www.iec.ch/members_experts/refdocs).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html. In the IEC, see www.iec.ch/understanding-standards.

This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

This third edition cancels and replaces the second edition (ISO/IEC 21122-3:2022), which has been technically revised.

The main changes are as follows:

— support for JPEG XS codestreams using temporal differential coding (TDC).

— clarifications on coding of interlaced signals.

A list of all parts in the ISO/IEC 21122 series can be found on the ISO and IEC websites.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

Introduction

This document is part of a series of standards for a low-latency lightweight image coding system, denoted JPEG XS.

In many use cases during production or transmission of a movie, limiting the latency and the recompression loss is a more important aspect than the compression efficiency. The JPEG XS coding system offers compression and recompression of image sequences with very moderate computational resources while remaining robust under multiple compression and decompression cycles and mixing of content sources, e.g. embedding of subtitles, overlays or logos. Typical target compression ratios ensuring visually lossless quality are in the range of 2:1 to 20:1, depending on the nature of the source material. The end-to-end latency can be confined to a fraction of a frame, typically between a small number of lines down to below a single line.

This document specifies transport and container formats for JPEG XS codestreams. It also defines metadata that enriches transport protocols for transmission of image sequences, in order to facilitate transport, editing and presentation.

Information technology — JPEG XS low-latency lightweight image coding system —

Part 3:
Transport and container formats

1 Scope

This document defines transport and container formats for JPEG XS codestreams as specified in ISO/IEC 21122-1. It defines file formats for working with still image and motion image sequence files on computer platforms and gives guidance on how to embed the codestream in transport streams, allowing internet-based communication.

This document uses already existing specifications for file formats and extends them for the embedding of JPEG XS codestreams.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 15076-1, *Image technology colour management — Architecture, profile format and data structure — Part 1: Based on ICC.1:2010*

ISO/IEC 646, *Information technology — ISO 7-bit coded character set for information interchange*

ISO/IEC 10646, *Information technology — Universal coded character set (UCS)*

ISO/IEC 11578, *Information technology — Open Systems Interconnection — Remote Procedure Call (RPC)*

ISO/IEC 14496-12, *Coding of audio-visual objects — Part 12: ISO base media file format*

ISO/IEC 21122-1, *JPEG XS low-latency lightweight image coding system — Part 1: Core coding system*

ISO/IEC 21122-2, *JPEG XS low-latency lightweight image coding system — Part 2: Profiles and buffer models*

ISO/IEC 23008-12:2022, *Information technology — High efficiency coding and media delivery in heterogeneous environments — Part 12: Image File Format*

ISO/CIE 11664-1, *Colorimetry — Part 1: CIE standard colorimetric observers*

Rec. ITU-T H.273 | ISO/IEC 23091-2, *Coding-independent code points — Part 2: Video*

ANSI/CTA 861-G:2016, *A DTV Profile for Uncompressed High Speed Digital Interfaces*

W3C Recommendation, Extensible Markup Language (XML) 1.0 (Fifth Edition), 26 Nov. 2008 (https://www.w3.org/TR/REC-xml/)

3 Terms and definitions

For the purposes of this document the terms and definitions given in ISO/IEC 14496-12, ISO/IEC 21122-1, ISO/IEC 21122-2, ISO/IEC 23008-12 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
aux
auxiliary component channel typically used as opacity channel or alpha mask

3.2
big-endian
byte ordering from the most significant to the least significant byte of multi-byte value representations

3.3
box
structured collection of data describing the image or the image decoding process

3.4
box content
data wrapped within the *box* (3.3) structure

3.5
box type
kind of information stored with the *box* (3.3)

3.6
byte
group of 8 bits

3.7
coding-independent code point
code point based on enumerated values for the definition of the colourspaces

Note 1 to entry: Code points defined in Rec. ITU-T H.273 | ISO/IEC 23091-2.

3.8
high efficiency image file format
image file format which can embed still images and *motion sequences* (3.11)

Note 1 to entry: Based on ISO/IEC 23008-12.

3.9
image collection
unordered set of images without an implied or signalled presentation order or presentation time stamps

3.10
JXS
still image file format with JPEG XS compressed images

3.11
motion sequence
movie
timed sequence (3.15) of images

3.12
sample
<coding> single element in the two-dimensional image array which comprises a component

Note 1 to entry: This definition is used in Annex A.

3.13
sample
<ISOBMFF> all the data associated with a single time

Note 1 to entry: This definition is used in Annexes B and C as data associated with one coded image in a sequence.

3.14
superbox
box (3.3) that carries other boxes as payload data

3.15
timed sequence
linearly ordered sequence of media entities such as images where each entity is presented at a well defined time stamp

4 Symbols and abbreviated terms

4.1 Symbols

N_c	number of components in an image as defined in ISO/IEC 21122-1
P_{lev}	Level, sublevel and frame-buffer level (if applicable) a particular codestream conforms to as defined in ISO/IEC 21122-2
P_{pih}	profile a particular codestream conforms to as defined in ISO/IEC 21122-2
`Picture()`	JPEG XS codestream as defined in ISO/IEC 21122-1
`Codestream_Header()`	codestream header preceding the image data in the codestream without any `tpc_marker()` as defined in subclause A.5.5
`Codestream_Body()`	coded image data in the codestream including any `tpc_marker()` if such a marker is present, without `Codestream_Header()` as defined in subclause A.5.5

4.2 Abbreviated terms

For the purposes of this document the abbreviated terms given in ISO/IEC 14496-12, ISO/IEC 21122-1, ISO/IEC 21122-2, ISO/IEC 23008-12 and the following apply.

CICP	coding-independent code points
CIE	Commision Internationale de l'Eclairage
HEIF	high efficiency image file format
ISOBMFF	iso base media file format
LSB	least significant bit
MSB	most significant bit
UTF-8	8-bit Unicode transformation format as defined in ISO/IEC 10646

4.3 Naming conventions for numerical values

Integer numbers are expressed as bit patterns, hexadecimal values, or decimal numbers. Bit patterns and hexadecimal values have both a numerical value and an associated particular length in bits.

Hexadecimal notation, indicated by prefixing the hexadecimal number by "0x", may be used instead of binary notation to denote a bit pattern having a length that is an integer multiple of 4. For example, 0x41 represents an eight-bit pattern having only its second most significant bit and its least significant bit equal to 1. Numerical values that are specified under a "**Code**" heading in tables that are referred to as "code tables" are bit pattern values (specified as a string of digits equal to 0 or 1 in which the left-most bit is considered the most-significant bit). Other numerical values not prefixed by "0x" are decimal values. When used in expressions, a hexadecimal value is interpreted as having a value equal to the value of the corresponding bit pattern evaluated as a binary representation of an unsigned integer (i.e., as the value of the number formed by prefixing the bit pattern with a sign bit equal to 0 and interpreting the result as a two's complement representation of an integer value). For example, the hexadecimal value 0xF is equivalent to the 4-bit pattern '1111' and is interpreted in expressions as being equal to the decimal number 15.

5 Conformance

This document shares common definitions for the structure of files (a sequence of objects, called boxes here, and atoms in other similar file formats), and a common definition of the general structure of an object (the size and type) as specified in Annex A.

File formats representing either images, or image sequences shall follow the specifications in Annexes B, C and D. All these specifications require that readers ignore objects that are unrecognizable to them.

This document takes precedence over those on which it is based, in any case where there are differences or conflicts; however, no such conflicts are known to exist.

For better readability and understanding, the syntax description for the different file formats is done in the same way as in the base formats.

6 Colour specification

JPEG XS (as defined in ISO/IEC 21122-1) describes only the encoded bitstream of an image. The integrated multiple component transformation is only responsible for a decorrelation of the different colour components allowing for the reduction of the entropy in the data. In order to properly display or interpret the image, it is essential that the colourspace of that image data is properly characterized. For this purpose, the respective container format or transport channel signals the correct colourspace. The defined formats in this document for JPEG XS signals the colour space as specified in Rec. ITU-T H.273 | ISO/IEC 23091-2.

7 Organization of the document

Annex A specifies boxes and superboxes that can be used to signal metadata for isolated JPEG XS codestreams or sequencs of JPEG XS codestreams. The boxes are identical or similar to the boxes defined in other ISO standards, e.g. JPEG 2000 (Rec. ITU-T T.800 | ISO/IEC 15444-1). The boxes defined in this annex are used throughout all other annexes of this document.

Annex B defines the JXS file format for still images based on JPEG XS codestreams and the boxes specified in Annex A.

Annex C specifies the integration of JPEG XS codestreams in the ISOBMFF (as defined in ISO/IEC 14496-12) for use of image sequences as movie in a file format.

Annex D specifies the integration of JPEG XS codestreams in the HEIF file format (as defined in ISO/IEC 23008-12) allowing the integration of both still images as well as movies in one format.

Annex E specifies the Media Type registration for JPEG XS codestreams solely any file format container, i.e. not contained within the file formats specified by Annex B, Annex C or Annex D.

Annex A
(normative)

Syntax elements for JPEG XS compressed content

A.1 General

This annex defines syntax elements identifying and representing meta data of JPEG XS compressed images, image collections or image sequences. It forms the basis for file formats that applications may choose to wrap one or multiple JPEG XS codestreams. Annex B describes a concrete file format that represents an individual JPEG XS image. This specification is based on the same syntax as the box-based file format for JPEG 2000 in ISO/IEC 15444-1:2019, Annex I or ISO/IEC 15444-2:2021, Annex M.

This annex:

— specifies a binary container for image, image collections, image sequences and metadata;

— specifies a mechanism by which metadata (including vendor-specific information) can be included in files or transport streams specified by this document;

— specifies a mechanism to indicate image properties, such as the tonescale or colourspace of the image;

— specifies a mechanism by which readers can recognize the existence of intellectual property rights information in the file.

A.2 Specification of syntax elements

A.2.1 General

The syntax elements defined in this annex provide foundations for storing application specific data (metadata) in association with JPEG XS codestreams, such as information which is required to display the images or stream of images. As many applications require a similar set of information to be associated with the compressed image data, it is useful to define the format of that set of data along with the definition of the compression technology and codestream syntax.

Conceptually, the syntax elements specified in this annex encapsulate JPEG XS codestreams along with other core pieces of information about such codestreams. A file created from the syntax elements defined in this annex is loosely called a JPEG XS enabled file. However, this annex does not define a file format itself, it only provides syntax elements upon which a file format can be defined. A concrete file format based on this annex is specified in Annex B.

The building-block of all JPEG XS enabled files is called a box. All information is encapsulated in boxes. This annex defines several types of boxes; the definition of each specific box type defines the kinds of information that can be found within a box of that type. Some boxes will be defined to contain other boxes.

A.2.2 Greyscale, colour, multi-component specification

One of the most important aspects of a file format is that it specifies the colourspace of the contained image data. In order to properly display or interpret the image data, it is essential that the colourspace of that image is properly characterized. The syntax elements defined in this subclause provide one method to specify the colourspace of the image based on coding-independent code points (CICP). The CICP enumerated method specifies the colourspace of an image by the use of three numeric values that identifies the colourspace. The set of supported colourspaces is specified in A.5.4.3. The allowed values are a subset of the code points defined in Rec. ITU-T H.273 | ISO/IEC 23091-2.

A.2.3 Inclusion of auxilliary channels

In many applications, components other than the colour channels are required (auxilliary channels). For example, many images used on web pages contain opacity information; the browser uses this information to blend the image into the background. Another example is the use of alpha channels in video production; video mixers use this alpha channel to mix multiple images. It is thus desirable to include both the colour and auxiliary channels within a single codestream.

Syntax elements defined in Annex A provide means to indicate the presence of auxiliary channels (such as opacity), to define the type of these channels, and to specify the ordering and source of these. When a reader opens a JPEG XS enabled file, it determines the ordering and type of each component. The application shall then match the component definition and ordering from the JPEG XS enabled file with the component ordering as defined by the colourspace specification. Once the file components have been mapped to the colour channels, the decompressed image can be processed through any needed colourspace transformations.

How applications respond to opacity or other auxiliary channels is outside the scope of this document.

A.2.4 Metadata

One important aspect of the syntax elements defined in Annex A is the ability to add metadata to a JPEG XS enabled file.

Some of the boxes provide a set of tools by which applications can add vendor-specific information to the JPEG XS enabled file format, like the Exif box or the XML box. These boxes are optional in conforming files and may be ignored by conforming readers.

A.2.5 Temporal differential coding of interlaced signals

Each field of an interlaced frame constitutes an independent image in the sense of ISO/IEC 21122-1. Coding parameters of the two fields shall then match, i.e. if temporal differential coding is enabled for the top field, it shall also be enabled for the bottom field and vice versa. Temporal differential coding then predicts between identical fields, i.e. the top field shall be predicted from the last top field in the past, and the bottom field shall be predicted from the bottom field in the past.

Conceptionally, an interlaced encoded JPEG XS file can therefore be understood as two otherwise independent JPEG XS streams interleaved within each other, where one stream consists of all top fields and the other consists of all bottom fields.

A.3 Concept of boxes

A.3.1 Key to graphical descriptions

Each box is described in terms of its function, usage and length. The function describes the information contained in the box. The usage describes the logical location and frequency of this box in the file. The length describes which parameters determine the length of the box.

These descriptions are followed by a figure that shows the order and relationship of the parameters in the box. Figure A.1 shows an example of this type of figure. A rectangle is used to indicate the parameters in the box. The width of the rectangle is proportional to the number of bytes in the parameter. A shaded rectangle (diagonal stripes) indicates that the parameter is of varying size. Two parameters with superscripts and a grey area between them indicate a run of several of these parameters. A sequence of two groups of multiple parameters with superscripts separated by a grey area indicates a run of that group of parameters (one set of each parameter in the group, followed by the next set of each parameter in the group). Optional parameters or boxes are shown with a dashed rectangle.

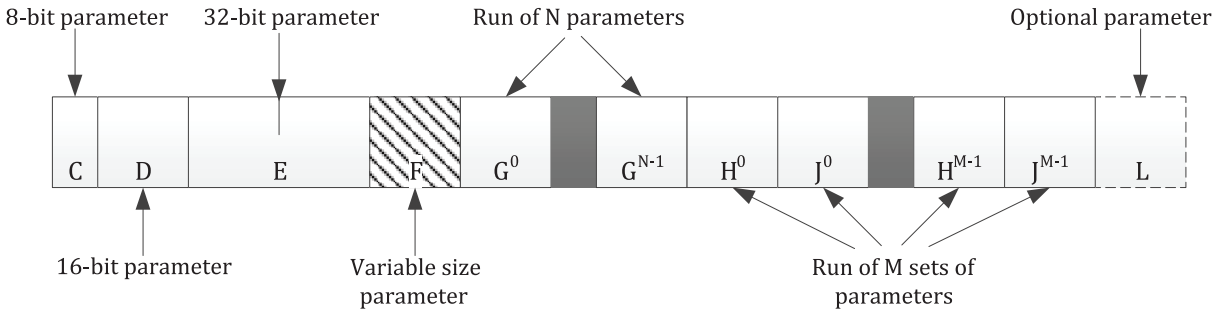

Figure A.1 — Example of a box description

The figure is followed by a list that describes the meaning of each parameter in the box. If parameters are repeated, the length and nature of the run of parameters is defined. As an example, in Figure A.1, parameters C, D, E and F are 8-, 16-, 32-bit and variable lengths, respectively. The notation G^0 and G^{N-1} implies that there are N different parameters, G^i, in a row. The group of parameters H^0 and H^{M-1}, and J^0 and J^{M-1} specify that the box will contain H^0, followed by J^0, followed by H^1 and J^1, continuing to H^{M-1} and J^{M-1} (M instances of each parameter in total). Also, the field L is optional and may not be found in this box.

After the list is a table that either describes the allowed parameter values or provides references to other tables that describe these values.

Some boxes may carry other boxes as payload data. Such boxes are denoted as superboxes. The payload size of a superbox is given by the sum of the box lengths of all the boxes it contains.

In addition, in a figure describing the contents of a superbox, an ellipsis (...) is used to indicate that the contents of the file between two boxes are not specifically defined. Any box (or sequence of boxes), unless otherwise specified by the definition of that box, may be found in place of the ellipsis.

For example, the superbox shown in Figure A.2 shall contain an AA box and a BB box, and the BB box shall follow the AA box. However, there may be other boxes found between boxes AA and BB. Dealing with unknown boxes is discussed in A.6.

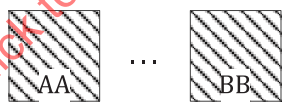

Figure A.2 — Example of a superbox description

A.3.2 Box definition

Physically, each object in the file is encapsulated within a binary structure called a box. That binary structure is as in Figure A.3 and detailed in Table A.1.

Figure A.3 — Organization of a box

LBox Box length. This field specifies the length of the box, stored as a 32-bit big-endian unsigned integer. This value includes all of the fields of the box, including the length and type. If the value of this field is 1, then the XLBox field shall exist and the value of that field shall be the actual length of the box. If the value of this field is 0, then the length of the box was not known when the LBox field was written. In this case, this box contains all bytes up to the end of the file. If a box of length 0 is contained within another box (its superbox), then the length of that superbox shall also be 0. This means that this box is the last box in the file. The values 2-7 are reserved for ISO/IEC use.

TBox Box type. This field specifies the type of information found in the DBox field. The value of this field is encoded as a 32-bit big-endian unsigned integer. However, boxes are generally referred to by an ISO/IEC 10646 character string translation of the integer value. For all box types defined within this document, box types are indicated as both character string (normative) and as 4-byte hexadecimal integers (informative). Also, a space character is shown in the character string translation of the box type as "\040". All values of TBox not defined within this documentare are reserved for ISO/IEC use.

XLBox Box extended length. This field specifies the actual length of the box if the value of the LBox field is 1. This field is stored as an 64-bit big-endian unsigned integer. The value includes all of the fields of the box, including the LBox, TBox and XLBox fields.

DBox Box contents. This field contains the actual information contained within this box. The format of the box contents depends on the box type and is defined individually for each type.

Table A.1 — Binary structure of a box

Field name	Size (bits)	Value
LBox	32	0, 1, or 8 to (2^{32}– 1)
TBox	32	Variable
XLBox	64 0	16 to (2^{64}– 1); if LBox = 1 Not applicable; if LBox ≠ 1
DBox	Variable	Variable

For example, consider the illustration in Figure A.4 of a sequence of boxes, including one box that contains other boxes:

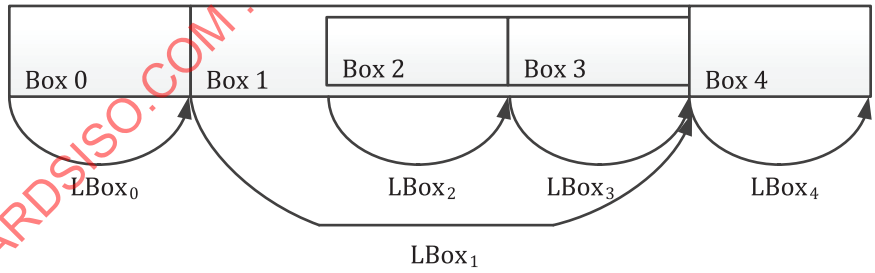

Figure A.4 — Illustration of box lengths

As shown in Figure A.4, the length of each box includes any boxes contained within that box. For example, the length of Box 1 includes the length of Boxes 2 and 3, in addition to the LBox and TBox fields for Box 1 itself. In this case, if the type of Box 1 was not understood by a reader, it would not recognize the existence of Boxes 2 and 3 because they would be completely skipped by jumping the length of Box 1 from the beginning of Box 1.

A.4 Overview of defined boxes

Table A.2 lists all boxes defined in Annex A. Indentation within the table indicates the hierarchical containment structure of the boxes within a JXS file as defined in Annex B.

The following boxes shall properly be interpreted by all readers. Each of these boxes conforms to the standard box structure as defined in A.3. The following clauses define the value of the DBox field from Table A.1 (the contents of the box). It is assumed that the LBox, TBox and XLBox fields exist for each box in the file as defined in A.3.

Table A.2 — Defined boxes

Box name	Type	Superbox	Comments
JPEG XS Signature box (A.5.1)	'JXS\040' (0x4A58 5320)	No	This box uniquely identifies the file as being part of the JPEG XS family of files.
File Type box (A.5.2)	'ftyp' (0x6674 7970)	No	This box specifies file type, version and compatibility information.
JPEG XS Video Support box (A.5.3)	'jpvs' (0x6A70 7673)	Yes	This box supports video information for JPEG XS codestreams.
JPEG XS Video Information box	'jpvi' (0x6A70 7669)	No	This box describes video information.
JPEG XS Profile and Level box	'jxpl' (0x6A78 706c)	No	This box specifies the used profile and level.
Buffer Model Description box	'bmdm' (0x626D 646D)	No	This box defines buffer model parameters.
Mastering Display Metadata box	'dmon' (0x646D 6f6E)	No	This box describes the display characteristics of the mastering display.
JPEG XS Video Transport Parameter box	'jptp' (0x6A70 7470)	No	This box describes parameters for packet-based video stream transport.
JPEG XS Header box (A.5.4)	'jp2h' (0x6A70 3268)	Yes	This box contains a series of boxes that contain header-type information about the file.
Image Header box	'ihdr' (0x6968 6472)	No	This box specifies aspects of the image geometry, number of components and bit depth.
Colour Specification box	'colr' (0x636F 6C72)	No	This box specifies the colourspace of the image.
Channel Definition box	'cdef' (0x6364 6566)	No	This box specifies the type and ordering of the components within the codestream.
Exif box	'Exif' (0x4578 6966)	No	This box contains metadata for photographic images as specified in ISO/IEC 23008-12
Contiguous Codestream box (A.5.5)	'jp2c' (0x6A70 3263)	No	This box contains the codestream as defined by ISO/IEC 21122-1.
Intellectual Property box (A.5.6)	'jp2i' (0x6A70 3269)	No	This box contains intellectual property information about the image.
XML box (A.5.7)	'xml\040' (0x786D 6C20)	No	This box provides a tool by which vendors can add XML formatted information.
UUID box (A.5.8)	'uuid' (0x7575 6964)	No	This box provides a tool by which vendors can add additional information to a file without risking conflict with other vendors.
UUID Info box (A.5.9)	'uinf' (0x7569 6E66)	Yes	This box provides a tool by which a vendor can provide access to additional information associated with a UUID.
UUID List box	'ulst' (0x756C 7374)	No	This box specifies a list of UUIDs.
URL box	'url\040' (0x7572 6C20)	No	This box specifies a URL.

NOTE Indented box names indicate that the corresponding boxes are contained within the non-indented superbox preceding it.

A JPEG XS enabled file may contain boxes not known to applications based solely on this document. If a reader finds a box that it does not understand, it shall skip and ignore that box.

A.5 Defined boxes

A.5.1 JPEG XS Signature box

The JPEG XS Signature box identifies that the format of this file is defined by the JPEG XS International Standard, as well as providing a small amount of information which can help determine the validity of the rest of the file. The JPEG XS Signature box shall be the first box in the file.

The type of the JPEG XS Signature box shall be `'JXS\040'` (0x4A58 5320). The length of this box shall be 12 bytes. The contents of this box shall be the 4-byte character string '<CR><LF><0x87><LF>' (0x0D0A 870A). For file verification purposes, this box can be considered a fixed-length 12-byte string which shall have the value: 0x0000 000C 4A58 5320 0D0A 870A.

The combination of the particular type and contents for this box enable an application to detect a common set of file transmission errors. The CR-LF sequence in the contents catches bad file transfers that alter newline sequences. The final linefeed checks for the inverse of the CR-LF translation problem. The third character of the box contents has its high-bit set to catch bad file transfers that clear bit 7.

A.5.2 File Type box

The File Type box specifies the International Standard which completely defines all of the contents of this file, as well as a separate list of readers, defined by other Recommendations | International Standards, with which this file is compatible, and thus the file can be properly interpreted within the scope of that other standard. This box shall immediately follow the JPEG XS Signature box. This differentiates the standard which completely describes the file from other standards that interpret a subset of the file.

All files shall contain one and only one File Type box. The type of the File Type box is 'ftyp' (0x6674 7970). The contents of this box shall be as in Figure A.5 and Table A.4.

Figure A.5 — Organization of the contents of a File Type box

BR Brand. This field specifies the International Standard which completely defines this file. This field is specified by a four-byte string of ISO/IEC 10646 characters. Brand values are defined by a concrete file format, for example, the file format in Annex B does suggest a brand value. Vendors can define their own brand values, and conforming readers shall instead check the compatibility list **CL^i** to learn whether they are able to interpret a file as intended by its creator.

MinV Minor version. This parameter defines the minor version number of this JXS specification to which the file conforms. The parameter is defined as a 32-bit big-endian unsigned integer. The value of this field shall be zero. However, readers shall continue to parse and interpret this file even if the value of this field is not zero.

CL^i Compatibility list. This field specifies a code representing this document, another standard, or a profile of another standard, to which the file conforms. This field is encoded as a four-byte string of ISO/IEC 10646 characters. The number of CLi fields is determined by the length of this box. Concrete file formats based on this annex define values for the **CL^i** field by which such files can be identified. Readers shall check the compatibility list to learn whether they are able to interpret the file contents according to the intent of its creator. Table A.3 lists compatibility values defined in this document

Table A.3 — Compatibility values CL^i

Value	Meaning
`'jxs\040'`	Files conforming to the file format specified in Annexes B, C or D of this document.
`'jxsi'`	Files conforming to the file format specified in Annex D of this document.
`'jxss'`	Files conforming to the file format specified in Annexes C or D of this document.
Other values	Reserved for other ISO/IEC uses

Table A.4 — Format of the contents of the File Type box

Field name	Size (bits)	Value
BR	32	0 to (2^{32}– 1)
MinV	32	0
CL^i	32	0 to (2^{32}– 1)

A.5.3 JPEG XS Video Support box (superbox)

A.5.3.1 General

The JPEG XS Video Support box contains information relevant for using JPEG XS codestreams in a video, such as video information (framerate, no. of fields, etc.), buffer model description data or mastering display metadata. This box is an optional superbox. If the JPEG XS Video Support box is used in a JXS file, at least the JPEG XS video information box and the JPEGXS Profile and Level box are mandatory. For retransmitting of JPEG XS codestreams over Internet protocols or over SDI link channels, it is recommended to store also the original buffer model description data used during the encoding.

The type of the JPEG XS Video Support box is `'jpvs'` (0x6A70 7673).

This box contains several boxes. Other boxes may be defined in other standards and may be ignored by conforming readers. Those boxes contained within the JPEG XS Video Support box that are defined within this document are as in Figure A.6:

Figure A.6 — Organization of the contents of a JPEG XS Video Support box

jpvi JPEG XS Video Information box. This box specifies video specific data about frame rate, field coding, time code and max. bit rate. This box shall be the first box in the JPEG XS Video Support box.

jxpl JPEG XS Profile and Level box. This box stores information about the used JPEG XS profile and level as described in ISO/IEC 21122-2. This box shall be the second box in the JPEG XS Video Support box.

bmdm Buffer Model Description box (optional). This box specifies metadata about the buffer model used during the encoding.

dmon Mastering Display Metadata box (optional). This box specifies information on the Mastering Display.

jptp JPEG XS Video Transport Parameter box (optional). This box specifies information how a decoder should be best parametrized for packet-based video transport.

A.5.3.2 JPEG XS Video Information box

If the JPEG XS codestream is used as part of a video stream or recorded from a video stream, this box specifies the characteristics of the video stream.

The type of the JPEG XS Video Information box is `'jpvi'` (0x6A70 7669) and contents of the box shall have the format as in Figure A.7 and Table A.5:

Figure A.7 — Organization of the contents of a JPEG XS Video Information box

Table A.5 — Format of the contents of the JPEG XS Video Information box

Field name	Size (bits)	Value
brat	32	1 to (2^{32}– 1)
frat	32	Variable, four sub fields, 0 if frame rate unknown
schar	16	Variable, three sub fields
tcod	32	HHMMSSFF

brat The brat parameter specifies the maximum bit rate of a video stream. This parameter is defined as a 32-bit big-endian unsigned integer which specifies a maximum instantaneous bit rate that is not to be exceeded, expressed in Mbits per second for the video stream at the specified frame rate. The maximum bit rate shall not exceed the bit rate specified for a given profile and level.

frat The frat parameter specifies the frame rate in frames per second and is a 32-bit big endian unsigned integer. The frame rate is expressed by a rational number of the form numerator/denominator. If the frame rate is an integer, the denominator value shall be equal to 1. If there are two video fields per frame, then the video field rate is twice the frame rate. If the frame rate is unknown, the parameter is 0. The encoding of this parameter is specified in Table A.6:

Table A.6 — Format of the frat parameter

Field position	Size (bits)	Field name
Bit 31 (MSB) –Bit 30	2	Interlace_Mode
Bit 29 –Bit 24	6	Framerate_Denominator
Bit 23 – Bit 16	8	Framerate_Reserved
Bit 15- Bit 0 (LSB)	16	Framerate_Numerator

Interlace_Mode:

Interlace_Mode specifies whether the original picture is progressive or interlaced, and in the latter case also the field order and the order of codestreams within a file. Values and their meanings are listed in Table A.7.

Table A.7 — Format of the contents of frat Interlace_Mode

Field value	Meaning
0	Progressive frame (frame contains one full-height picture)
1	Interlaced frame, first picture is top video field (top field first)
2	Interlaced frame, first picture is bottom video field (bottom field first)
3	Reserved

NOTE 1 The frat field does not change between the two fields of an interlaced frame. It specifies which of the two fields comes first in the frame, and which of the two codestreams comes first in a file. It is therefore not an indicator of the field type itself.

Framerate_Denominator:

Framerate_Denominator code specifies the denominator value for calculating the frame rate as listed in Table A.8.

Table A.8 — Format of the contents of frat Framerate_Denominator

Field Value	Meaning – denominator value
0	Reserved
1	denominator value is 1
2	denominator value is 1.001
3 – 63	Reserved

Framerate_Reserved:

Reserved for ISO/IEC, should be 0.

Framerate_Numerator:

Framerate_Numerator code shall specify directly the numerator value for calculating the frame rate.

NOTE 2 The NTSC frame rate 30/1.001 is correctly expressed as Framerate_Numerator field value 30 divided by Framerate_Denominator field value 2 (relates to denominator of 1.001). A frame rate of 24 frames/s is coded as Framerate_Numerator field value 24 divided by Framerate_Denominator field value 1 (relates to denominator value 1) and the frame rate typically referred to as 23.98 frames/s is coded as Framerate_Numerator 24 and Framerate_Denominator 2.

schar The schar parameter specifies the sample (3.11) characteristics of the image pixels and is defined as 2-Byte big-endian unsigned integer. Its encoding is specified in Table A.9:

Table A.9 — Format of the schar parameter

Field position	Size (bits)	Field name
Bit 15 (MSB)	1	Valid_Flag
Bit 14 – Bit 8	7	Sample_Reserved
Bit 7 – Bit 4	4	Sample_Bitdepth
Bit3 - Bit 0 (LSB)	4	Sampling_Structure

Valid_Flag:

Valid Flag specifies if other schar subfields contain valid data, 1 for valid, 0 for invalid. In the case of invalid signalling, all schar subfields shall be 0.

Sample_Reserved:

Reserved for ISO/IEC, should be 0.

Sample_Bitdepth:

Sample_Bitdepth code shall specify directly the bitdepth of the components minus 1 as defined also in the ihdr BPC. If not defined otherwise, it relates to all components.

Sampling_Structure:

Sampling_Structure code shall specify the sampling structure of the image. Values and their meanings are listed in Table A.10.

Table A.10 — Format of the contents of schar Sampling_Structure

Field value	Meaning	N_c
0	4:2:2 (YCbCr)	3
1	4:4:4 (YCbCr)	3
2	4:4:4 (RGB)	3
3	4:2:0 (YCbCr)	3
4	4:2:2:4 (YCbCrAux)	4
5	4:4:4:4 (YCbCrAux)	4
6	4:4:4:4 (RGBAux)	4
7-15	Reserved	Reserved

NOTE 3 The Sampling Structure defines only the type of sampling, not the order of the components. In the codestream, the component order is by default RGBAux or YCbCrAux. This does not prevent the decoder from delivering the components to a transmission link or displaying in another order like GBR.

Tcod time code. This parameter is a 4-byte unsigned integer field in the form HHMMSSFF which specifies the hour (HH: 0-23), minutes (MM: 0-59), seconds (SS: 0-59) and frame count (FF: 1-60). The HH, MM, SS, and FF fields are individual bytes packed contiguously. This parameter specifies the time code of the coded frame in the video stream.

NOTE 4 The Tcod parameter signals the relative time at which a frame was recorded. The time origin is arbitrary and can be application dependent. The purpose of this field is to facilitate identification of frames for non-linear editing of video sequences.

A.5.3.3 JPEG XS Profile and Level box

This box stores information about the used JPEG XS profile and level as described in ISO/IEC 21122-2:2024, Annex A. Although this information is redundant as it is also included within the bitstream, it helps parsers to identify at an early stage if the decoder is able to decode the bitstream. Especially as it follows the same strategy as in the ISOBMFF (see ISO/IEC 14496-12).

The type of the JPEG XS Profile and Level box is `'jxpl'` (0x6A78 706C) and contents of the box shall have the formats as in Figure A.8 and Table A.11.

Figure A.8 — Organization of the contents of a JPEG XS Profile and Level box

P_{pih} Profile of the codestream as defined in ISO/IEC 21122-2

P_{lev} Level, sublevel and FBB level (if applicable) of the codestream as defined in ISO/IEC 21122-2

Table A.11 — Format of the contents of the JPEG XS Profile and Level box

Field name	Size (bits)	Value
P_{pih}	16	Variable, defined in ISO/IEC 21122-2
P_{lev}	16	Variable, defined in ISO/IEC 21122-2

A.5.3.4 Buffer Model Description box (optional)

This box stores all information related to the buffer model that is necessary to properly decode an ISO/IEC 21122-1 compliant codestream and test it for conformance with the buffer model defined in ISO/IEC 21122-2.

The type of the buffer model description box is `'bmdm'` (0x626D 646D) and contents of the box has the formats as in Figure A.9 and Table A.12:

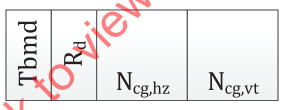

Figure A.9 — Organization of the contents of a Buffer Model Description box

Tbmd Buffer model type. This parameter specifies the type of buffer model as defined in ISO/IEC 21122-2.

R_d This parameter shall be 0. All other values are reserved for ISO/IEC purposes.

N_{cg,hz} Number of coefficient groups representing a horizontal blanking periods assumed in the buffer model during which the transmission channel continues transmission.

N_{cg,vt} Number of coefficient groups representing a vertical blanking period assumed in the buffer model during which the transmission channel continues transmission.

Table A.12 — Format of the contents of the Buffer Model Description box

Field name	Size (bits)	Value
Tbmd	8	0,1,2
R_d	8	0
$N_{cg,hz}$	16	0 to 65535
$N_{cg,vt}$	16	0 to 65535

A.5.3.5 Mastering Display Metadata box (optional)

This box specifies the characteristics of the mastering display metadata and the light level in the frame or in a stream. The type of the mastering display metadata box is `'dmon'` (0x646d 6f6e) and contents of the box shall have the format as in Figure A.10:

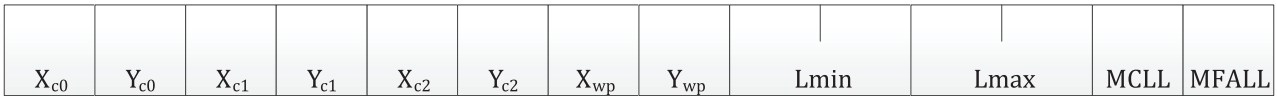

Figure A.10 — Mastering Display Metadata

The following fields X_{c0}, Y_{c0}, X_{c1}, Y_{c1}, X_{c2}, Y_{c2}, X_{wp}, Y_{wp}, L_{min} and L_{max} correspond to the fields defined in Reference [14]. The fields MCLL and MFALL shall be defined as in ANSI/CTA 861-G:2016. If these 12 fields have unknown values at the time of generating the frame or stream, the box shall not be included.

The parameters X_{ci} and Y_{ci} shall be defined as 2-byte unsigned integers that specify the normalized x and y chromaticity coordinates, respectively, of the colour primary component c_i of the mastering display in increments of 0.00002, according to the CIE 1931 definition of x and y as specified in ISO/CIE 11664-1 (see also ISO/CIE 11664-3 and CIE 15). For describing mastering displays that use red, green, and blue colour primaries, index value c0 shall correspond to the green primary, c1 shall correspond to the blue primary, and c2 shall correspond to the red colour primary. The values of X_{ci} and Y_{ci} shall be in the range of 0 to 50 000, inclusive.

X_{wp} and Y_{wp} shall be defined as 2-byte unsigned integers that specify the normalized x and y chromaticity coordinates, respectively, of the white point of the mastering display in normalized increments of 0.00002, according to the CIE 1931 definition of x and y as specified in ISO/CIE 11664-1 (see also ISO/CIE 11664-3 and CIE 15). The values of X_{wp} and Y_{wp} shall be in the range of 0 to 50 000.

L_{min} and L_{max} are 32-bit big-endian unsigned integers that specify the nominal maximum and minimum display luminance, respectively, of the mastering display. The minimum luminance of the mastering display is computed by L_{min}×0.0001 cd/m^2, the maximum luminance by L_{max}×0.0001 cd/m^2. L_{min} shall be less than L_{max}.

At minimum luminance, the mastering display is considered to have the same nominal chromaticity as the white point.

MCLL – MaxCLL: This 16-bit field specifies the Maximum Content Light Level and corresponds to the brightest pixel in the entire stream. Its luminance is computed by **MCLL**×cd/m^2. It is measured according to ANSI/CTA 861-G:2016, P.1.

MFALL – MaxFall: This 16-bit specifies the Maximum Frame Average Light Level and corresponds to the highest frame average brightness per frame in the entire stream. Its luminance is computed by **MFALL**× cd/m^2. It is measured according to ANSI/CTA 861-G:2016, P.2.

If for some reason the MaxCLL or MaxFALL values are unknown, the value 0x0000 shall be used.

EXAMPLE As an example, Table A.13 contains values for Rec. ITU-R BT.709-5.

Table A.13 — Default values for mastering display parameters

Parameter	Default value
Xc0	0x3A98
Yc0	0x7530
Xc1	0x1D4C
Yc1	0x0BB8
Xc2	0x7D00
Yc2	0x4074
Xwp	0x3D13

Table A.13 *(continued)*

Parameter	Default value
Ywp	0x4042
Lmin	0x00000064
Lmax	0x000F4240
MCLL	0x0000
MFall	0x0000

A.5.3.6 JPEG XS Video Transport Parameter box (optional)

If a JPEG XS codestream is transported over a packed-based network connection, this box provides information a decoder may use to parametrize itself optimally to minimize the latency by adapting to the source of the stream. In particular, multi-core CPU decoder implementations may profit by mirroring their assignment of slices to processing units to that of the encoder and the characteristics of the network. The layout of the box is as depicted in Figure A.11, its contents is specified in Table A.15.

Figure A.11 — Organization of the JPEG XS Video Transport Parameter box

The parameters in the JPEG XS Video Transport Parameter box are specified as follows:

Slgs This field suggests to the decoder how many contiguous slices should be assigned to the same processing unit out of multiple parallel operating units to match the strategy of the encoder. If **Slgs** is 0, no particular assignment of slices to processing units is suggested.

If the decoder follows the information in this box, slices 0 to **Slgs**−1 would be assigned to the first available processing core, slices **Slgs** to 2×**Slgs**−1 to the second, and so on.

Rsync This field suggests to the decoder how many parallel decoding units should be assigned to decode the image with minimal latency. If the host system of the decoder cannot supply **Rsync** parallel processing units, it is suggested to employ an integer fraction or an integer multiple of **Rsync** units to minimize latency.

If this field is 0, no particular number of parallel processing units is suggested.

Tseq This field identifies the size of the decoder input packet reordering buffer necessary to reshuffle incoming packets such that their payload data is in sequential order of the encoded image data and the transport mechanism. The encoding of the **Tseq** field is specified in Table A.14.

Table A.14 — Allowed value of the Tseq field

Value	Meaning
0	Slice based transport, no requirements on the size of the input reorder buffer are imposed to ensure decoding of the stream, and the only source of out-of-order packet delivery is due to the transport channel itself. Decoders may assume to operate successfully without, or with only a minimally sized reorder buffer.
2	Slice based transport, though slices may be delivered out of order. Decoders may require a reordering buffer of a full frame to bring slices back into top to bottom order.
255	Codestream based transport. The only source of out-of-order packet delivery is due to the transport channel itself. Decoders may assume to operate successfully without, or with only a minimally sized reorder buffer.
All other values	Reserved for ISO/IEC purposes

MTU The value of this field shall be 0. All other values are reserved for ISO/IEC purposes.

Table A.15 — Format of the JPEG XS Video Transport Parameter box

Field name	Size (bits)	Value
Slgs	16	0 to 65536
Rsync	8	0 to 255
Tseq	8	0
MTU	16	0

A.5.4 JPEG XS Header box (superbox)

A.5.4.1 General

The JPEG XS Header box contains generic information about the file, such as the number of components, bits per component and colourspace. This box is a superbox. Within a JXS file, there shall be exactly one JPEG XS Header box. The JPEG XS Header box may be located anywhere within the file after the File Type box but before the Contiguous Codestream box. It also shall be at the same level as the JPEG XS Signature and File Type boxes (it shall not be inside any other superbox within the file).

The type of the JPEG XS Header box is `'jp2h'` (0x6A78 7368).

This box contains several boxes. Other boxes may be defined in other standards and may be ignored by conforming readers. Those boxes contained within the JPEG XS Header box that are defined within this document are as in Figure A.12:

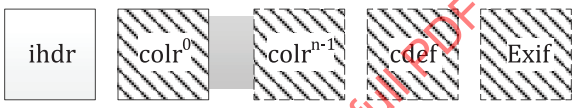

Figure A.12 — Organization of the contents of a JXS Header box

ihdr Image Header box. This box specifies information about the reference grid geometry, bit depth and the number of components. This box shall be the first box in the JPEG XS Header box and is specified in A.5.4.2.

colr^{i} Colour Specification boxes. These boxes specify the colourspace of the decompressed image. Their structures are specified in A.5.4.3. There shall be at least one Colour Specification box within the JPEG XS Header box. The use of multiple Colour Specification boxes provides the ability for a decoder to be given multiple optimization or compatibility options for colour processing. These boxes may be found anywhere in the JPEG XS Header box provided that they come after the Image Header box. All Colour Specification boxes shall be contiguous within the JPEG XS Header box.

cdef Channel Definition box. This box defines the channels in the image. Its structure is specified in A.5.4.4. This box may be found anywhere in the JXS Header box provided that it comes after the Image Header box.

Exif Exif box. This box contains additional metadata as specified in A.5.4.5.

A.5.4.2 Image Header box

This box contains fixed length generic information about the image, such as the image size and number of components. The contents of the JPEG XS Header box shall start with an Image Header box. Instances of this box in other places in the file shall be ignored. The length of the Image Header box shall be 22 bytes, including the box length and type fields. Much of the information within the Image Header box is redundant with information stored in the codestream itself.

All references to "the codestream" in the descriptions of fields in this Image Header box apply to the codestream found in the first Contiguous Codestream box in the file. Files that contain contradictory

information between the Image Header box and the first codestream are not conforming files. However, readers may choose to attempt to read these files by using the values found within the codestream.

The type of the Image Header box shall be `'ihdr'` (0x6968 6472) and the contents of the box shall have the format as in Figure A.13 and Table A.16:

Figure A.13 — Organization of the contents of an Image Header box

HEIGHT Image area height. The value of this parameter indicates the height of the sample grid. This field is stored as a 32-bit big-endian unsigned integer.

For progressive signals, the value of this field shall be identical to the height of the image as indicated in the picture header of the codestream or codestreams contained in the file.

For interlaced signals, the value of this field is the height of the frame, and therefore differs from the height recorded in the picture header of each field. It shall be the sum of the heights of the top and bottom fields as indicated in the picture header of the codestreams representing them.

WIDTH Image area width. The value of this parameter indicates the width of the sample grid. This field is stored as a 32-bit big-endian unsigned integer.

For progressive and interlaced signals, the value of this field shall be identical to the width of the frames or fields as indicated in the picture header of the codestream or codestreams contained in the file.

NC Number of components. This parameter specifies the number of components in the codestream and is stored as a 2-byte big-endian unsigned integer. The value of this field shall be equal to the value of the N_C field in the `picture_header()` of the codestream. If no Channel Definition Box is available, the order of the components for colur images is R-G-B-Aux or Y-U-V-Aux.

BPC Bits per component. This parameter specifies the bit depth of the components in the codestream, minus 1, and is stored as a 1-byte field.

The low 7-bits of the value indicate the bit depth of the components. The MSB is reserved for ISO/IEC purposes and shall be 0.

C Compression type. This parameter specifies the compression algorithm used to compress the image data. The value of this field shall be 12 for JPEG XS. It is encoded as a 1-byte unsigned integer. Other values are reserved for ISO/IEC use.

UnkC Colourspace unknown. This field specifies if the actual colourspace of the image data in the codestream is known. This field is encoded as a 1-byte unsigned integer. Allowed values for this field are 0, if the colourspace of the image is known and correctly specified in the Colourspace Specification boxes within the file, or 1 if the colourspace of the image is not known. A value of 1 is used in cases such as the transcoding of legacy images where the actual colourspace of the image data is not known. In these cases, while the colourspace interpretation methods specified in the file may not accurately reproduce the image with respect to an original, the image should be treated as if the methods accurately reproduced the image. Values other than 0 and 1 are reserved for ISO/IEC use.

IPR Intellectual property. This parameter indicates whether this JXS file contains intellectual property rights information. If the value of this field is 0, this file does not contain rights information, and thus the file does not contain an IPR box. If the value is 1, then the file does contain rights information and thus does contain an IPR box as defined in A.5.6. Other values are reserved for ISO/IEC use.

Table A.16 — Format of the contents of the Image Header box

Field name	Size (bits)	Value
HEIGHT	32	1 to (2^{32}– 1)
WIDTH	32	1 to (2^{32}– 1)
NC	16	1 to 8
BPC	8	See Table A.17
C	8	12
Unk	8	0 to 1
IPR	8	0 to 1

Table A.17 — BPC values

Values (bits) MSB LSB	Component sample (3.11) precision
x000 0000 to x000 1111	Component bit depth = value + 1. From 1 bit deep to 16 bits deep respectively (counting the sign bit, if appropriate)
0xxx xxxx	Components are unsigned values
	All other values reserved for ISO/IEC use

A.5.4.3 Colour Specification box

Each Colour Specification box defines one method by which an application can interpret the colourspace of the decompressed image data and identify associated processing for correct representation on the display. This colour specification is to be applied to the channel representing signed or unsigned integers, and associated with colours according to the Channel Definition box (see A.5.4.4). The reconstructed numerical values of channel number i are to be interpreted in combination with the relevant colourspace definition.

A JXS file may contain multiple Colour Specification boxes, but shall contain at least one with a METH value of 5 as its first Colour Specification box. Other Colour Specification boxes may specify different methods for achieving "equivalent" results. A conforming JXS reader may ignore all Colour Specification boxes after the first. However, readers conforming to other standards may use those boxes as defined in those other standards.

The type of a Colour Specification box is `'colr'` (0x636F 6C72). The content of a Colour Specification box is as in Figure A.14, and Table A.19.

Figure A.14 — Organization of the contents of a Colour Specification box

METH Specification method. This field specifies the method used by this Colour Specification box to define the colourspace of the decompressed image. This field is encoded as a 1-byte unsigned integer. The value of this field shall be 5, as defined in Table A.18.

Table A.18 — Allowed METH values

Value	Meaning
5	**Coding Independent Code Points CICP:** This Colour Specification box shall contain Coding Independent Code Points as defined in Rec. ITU-T H.273 | ISO/IEC 23091-2 in the METHDAT field.
other values	Reserved for ISO/IEC use. If the value of METH is not 5, there may be fields in this box following the APPROX field, and a conforming JXS reader may ignore the entire Colour Specification box.

PREC Precedence. This field is reserved for ISO/IEC use and the value shall be set to zero; however, conforming readers shall ignore the value of this field. This field is specified as a signed 1-byte integer.

APPR Colourspace approximation. This field specifies the extent to which this colour specification method approximates the "correct" definition of the colourspace. The value of this field shall be set to zero; however, conforming readers shall ignore the value of this field. Other values are reserved for ISO/IEC uses. This field is specified as a 1-byte unsigned integer.

METHDAT Method data: This field contains additional data for the selected colour specification method.

Table A.19 — Format of the contents of the Colour Specification box

Field name	Size (bits)	Value
METH	8	5
PREC	8	0
APPROX	8	0
METHDAT	56 if METH=5	Variable

METHDAT values for the Coding Independent Code Points method

The Coding Independent Code Points method contains colour specifications as enumerated values in the METHDAT field, defined also in Rec. ITU-T H.273 | ISO/IEC 23091-2. The total length of all data fields is 56 bit in 5 subfields. Its format is depicted in Figure A.15 and specified in Table A.20:

Key

CP COLOUR_PRIMARIES
TC TRANSFER_CHARACTERISTICS
MC MATRIX_COEFFICIENTS
V VIDEO_FULL_RANGE_FLAG + CICP_RESERVED Bits

Figure A.15 — Organization of the contents of the METHDAT field for the CICP method

COLOUR_PRIMARIES Colour Primaries: This field contains an enumerated value for the colour primaries as defined in Rec. ITU-T H.273 | ISO/IEC 23091-2 for video code points. This field is specified as an unsigned 2-byte integer.

TRANSFER_CHARACTERISTICS Transfer Characteristics: This field contains an enumerated value for the transfer characteristics as defined in Rec. ITU-T H.273 | ISO/IEC 23091-2 for video code points. This field is specified as an unsigned 2-byte integer.

MATRIX_COEFFICIENTS Matrix coefficents: This field contains an enumerated value for the matrix coefficients as defined in Rec. ITU-T H.273 | ISO/IEC 23091-2 for video code points. This field is specified as an unsigned 2-byte integer.

VIDEO_FULL_RANGE_FLAG Video Full Range Flag: This flag specifies the scaling and offset values applied in association with the Matrix Coefficients as defined in Rec. ITU-T H.273 | ISO/IEC 23091-2 for video code points. If the colorspace supports multiple value ranges, the value 1 indicates full range. If the colourspace does not support multiple value ranges, the value 0 shall be used. This field is specified as 1-bit field and this bit is located as MSB in the V byte.

CICP_RESERVED This field is reserved for future use by ISO/IEC. This field is specified as a 7-bit field and these 7 bits are the least significant bits of the V byte.

Table A.20 — Format of the contents of the Colour Specification box for the CICP method

Field name	Size (bits)
COLOUR_PRIMARIES	16
TRANSFER_CHARACTERISTICS	16
MATRIX_COEFFICIENTS	16
VIDEO_FULL_RANGE_FLAG	1
CICP_RESERVED	7

EXAMPLE Table A.21 shows examples of value combinations:.

Table A.21 — Example of value combinations for Table A.18 (informative)

Colourspace Definition	COLOUR_ PRIMARIES	TRANSFER_ CHARACTERISTICS	MATRIX_ COEFFICIENTS	VIDEO_FULL_ RANGE_FLAG
IEC 61966-2-1 sRGB	1	13	0	0
IEC 61966-2-1 sYCC	1	13	1	0
Rec. ITU-R BT.709-6	1	1	1	0 or 1
Rec. ITU-R BT.601-7 625	5	6	5	0 or 1
Rec. ITU-R BT.601-7 525	6	6	6	0 or 1
Rec. ITU-R BT.2020-2	9	14 or 15	9 or 10	0 or 1
Rec. ITU-R BT.2100-0	9	16 or 18	9	0 or 1
Society of Motion Picture and Television Engineers ST 428-1 (CIE 1931 XYZ as in ISO/CIE 11664-1)	10	17	0	0
Society of Motion Picture and Television Engineers RP 431-2 (2011)	11	17	0	0
Society of Motion Picture and Television Engineers EG 432-1 (2010)	12	17	0	0

A.5.4.4 Channel Definition box (optional)

The Channel Definition box specifies the meaning of the samples (3.11) in each channel in the image. The exact location of this box within the JXS Header box may vary provided that it follows the Image Header box. If a Channel Definition box is not present, a reader shall map component *i* to channel *i*, for all components in the codestream.

There shall be at most one Channel Definition box inside a JXS Header box.

This box contains an array of channel descriptions. For each description, three values are specified: the index of the channel described by that association, the type of that channel, and the association of that channel with particular colours. This box may specify multiple descriptions for a single channel.

If the Cpih field of the picture_header is 1, a multiple component transform is specified within the codestream, the image shall be in an RGB colourspace and the red, green and blue colours as channels 0, 1 and 2 in the codestream, respectively.

The type of the Channel Definition box is `'cdef'` (0x6364 6566). The contents of this box shall be as in Figure A.16 and Table A.25:

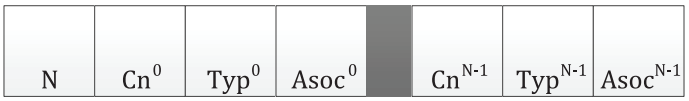

Figure A.16 — Organization of the contents of a Channel Definition box

N Number of channel descriptions. This field specifies the number of channel descriptions in this box. This field is encoded as a 2-byte big-endian unsigned integer.

Cn^i Channel index. This field specifies the index of the channel for this description. The value of this field represents the index of the channel as defined within the Component Mapping box or the actual component from the codestream if the file does not contain a Component Mapping box. This field is encoded as a 2-byte big-endian unsigned integer.

Typ^i Channel type. This field specifies the type of the channel for this description. The value of this field specifies the meaning of the decompressed samples in this channel. This field is encoded as a 2-byte big-endian unsigned integer. Allowed values of this field are shown in Table A.22:

Table A.22 — Typ^i field values

Value	Meaning
0	This channel is the colour image data for the associated colour.
1	Opacity. A sample value of 0 indicates that the sample (3.11) is 100 % transparent, and the maximum value of the channel (related to the bit depth of the codestream component) indicates a 100 % opaque sample.
2	Premultiplied opacity. An opacity channel as specified above, except that the value of the opacity channel has been multiplied into the colour channels for which this channel is associated. Premultiplication is defined as follows: $S_p = S \times \alpha / \alpha_{max}$ where S is the original sample (3.11), S_p is the pre multiplied sample (the sample stored in the image), α is the value of the opacity channel, and α_{max} is the maximum value of the opacity channel as defined by the bit depth of the opacity channel.
3 to ($2^{16}-2$)	Reserved for ISO/IEC use
$2^{16}-1$	The type of this channel is not specified.

Asoc^i Channel association. This field specifies the index of the colour for which this channel is directly associated (or a special value to indicate the whole image or the lack of an association). For example, if this channel is an opacity channel for the red channel in an RGB colourspace, this field would specify the index of the colour red. Table A.23 specifies allowed association values. Table A.24 specifies allowed colour indices. This field is encoded as a 2-byte big-endian unsigned integer.

Table A.23 — Asoc^i field values

Value	Meaning
0	This channel is associated as the image as a whole (for example, an independent opacity channel that should be applied to all colour channels).
1 to (2^{16} – 2)	This channel is associated with a particular colour as indicated by this value. This value is used to associate a particular channel with a particular aspect of the specification of the colourspace of this image. For example, indicating that a channel is associated with the red channel of an RGB image allows the reader to associate that decoded channel with the Red input to an ICC profile contained within a Colour Specification box. Colour indicators are specified in Table A.24.
2^{16} – 1	This channel is not associated with any particular colour.

Table A.24 — Colours indicated by the Asoc^i field

Class of colourspace	Colour indicated by the following value of the Asoc^i field			
	1	2	3	4
RGB	R	G	B	
Greyscale	Y			
YCbCr	Y	Cb	Cr	

The values in Table A.24 specify indices that have been assigned to represent specific "colours" and do not refer to specific channels (or components within the codestream). Readers shall use the information contained within the Channel Definition box to determine which channels contain which colours.

In this box, channel indices are mapped from particular components within the codestream. Colour indices specify how a particular channel shall be interpreted based on the specification of the colourspace of the image. There shall be one channel definition in this box for every colour required by the colourspace specification of this file as specified by the Colourspace Specification box.

For example, the green colour in an RGB image is specified by a {Cn, Typ, Asoc} value of {*i*, 0, 2}, where *i* is the index of that channel (either directly or as generated by applying the reverse multiple component transform to the actual components in the codestream). Applications that are only concerned with extracting the colour channels can treat the Typ/Asoc field pair as a four-byte value where the combined value maps directly to the colour indices (as the Typ field for a colour channel shall be 0).

In another example, the codestream may contain a channel *i* that specifies opacity blending samples (3.11) for the red and green channels, and a channel *j* that specifies opacity blending samples for the blue channel. In that file, the following {Cn, Typ, Asoc} tuples would be found in the Channel Definition box for the two opacity channels: {*i*, 1, 1}, {*i*, 1, 2} and {*j*, 1, 3}.

There shall be either exactly one opacity channel, exactly one pre-multiplied opacity channel, or neither associated with a single colour channel in an image. Multiple channels can be associated with the same colour, means there may be more than one channel with the same Typi and Asoci value pair.

If the codestream carries CFA pattern sensor data, the Channel Definition box indicates four channels corresponding to the four colour filters (*i,j,k,l*) of a CFA pattern sensor. In such a case, channel *i* would be associated to red, channels *j* and *k* to green, and channel *l* to blue. The {Cn,Typ,Asoc} tuples in such a case would be: {*i*,1,1}, {*j*,1,2}, {*k*,1,2}, {*l*,1,3}. The placement of the channels on the sensor grid array is then found in the CRG marker of the codestream, see ISO/IEC 21122-1. ISO/IEC 21122-1 assigns component 0 always to the red filter, components 1 and 2 to the green filter, and component 3 to the blue filter, regardless of the physical arrangement of the sensor elements on the sensor.

If the codestream contains only colour channels and those channels are ordered in the same order as the associated colours (for example, an RGB image with three channels in the order R, G, then B), then this box may not exist. If there are any auxiliary channels or the channels are not in the same order as the colour indices, then the Channel Definition box (see Table A.25) shall be found within the JXS Header box with a complete list of channel definitions.

Table A.25 — Format of the Channel Definition box

Parameter	Size (bits)	Value
N	16	1 to (2^{16}– 1)
Cn^i	16	0 to (2^{16}– 1)
Typ^i	16	0 to (2^{16}– 1)
$Asoc^i$	16	0 to (2^{16}– 1)

A.5.4.5 Exif box (optional)

The Exif box specifies additional vendor specific camera data, as ExifDataBlock defined in ISO/IEC 23008-12. The type of an Exif box is `'Exif'` (0x4578 6966). The contents of the box shall be as in Figure A.17:

Figure A.17 — Organization of the contents of the Exif box

Exif This field is 'ExifDatablock' as defined in ISO/IEC 23008-12.

A.5.5 Contiguous Codestream box

The Contiguous Codestream box contains a valid and complete JPEG XS codestream, as defined in ISO/IEC 21122-1. When displaying the image, a conforming reader shall ignore all codestreams after the first codestream found in the file. Contiguous Codestream boxes may be found anywhere in the file except before the JPEG XS Header box.

The type of a Contiguous Codestream box is `'jp2c'` (0x6A70 3263). The contents of the box shall be as in Figure A.18 and Table A.26:

Figure A.18 — Organization of the contents of the Contiguous Codestream box

Table A.26 — Format of the contents of the Contiguous Codestream box

Field name	Size (bits)	Value
Code	Variable	Variable

Code This field contains a valid and complete JPEG XS codestream as specified by ISO/IEC 21122-1 denoted as `Picture()`. The codestream structure is repeated in Table A.27. The left column of the table lists the structure as defined in ISO/IEC 21122-1, the right column combines some of the elements of the structure for the definition of the `Codestream_Header()` and the `Codestream_Body()`.

Table A.27 — JPEG XS codestream structure

Syntax as defined in ISO/IEC 21122-1	Simplified structure
Picture() {	
SOC_marker()	**Codestream_Header()**
capabilities_marker()	
picture_header()	
component_table()	
weights_table()	
other_markers()	
extension_marker()	
tpc_marker()	**Codestream_Body()**
for(t=0,p=0;!endofimage;t=t+1) {	
slice_header()	
for(u=0;u<N_p[t];p=p+1,u=u+1) {	
compute_packet_inclusion(p)	
precinct_header(p)	
for(s=0;s<N_{pc}[p];s=s+1) {	
packet_header(p,s)	
packet_body(p,s)	
}	
padding_data()	
}	
}	
EOC_marker()	
}	

Codestream_Header() The Codestream_Header() includes the SOC_marker(), the capabilities_marker(), the picture_header(), the component_table(), the weights_table(), other_markers() and the extension_marker() as defined in ISO/IEC 21122-1, except the tpc_marker(), where other_markers() indicates any marker segment with a marker in the ranges 0xff16 to 0xff1f and 0xff51 to 0xff5f except 0xff1a.

Codestream_Body() The Codestream_Body() is a Picture() as defined in ISO/IEC 21122-1 without the Codestream_Header(), but including the tpc_marker() if this marker is present at all.

NOTE By subclause B.2.1, files in the JPX file format specified in Annex B do not use temporal differential coding and thus will not carry a tpc_marker().

A.5.6 Adding intellectual property rights information in JPEG XS enabled files

This document specifies a box type for a box which is devoted to carrying intellectual property rights information within a JPEG XS enabled file. Inclusion of this information is optional. The definition of the format of the contents of this box is reserved for ISO/IEC. However, the type of this box is defined in this document as a means to allow applications to recognize the existence of IPR information. Use and interpretation of this information is beyond the scope of this document.

In general, an IPR box found at the top level of the file specifies IPR for the file as a whole. IPR boxes may be found at other locations, including inside superboxes defined by other International Standards. For those IPR boxes, the rights specified refer to the entity defined by the containing superbox.

The type of the Intellectual Property box is 'jp2i' (0x6A70 3269).

A.5.7 XML boxes

An XML box contains vendor-specific information (in XML format) other than the information contained within boxes defined by this document. There may be multiple XML boxes within the file, and those boxes may be found anywhere in the file except before the File Type box.

The type of an XML box is `'xml\040'` (0x786D 6C20). The contents of the box shall be as in Figure A.19:

Figure A.19 — Organization of the contents of the XML box

DATA This field shall contain a well-formed XML document as defined by W3C Recommendation, XML 1.0 (Fifth Edition).

The existence of any XML boxes is optional for conforming files. Also, any XML box shall not contain any information necessary for decoding the image to the extent that is defined within this document, and the correct interpretation of the contents of any XML box shall not change the visual appearance of the image. All readers may ignore any XML box in the file.

A.5.8 UUID boxes

A UUID box contains vendor-specific information other than the information contained within boxes defined within this document. There may be multiple UUID boxes within the file, and those boxes may be found anywhere in the file except before the File Type box.

The type of a UUID box is `'uuid'` (0x7575 6964). The contents of the box shall be as in Figure A.20 and Table A.28:

Figure A.20 — Organization of the contents of the UUID box

ID This field shall contain a 16-byte UUID as specified by ISO/IEC 11578. The value of this UUID specifies the format of the vendor-specific information stored in the DATA field and the interpretation of that information.

DATA This field contains vendor-specific information. The format of this information is defined outside of the scope of this document, but it is indicated by the value of the UUID field.

Table A.28 — Format of the contents of a UUID box

Field name	Size (bits)	Value
UUID	128	Variable
DATA	Variable	Variable

The existence of any UUID boxes is optional for conforming files. Also, any UUID box shall not contain any information necessary for decoding the image to the extent that is defined within this document, and the interpretation of the information in any UUID box shall not change the visual appearance of the image. All readers may ignore any UUID box.

A.5.9 UUID Info boxes (superbox)

A.5.9.1 General

While it is useful to allow vendors to extend JPEG XS enabled files by adding information using UUID boxes, it is also useful to provide information in a standard form which can be used by non-extended applications to get more information about the extensions in the file. This information is contained in UUID Info boxes. A JPEG XS enabled file may contain zero or more UUID Info boxes. These boxes may be found anywhere in the top level of the file (the superbox of a UUID Info box shall be the file itself) except before the File Type box.

These boxes, if present, may not provide a complete index for the UUIDs in the file, may reference UUIDs not used in the file, and possibly may provide multiple references for the same UUID.

The type of a UUID Info box is `'uinf'` (0x7569 6E66). The contents of a UUID Info box are as in Figure A.21:

Figure A.21 — Organization of the contents of a UUID Info box

UList UUID List box. This box contains a list of UUIDs for which this UUID Info box specifies a link to more information. The format of the UUID List box is specified in A.5.9.2.

DE Data Entry URL box. This box contains a URL. An application can acquire more information about the UUIDs contained in the UUID List box. The format of a Data Entry URL box is specified in A.5.9.3.

A.5.9.2 UUID List box

This box contains a list of UUIDs. The type of a UUID List box shall be `'ulst'` (0x756C 7374). The contents of a UUID List box shall be as in Figure A.22 and Table A.29:

Figure A.22 — Organization of the contents of a UUID List box

NU Number of UUIDs. This field specifies the number of UUIDs found in this UUID List box. This field is encoded as a 2-byte big-endian unsigned integer.

ID^i ID. This field specifies one UUID, as specified in ISO/IEC 11578, which shall be associated with the URL contained in the URL box within the same UUID Info box. The number of UUIDi fields shall be the same as the value of the NU field. The value of this field shall be a 16-byte UUID.

Table A.29 — UUID List box contents data structure values

Parameter	Size (bits)	Value
NU	16	0 to $(2^{16} - 1)$
$UUID^i$	128	0 to $(2^{128} - 1)$

A.5.9.3 Data Entry URL box

This box contains a URL which can be used by an application to acquire more information about the associated vendor-specific extensions. The format of the information acquired through the use of this URL is not defined in this document. The URL type should be of a service which delivers a file (e.g. URLs of type file, http, ftp, etc.), which ideally also permits random access. Relative URLs are permissible and are relative to the file containing this Data Entry URL box.

The type of a Data Entry URL box is `'url\040'` (0x7572 6C20). The contents of a Data Entry URL box shall be as in Figure A.23 and Table A.30:

Figure A.23 — Organization of the contents of a Data Entry URL box

VERS Version number. This field specifies the version number of the format of this box and is encoded as a 1-byte unsigned integer. The value of this field shall be 0.

FLAG Flags. This field is reserved for other uses to flag particular attributes of this box and is encoded as a 3-byte unsigned integer. The value of this field shall be 0.

LOC Location. This field specifies the URL of the additional information associated with the UUIDs contained in the UUID List box within the same UUID Info superbox. The URL shall be encoded as a null terminated string encoded in UTF-8 as specified by ISO 10646.

Table A.30 — Data Entry URL box contents data structure values

Parameter	Size (bits)	Value
VERS	8	0
FLAG	24	0
LOC	varies	varies

A.6 Dealing with unknown boxes

A JPEG XS enabled file may contain boxes not known to applications based solely on this document. If a conforming reader finds a box that it does not understand, it shall skip and ignore that box.

Annex B
(normative)

Use of JPEG XS codestreams in still image file format - JXS

B.1 General

This annex defines a still image file format that applications may choose to wrap a codestream based on a JPEG XS compressed image. While not all applications will use this format, many applications will find that it meets their needs. However, those applications that do implement this file format shall implement it as described in this entire annex. This specification is based on the same syntax as the box-based file format for JPEG 2000 in ISO/IEC 15444-1:2019, Annex I or ISO/IEC 15444-2:2021, Annex M.

This annex specifies a binary container (file) for both image and metadata based on the mechanisms of Annex A;

B.2 Specification of the JXS file format

B.2.1 General

The file format specified in this annex shall not carry codestreams that depend on temporal differential coding as specified in ISO/IEC 21122-1. The codestreams encapsulated in the file format specified in this annex therefore can be decoded without requiring information or state from previously reconstructed images.

B.2.2 File identification

JXS files can be identified using several mechanisms. When stored in traditional computer file systems, JXS files should be given the file extension ".jxs" (readers should allow mixed case for the alphabetic characters). Another possibility is to identify the file by the Signature box (A.5.1) and the File Type box (B.2.5).

B.2.3 File organization

A JXS file represents a collection of boxes and superboxes as defined in Annex A and Table B.1. The binary structure of a file is a contiguous sequence of boxes. The start of the first box shall be the first byte of the file, and the last byte of the last box shall be the last byte of the file.

The binary structure of a box is identical to ISO/IEC 15444-1:2019 and defined in A.3.

Logically, the structure of a JXS file is as shown in Figure B.1. Boxes with dashed borders are optional in conforming JXS files. However, an optional box may define mandatory boxes within that optional box. In that case, if the optional box exists, those mandatory boxes within the optional box shall exist. If the optional box is not present, then the mandatory boxes within those boxes shall also not be present.

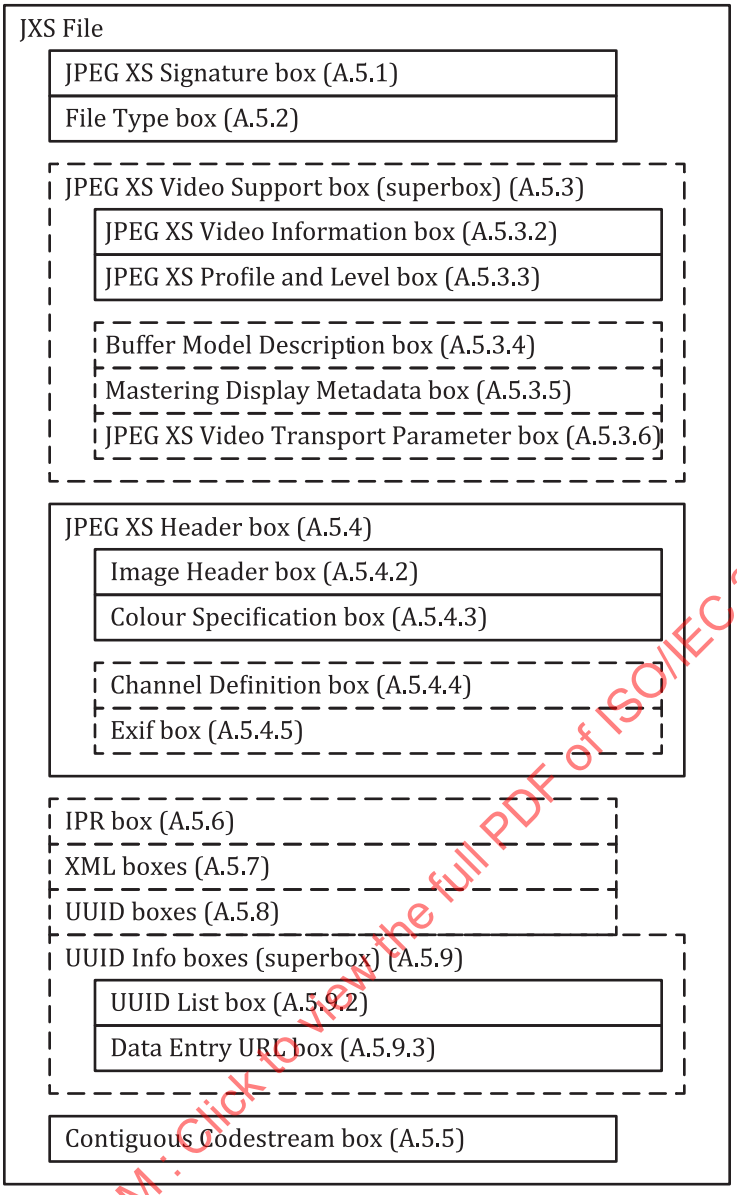

Figure B.1 — Conceptual structure of a JXS file

Figure B.1 specifies only the containment relationship between the boxes in the file. The JPEG XS Signature box shall be the first box in a JXS file, the File Type box shall immediately follow the JPEG XS Signature box and the JPEG XS Header box shall fall before the Contiguous Codestream box. For other boxes, a particular order of those boxes in the file is not generally implied.

The file shown in Figure B.1 is a strict sequence of boxes. Other boxes may be found between the boxes defined in this document. However, all information contained within a JXS file shall be in the box format; byte-streams not contained in the box format shall not be found in the file.

As shown in Figure B.1, a JXS file contains a JPEG XS Signature box, JPEG XS Header box, and one or more Contiguous Codestream boxes. A JXS file may also contain other boxes as determined by the file writer. For example, a JXS file may contain several XML boxes (containing metadata) between the JPEG XS Header box and the first Contiguous Codestream box.

B.2.4 Conformance with the file format

All files conforming to Annex B shall contain all boxes required by Table B.1, and those boxes shall be as defined in Annex A. Also, all conforming readers shall correctly interpret all required boxes defined in Table B.1 and thus shall correctly interpret all conforming files.

Because all information is encapsulated in boxes, and all boxes have types, the format provides a simple mechanism for a reader to extract relevant information, while ignoring any box that contains information that is not understood by that particular reader. In this way, new boxes can be created, through this or other International Standards. Also, any new box added to a JXS file shall not change the visual appearance of the image.

Defining boxes for private implementation purposes is discouraged. Instead, implementation-specific metadata should be carried by UUID boxes as specified in A.5.8.

Table B.1 — Required and optional boxes

Box name	Type	Superbox	Required?
JPEG XS Signature box (A.5.1)	'JXS\040' (0x4A58 5320)	No	Required
File Type box (A.5.2)	'ftyp' (0x6674 7970)	No	Required
JPEG XS Video Support box (A.5.3)	'jpvs' (0x6A70 7673)	Yes	Optional
JPEG XS Video Information box	'jpvi' (0x6A70 7669)	No	Required
JPEG XS Profile and Level box	'jxpl' (0x6A78 706c)	No	Required
Buffer Model Description box	'bmdm' (0x626D 646D)	No	Optional
Mastering Display Metadata box	'dmon' (0x646D 6f6E)	No	Optional
JPEG XS Video Transport Parameter box	'jptp' (0x6A70 7470)	No	Optional
JPEG XS Header box (A.5.4)	'jp2h' (0x6A70 3268)	Yes	Required
Image Header box	'ihdr' (0x6968 6472)	No	Required
Colour Specification box	'colr' (0x636F 6C72)	No	Required
Channel Definition box	'cdef' (0x6364 6566)	No	Optional
Exif box	'Exif' (0x4578 6966)	No	Optional
Contiguous Codestream box (A.5.5)	'jp2c' (0x6A70 3263)	No	Required
Intellectual Property box (A.5.6)	'jp2i' (0x6A70 3269)	No	Optional
XML box (A.5.7)	'xml\040' (0x786D 6C20)	No	Optional
UUID box (A.5.8)	'uuid' (0x7575 6964)	No	Optional
UUID Info box (A.5.9)	'uinf' (0x7569 6E66)	Yes	Optional
UUID List box	'ulst' (0x756C 7374)	No	Optional
URL box	'url\040' (0x7572 6C20)	No	Optional

B.2.5 File Type box

The File Type box in a JXS file shall follow its definition as given in subclase A.5.2. This box shall immediately follow the JPEG XS Signature box.

Readers shall use the **CL^{i}** fields to identify whether they are able to interpret the file contents according to the intent of its creator.

CL^{i} Compatibility list. This field specifies a code representing this document, another standard, or a profile of another standard, to which the file conforms. This field is encoded as a four-byte string of ISO/IEC 10646 characters. See Table B.1 for compatibility values that apply to the file format defined in this Annex.

A file that conforms to Annex B of this document shall have at least one CLi field in the File Type box and shall contain the value `'jxs\` in one of the **CL^{i}** fields in the File Type box, and all conforming readers shall properly interpret all files with `'jxs\040'` in one of the CLi fields. This value indicates that a frame buffer and temporal differential coding are not required to interpret the file in the manner intended by the creator.

Other values of the Compatibility list field are reserved for ISO/IEC use.

Table B.2 — Compatibility values

Value	Meaning
`'jxs\040'`	Files conforming to the file format specified in Annex B of this document.
Other values	Reserved for other ISO/IEC uses

B.3 Still image JPEG XS coding files Media Type registration

B.3.1 General

The file extension and Media Type of a file for a still image JPEG XS coding file usually reflect the major brand in the FileTypeBox. For still image JPEG XS coding files defined in Annex B, the media type defined here should be used. This annex provides a media type registration following IETF RFC 6838.

B.3.2 Registration

```
Media type name: image
Media subtype name: jxs
Required parameters: none
Optional parameters: none
Encoding considerations: binary

            Files are binary and should be transmitted in a suitable encoding without CR/LF
            conversion, 7-bit stripping etc.; base64 is a suitable encoding.

Security considerations:

            The conveyed coded image files defined in Annex B of ISO/IEC 21122-3 use a structure
            that can store image data, metadata corresponding to this image data, and other
            user-defined data. The data files have an extensible structure, so that it is
            theoretically possible that metadata fields could be defined in the future that
            could be used to induce particular actions on the part of the recipient, thus
            presenting additional security risks, but this type of capability is currently
            not supported in the current referenced specifications.

Interoperability considerations:
```

JPEG XS coded image files can conform to one of several profiles and levels of capabilities (as specified in ISO/IEC 21122-2) – not all of which may be supported by a receiving decoder. As a result, implementations may attempt to decode and display an encoded JPEG XS image only to determine that the image cannot be rendered either partially or in full.

Published specifications:

ISO/IEC 21122-3, *Information technology – JPEG XS low-latency lightweight image coding system – Part 3: Transport and container formats*

Applications: Multimedia, Imaging, Pictures, Scientific

Fragment identifier considerations: None

Restrictions on usage: None

Additional information:

Deprecated alias names for this type: N/A

Magic number(s):

Starts with 12-byte string 0x0000 000C 4A58 5320 0D0A 870A, as specified in ISO/IEC 21122-3.

File extension(s): jxs

Macintosh File Type Code(s): N/A

Object Identifiers: N/A

Intended usage: Common

Notes: None

Other general information: It should be noted that selected metadata fields may encompass information partly intended to protect the image against unauthorized use or distribution. In this case, the intention may be that alteration or removal of the data in the fields would be treated as an offence. Metadata fields may also contain information about the source of the image content.

Annex C
(normative)

Use of JPEG XS codestreams in the ISOBMFF - Motion JPEG XS

C.1 General

This annex specifies the use of JPEG XS coding for timed sequences of images within files based on the ISO base media file format (defined in ISO/IEC 14496-12), denoted Motion JPEG XS. The Motion JPEG XS file format is designed to contain one or more motion sequences of JPEG XS compressed images, with their timing. It is intended as a 'building block', specifying only the video format. An application would be expected to combine Motion JPEG XS with suitable audio, metadata, etc. for a complete application specification; that specification would normally select profiles and levels of Motion JPEG XS, and can also specify application profiles and levels that apply to the integration.

Motion JPEG XS is expected to be used in a variety of applications, particularly where JPEG XS coding technology is already available for other reasons, or where the high-quality frame-based approach, with no inter-frame coding, is appropriate. These application areas include:

— digital still cameras,

— error-prone environments such as wireless and the internet,

— video capture,

— high quality digital video recording for professional broadcasting and motion picture production from film-based to digital systems,

— and high-resolution medical and satellite imaging.

Motion JPEG XS is a flexible format, permitting a wide variety of usages, such as editing, display, interchange, and streaming.

NOTE A sample in the context of ISOBMFF (ISO/IEC 14496-12) is "all the data associated with a single time". In this annex, it is meant as data associated with one coded image not "one element in the two-dimensional image array which comprises a component".

C.2 Compatibility and technology derivation

C.2.1 Family members

This is a 'building block' specification; it defines how to store motion JPEG XS sequences in a file format based on the ISO base media file format. It stands as a member of a family of specifications with common formatting.

Since this is a building block specification, if audio is needed, then suitable audio support should be selected from other specifications using the ISO base media file format (ISO/IEC 14496-12).

These specifications share a common definition for the structure of a file (a sequence of objects, called boxes here, and atoms in other similar file formats), and a common definition of the general structure of an object (the size and type).

All these specifications require that readers ignore objects that are unrecognizable to them.

This specification takes precedence over those on which it is based, in any case where there are differences or conflicts; however, no such conflicts are known to exist.

C.2.2 Conformance

Implementations of motion JPEG XS decoders shall support the decoding of video tracks using the JPEG XS coding technology. Files conforming to this specification shall contain at least one motion JPEG XS video track.

C.2.3 Profiles and levels

The conformance to profiles is indicated in the file type box by the addition of the compatible profiles as brands within the compatibility list. Files conforming to this Annex are indicated by at least one entry in the **CL^{i}** fields of the file type box of the values `'jxs\040'` or `'jxss'`. While an entry of the former value indicates that a reader does not require a frame buffer and hence does not need to implement temporal differential coding to interpret the file, the presence of the second value in the **CL^{i}** fields indicate that temporal differential coding is required to interpret the file in the manner intended by the creator.

C.3 Sample entry and sample formats for motion sequences

C.3.1 General

The sample entry and sample formats for JPEG XS codestreams in the ISOBMFF are derived from the syntax in ISO/IEC 14496-12 and defined in B.3.2 to B.3.5.

C.3.2 Definition

Box Types: `'jxsm'`

Container: Sample Table Box (`'stbl'`)

Mandatory: Yes

Quantity: Exactly one

The format of a sample (3.13) when the sample entry name is `'jxsm'` is a JPEG XS codestream, called `Picture()` without the `Codestream_Header()` as defined in A.5.5.

Each image presented to a JPEG XS decoder is logically formed by appending the content of a sample to the content of the JPEGXSCodestreamHeaderBox().

All images in the sequence obey the constraints of the profile and level indicators in the JPEG XS Profile Box, if present; if no specific profile is indicated, then the Main Profile 444.12 of ISO/IEC 21122-2 shall be inferred (*Ppih*=0x3A40).

The values present in the `VisualSampleEntry`, its constituent boxes including the JPEG XS Video Support box, and the codestreams that these boxes describe, shall agree, to the extent that the format and precision of fields allow. This agreement includes, but is not limited to, width and height information, and the resolution declaration (within the accuracy permitted by the different representations). Files with conflicts are non-conforming and readers may attempt to decide which values are correct, or reject the file.

The fields `horizresolution` and `vertresolution` in the Visual Sample Entry indicate the highest resolution component of the image (which is typically, but not required to be, the luminance, in an image in which not all components have the same spatial sampling density).

If the coded images contain an alpha plane, a suitable value of ‘depth’, as indicated in the Visual Sample Entry, shall be used.

Colour information may be supplied in one or more ColourInformationBoxes. These should be placed in order in the sample entry starting with the most accurate (and potentially the most expensive to process), in progression to the least. These are advisory and concern rendering and colour conversion, and there is no normative behaviour associated with them; a reader may choose to use the most suitable. A ColourInformationBox with an unknown colour type may be ignored. Values of the field `colour_type` other than those documented here are reserved.

The ColourInformationBox is specific to the `VideoSampleEntry` defined in ISO/IEC 14496-12, and is not to be confused with the 'colr' box defined in other standards such as the JPX File Format (Rec. ITU-T T.801 | ISO/IEC 15444-2) or Annex B, which can be discriminated both by context and by the initial bytes of the box. More specific, the method enumerated with the value 5 in Annex A is identical to the method defined by `'nclx'` in the ColourInformationBox specific to the `VideoSampleEntry`.

NOTE If there is a need for two images in each file-format sample (3.13), for example for support of interlaced coding or separate alpha coding, this is indicated in the VideoSupportBox.

C.3.3 Syntax

```
// Visual Sequences
class JXSMSampleEntry() extends VisualSampleEntry ('jxsm'){
   JPEGXSVideoSupportBox();       // as defined in Annex A.5.3
   ColourInformationBox();        // as defined in ISO/IEC 14496-12
   JPEGXSCodestreamHeaderBox();
}
class JPEGXSVideoSupportBox() extends Box('jpvs'){
   JPEGXSVideoInformationBox(); // as defined in Annex A.5.3.2
   JPEGXSProfileandLevelBox();  // as defined in Annex A.5.3.3
   BufferModelDescriptionBox();  // optional, as defined in Annex A.5.3.4
   MasteringDisplayMetadataBox();// optional, as defined in Annex A.5.3.5
}
class JPEGXSCodestreamHeaderBox() extends Box('jxsH'){
   Codestream_Header();           // as defined in Annex A.5.5
}
```

C.3.4 Semantics

In the Visual Sample Entry:

— `Compressorname` the value `"\016Motion JPEG XS"` is suggested but not required (\016 is 14, the length of the string as a byte)

— `depth` takes one of the following values; other values are reserved, and if found, the composition behaviour is undefined

0x18 – images are in colour with no alpha

0x28 – images are in colour with alpha

In the Colour Information Box:

— for colour_type `'nclx'`: these fields are exactly the same fields as defined in Annex A for METH value 5 in still image format JXS

— `ICC_profile`: shall be an ICC profile as defined in ISO 15076-1 or ICC.1 is supplied.

NOTE ICC.1:2010 is technically identical to ISO 15076-1:2010.

C.3.5 Example of sample entry formats

Example of a Visual Sample Entry for a Video with BT.709, 4k/60p, YCbCr, 4:2:2, 10 bit, Time Code 01:23:40:59 JPEG XS Main Profile, max. bit rate 2GBit/s,