DRAFT AMENDMENT ISO/IEC 15444-1:2004/DAM 6

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

Part 1 — Amendment 6:Updated ICC profile support and resolution clarification

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

Partie 1 — Amendement 6: Support de profil ICC mis à jour et clarification de la résolution

ICS 35.040

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INTERNATIONAL STANDARD
ISO/IEC 15444-1:2004/DAM 6
ITU-T Rec. T.800 (08/2002)/Amd.6 (200X E)
ITU-T RECOMMENDATION

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

AMENDMENT 6: Updated ICC profile support, bit depth and resolution clarifications

1) Clause 2.2 Additional References

Replace:

— Specification ICC.1:1998-09, File format for Color Profiles.

With:

— Specification ICC.1:1998-09, File format for Color Profiles.

— ISO 15076-1:2005 Image technology colour management -- Architecture, profile format and data structure -- Part 1: Based on ICC.1:1998-09, File format for Color Profiles

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

2) Clause 4.1 Abbreviations

Replace:

ICC International Colour Consortium

With:

ICC International Color Consortium

3) Annex I.2.3 Greyscale, colour, palette, multi-component specification

Replace:

I.2.3 Greyscale, colour, palette, multi-component specification

The JP2 file format provides two methods to specify the colourspace of the image. The enumerated method specifies the colourspace of an image by specifying a numeric value that specifies the colourspace. In this Recommendation | International Standard, images in the sRGB colourspace and greyscale images can be defined using the enumerated method.

The JP2 file format also provides for the specification of the colourspace of an image by embedding a restricted form of an ICC profile in the file. That profile shall be of either the Monochrome or Three-Component Matrix-Based class of input profiles as defined by the ICC Profile Format Specification, ICC.1:1998-09. This allows for the specification of a wide range of greyscale and RGB class colourspaces, as well as a few other spaces that can be represented by those two profile classes. See J.9 for a more detailed description of the legal colourspace transforms, how those transforms are stored in the file, and how to process an image using that transform without using an ICC colour management engine.

While restricted, these ICC profiles are fully compliant ICC profiles and the image can thus be processed through any ICC compliant engine that supports profiles as defined in ICC.1:1998-09.

In addition to specifying the colourspace of the image, this Recommendation | International Standard provides a means by which a single component palettized image can be decoded and converted back to multiple-component form by the translation from index space to multiple-component space. Any such depalettization is applied before the colourspace is interpreted. In the case of palettized images, the specification of the colourspace of the image is applied to the multiple component values stored in the palette.

With:

I.2.3 Greyscale, colour, palette, multi-component specification

The JP2 file format provides two methods to specify the colourspace of the image. The enumerated method specifies the colourspace of an image by specifying a numeric value that identifies the colourspace. In this Recommendation | International Standard, images in the sRGB and sYCC colourspaces and greyscale images can be defined using the enumerated method.

The JP2 file format also provides for the specification of the colourspace of an image by embedding one of a restricted subset of ICC Input and Display profiles in the file. The restricted subset of ICC profiles is defined in Annex I.3.2. Their use allows for the specification of a wide range of greyscale and RGB class colourspaces, as well as some other spaces that can be represented by those two profile classes.

In addition to specifying the colourspace of the image, this Recommendation | International Standard provides a means by which a single component palettized image can be decoded and converted back to multiple-component form by the translation from index space to multiple-component space. Any such depalettization is applied before the colourspace is interpreted. In the case of palettized images, the specification of the colourspace of the image is applied to the multiple component values stored in the palette.

4) Annex I.3.2 Restricted ICC profile method

Replace:

I.3.2 Restricted ICC profile method

An application may also specify the colourspace of an image using two restricted types of ICC profiles. This method handles the specification of the most commonly used RGB and greyscale class colourspaces through a low-complexity method.

An ICC profile is a standard representation of the transformation required to convert one colourspace into another colourspace. With respect to the JP2 file format, an ICC profile defines how decompressed samples from the codestream are converted into a standard colorspace (the Profile Connection Space (PCS)). Depending on the original colourspace of the samples, this transformation may be either very simple or very complex.

The ICC Profile Format Specification defines two specific classes of ICC profiles that are simple to implement, referred to within the profile specification as Monochrome Input and Three-Component Matrix-Based Input Profiles. These profiles limit the transformation from the source colourspace to the PCS$_{XYZ}$ to the application of a non-linearity curve and a 3x3 matrix. It is practical to expect all applications, including simple devices, to be able to process the image through this transformation. Thus all conforming applications are required to correctly interpret the colourspace of any image that specifies the colourspace using this subset of possible ICC profile types.

For the JP2 file format, profiles shall conform to the ICC profile definition as defined by the ICC Profile description of the legal colourspace transforms, how those transforms are stored in the file, and how to process an image using that transform without using an ICC colour management engine.

With:

I.3.2 Restricted ICC profile method

An application may also specify the colourspace of an image using a restricted subset of ICC profiles. This method handles the specification of the most commonly used RGB and greyscale class colourspaces through a low-complexity method.

An ICC profile is a standard representation of the transformation required to convert one colourspace into another colourspace. With respect to the JP2 file format, an ICC profile defines how decompressed samples from the codestream are converted into a standard colourspace (the Profile Connection Space (PCS)). Depending on the original colourspace of the samples, this transformation may be either very simple or very complex.

ISO 15076-1:2010 defines two classes of ICC profiles, Input and Display, with profile types that are simple to implement. They are the Monochrome and Three-Component Matrix-Based Input Profiles and the Monochrome and Three-Component Matrix-Based Display profiles. These profiles limit the transformation from the source colourspace to the PCS$_{XYZ}$ to the application of either a non-linearity curve in the case of the Monochrome Input and Display profiles or a non-linearity curve and a 3x3 matrix in the case of the Three-Component Matrix-Based Input and Display Profiles. All applications, including simple devices, are expected to be able to process the image through these transformations. All conforming applications are required to correctly interpret the colourspace of any image that specifies the colourspace using this

restricted subset of possible ICC profile types. Although restricted, these ICC profiles are fully compliant ICC profiles and the image can therefore be processed through any ICC compliant engine that supports profiles as defined in ISO 15076-1:2005.

NOTE: ICC.1:1998-09 specifies what are known as V2 ICC profiles. The restricted ICC profile subset defined here are compatible with the most recent specification for the V2 ICC Profile Format, ISO 15076-1:2005. This was followed by a major revision of the ICC Profile Format to V4, which is specified in ISO 15076-1:2010. The move from V2 to V4 ICC profiles requires a change in Colour Management Modules (CMMs), which implement ICC-compliant colour transformations. However, it is common practice for V4 CMMs to support V2 profiles and the majority of profiles that a CMM has to process are still V2.

For the JP2 file format, profiles shall conform to the ICC profile definition as defined by ISO 15076-1:2005, including the restrictions specified above. Annex J.9 has a more detailed description of the legal colourspace transforms, how those transforms are stored in the file, and how to process an image using that transform without using an ICC colour management engine.

5) Annex I.5.3.1 Image Header Box

Add the following NOTE at the end of I.5.3.1:

NOTE: While subclause I.5.3.1.1 defines the default image dimension in pixels, the relation to physical dimensions is given by the Capture Resolution Box (see I.5.3.7.1) and the Display Resolution Box (see I.5.3.7.2). Note that image pixels might not be square.

6) Annex I.5.3.3 Colour Specification box

Replace the first paragraph of subclause I.5.3.3

Each Colour Specification box defines one method by which an application can interpret the colourspace of the decompressed image data. This colour specification is to be applied to the image data after it has been decompressed and after any reverse decorrelating component transform has been applied to the image data.

with:

Each Colour Specification box defines one method by which an application can interpret the colourspace of the decompressed image data. This colour specification is to be applied to the channel, representing signed or unsigned integers, and associated to colours according to the Channel Definition Box (see subclause I.5.3.6). The reconstructed numerical values of channel number i are to be interpreted using the value BPC^i in combination with the relevant colourspace definition.

The symbol BPC^i is here defined as follows: It shall be identical to the value of the B^j field of the Palette Box (see subclause I.5.3.4) if channel i is the output of palette column j, or to the value of the Bits Per Component Box BPC^j if channel i is the direct output of component j, or to the value of the BPC field of the Image Header Box if no Bits Per Component Box is present. BPC^i identifies the number of bits (bit precision) of the numerical values carried by channel i, including the sign bit if present, minus one.

If the colourspace is defined by an ICC profile, the input channels should carry unsigned values; usage of signed samples is discouraged and currently not defined by the ICC. The values x^i of channel i shall be mapped to device colour values d^i, as follows.

$$d^i = Lmax^i * x^i / (2^{BPCi+1}-1),$$

Here, $Lmax^i$ is the maximum input value associated with the relevant ICC tone reproduction curve.

If the colourspace is an enumerated colourspace and the values x^i for channel i are unsigned quantities, they shall be mapped to colour values d^i according to

$$d^i = Lmin^i + (Lmax^i - Lmin^i) * x^i / (2^{BPCi+1}-1),$$

for the purpose of establishing a correct interpretation with respect to the colourspace. Here, $Lmin^i$ and $Lmax^i$ are the minimum and maximum allowed values for the relevant colour channel, in the numerical framework used to define the colourspace.

If, however, the values x^i for channel i, are signed quantities, they shall be mapped to colour values d^i according to

$$d^i = Lzero^i + (Lmax^i - Lzero^i) * x^i / (2^{(BPCi \text{ AND } 0x7f)}-1),$$

for the purpose of establishing a correct interpretation with respect to the colourspace. Here $Lmax^i$ is again the maximum allowed value for the relevant colour, in the numerical framework used to define the colourspace, while $Lzero^i$ is the value of channel i in the representation of the colour that corresponds to the absence of any scene radiance, the complete absorption of visible light or the achromatic level, if this interpretation is applicable and all channel values are uniquely defined in this case.

Table I-10 defines both the enumerated colourspaces and the corresponding values of $Lzero^i$, $Lmin^i$ and $Lmax^i$ for this Recommendation | International Standard.

Replace Table I.9 – Legal METH values

Value	Meaning
1	**Enumerated Colourspace**. This colourspace specification box contains the enumerated value of the colourspace of this image. The enumerated value is found in the EnumCS field in this box. If the value of the METH field is 1,then the EnumCS shall exist in this box immediately following the APPROX field, and the EnumCS field shall be the last field in this box
2	**Restricted ICC profile**.This Colour Specification box contains an ICC profile in the PROFILE field. This profile shall specify the transformation needed to convert the decompressed image data into the PCS_{XYZ}, and shall conform to either the Monochrome Input or Three-Component Matrix-Based Input profile class, and contain all the required tags specified therein, as defined in ICC.1:1998-09. As such, the value of the Profile Connection Space field in the profile header in the embedded profile shall be ‘XYZ\040’ (0x5859 5A20) indicating that the output colourspace of the profile is in the XYZ colourspace. Any private tags in the ICC profile shall not change the visual appearance of an image processed using this ICC profile. The components from the codestream may have a range greater than the input range of the tone reproduction curve (TRC) of the ICC profile. Any decoded values should be clipped to the limits of the TRC before processing the image through the ICC profile. For example, negative sample values of signed components may be clipped to zero before processing the image data through the profile. See Annex J.9 for a more detailed description of the legal colourspace transforms, how those transforms are stored in the file, and how to process an image using that transform without using an ICC colour management engine. If the value of METH is 2, then the PROFILE field shall immediately follow the APPROX field and the PROFILE field shall be the last field in the box.
other values	Reserved for other ISO use. If the value of METH is not 1 or 2, there may be fields in this box following the APPROX field, and a conforming JP2 reader shall ignore the entire Colour Specification box.

with:

Value	Meaning
1	**Enumerated Colourspace**. This colourspace specification box contains the enumerated value of the colourspace of this image. The enumerated value is found in the EnumCS field in this box. If the value of the METH field is 1, then the EnumCS shall exist in this box immediately following the APPROX field, and the EnumCS field shall be the last field in this box
2	**Restricted ICC profile**. This Colour Specification box contains an ICC profile in the PROFILE field. This profile shall specify the transformation needed to convert the decompressed image data into the PCS_{XYZ}, and shall conform to either the Monochrome Input, the Three-Component Matrix-Based Input profile class, the Monochrome Display or the Three-Component Matrix-Based Display class and contain all the required tags specified therein, as defined in ISO 15076-1:2005. As such, the value of the Profile Connection Space field in the profile header in the embedded profile shall be ‘XYZ\040’ (0x5859 5A20) indicating that the output colourspace of the profile is in the XYZ colourspace. Any private tags in the ICC profile shall not change the visual appearance of an image processed using this ICC profile. The components from the codestream may have a range greater than the input range of the tone reproduction curve (TRC) of the ICC profile. Any decoded values should be clipped to the limits of the TRC before processing the image through the ICC profile. For example, negative sample values of signed components may be clipped to zero before processing the image data through the profile. See Annex J.9 for a more detailed description of the legal colourspace transforms, how those transforms are stored in the file, and how to process an image using that transform without using an ICC colour management engine. If the value of METH is 2, then the PROFILE field shall immediately follow the APPROX field and the PROFILE field shall be the last field in the box.
other values	Reserved for other ISO use. If the value of METH is not 1 or 2, there may be fields in this box following the APPROX field, and a conforming JP2 reader shall ignore the entire Colour Specification box.

Replace Table I.10 – Legal EnumCS value:

Value	Meaning
16	sRGB as defined by IEC 61966–2–1
17	greyscale: A greyscale space where image luminance is related to code values using the sRGB non-linearity given in Eqs. (2) through (4) of IEC 61966–2–1 (sRGB) specification: $Y' = Y_{8bit} / 255$ (I-1) for $(Y' \le 0{,}04045)$, $Y_{lin} = Y' / 12{,}92$ (I-2) for $(Y' > 0{,}04045)$, $Y_{lin} = \left(\frac{Y' + 0{,}055}{1{,}055}\right)^{2{,}4}$ where Y_{lin} is the linear image luminance value in the range 0.0 to 1.0. The image luminance values should be interpreted relative to the reference conditions in Section 2 of IEC 61966–2–1.
18	sYCC as defined by IEC 61966-2-1 Amd. 1 NOTE — It is not recommend to use ICT or RCT specified in Annex G of this Recommendation | International Standard with sYCC image data.See Annex J.15 for guidelines on handling YCC codestreams
other values	Reserved for other ISO uses

with:

Value	Meaning
16	sRGB as defined by IEC 61966-2-1with $Lmin_i$=0 and $Lmax_i$ =255. This colourspace shall be used with channels carrying unsigned values only.
17	greyscale: A greyscale space where image luminance is related to code values using the sRGB non-linearity given in Equations (2) through (4) of IEC 61966-2-1 (sRGB) specification: $Y' = d^i$ (I-1) for $(Y' \le 0{,}04045)$, $Y_{lin} = Y' / 12{,}92$ (I-2) for $(Y' > 0{,}04045)$, $Y_{lin} = \left(\frac{Y' + 0{,}055}{1{,}055}\right)^{2{,}4}$ where Y_{lin} is the linear image luminance value in the range 0.0 to 1.0 and d^i is the channel input value scaled according to subclause I.5.3.3 with $Lmin^i$=0 and $Lmax^i$=1.0. The image luminance values should be interpreted relative to the reference conditions in Section 2 of IEC 61966-2-1. This colourspace shall be used with channels carrying unsigned values only.
18	sYCC as defined by IEC 61966-2-1 Amd. 1with $Lmin_i$=0 and $Lmax_i$ =255. This colorspace shall be used with channels carrying unsigned values only. NOTE – It is not recommend to use ICT or RCT specified in Annex G with sYCC image data. See J.15 for guidelines on handling YCC codestreams.
other values	Reserved for other ISO uses

Replace the paragraph defining the PROFILE field:

PROFILE: ICC profile. This field contains a valid ICC profile, as specified by the ICC Profile Format Specification, which specifies the transformation of the decompressed image data into the PCS. This field shall not exist if the value of the METH field is 1. If the value of the METH field is 2, then the ICC profile shall conform to the Monochrome Input Profile class or the Three-Component Matrix-Based Input Profile class as defined in ICC.1:1998-09.

with:

PROFILE: ICC profile. This field contains a valid ICC profile, as specified by the ICC Profile Format Specification, which specifies the transformation of the decompressed image data into the PCS. This field shall not exist if the value of the METH field is 1. If the value of the METH field is 2, then the ICC profile shall conform to the Monochrome Input Profile class, the Three-Component Matrix-Based Input Profile class, the Monochrome Display profile type or the Three-Component Matrix-Based Display profile type as defined in ISO 15076-1:2005.

7) I.5.3.7.1 Capture Resolution box

Replace:

This box specifies the grid resolution at which the source was digitized to create the image samples specified by the codestream. For example, this may specify the resolution of the flatbed scanner that captured a page from a book. The capture grid resolution could also specify the resolution of an aerial digital camera or satellite camera.

With

If this box exists, it shall specify the grid resolution of the source from which the image samples represented by the codestream were captured or created. The dimensions of the reference grid are given by the contents of the Image Header Box, see subclause I.5.3.1.

The contents of the Capture Resolution Box shall be consistently adjusted between edits such that the resolution as given by this box always reflects the physical separation between reference grid points on the image region encoded or represented by the file.

If the Codestream box does not represent a physical image, this box might not exist, or might represent a physical dimension intended by the creator of the image.

NOTE: For example, this box could specify the resolution of the flatbed scanner that captured a page from a book. The capture grid resolution could also specify the resolution of an aerial digital camera or satellite camera. It may also specify the resolution at which the image in the file was rendered from a vector original or from a raster original in a resampling operation. If a new JPEG 2000 file is created by cropping from an original file, the contents of the Capture resolution box will not change as the resolution of the sample grid does not change, i.e. both the sample grid size and the size of the image described by it shrink by the same amount. If, however, an image is transcoded to a lower resolution, for example by dropping finer resolution levels, any accompanying change in the dimensions of the image on the reference grid and associated changes in the Image Header Box will need to be reflected to the contents of the Capture Resolution Box by dividing the resolution in both the horizontal and vertical directions by an appropriate factor. Note further that image pixels may not be square, i.e. horizontal and vertical grid resolutions may differ, and that not each position of the reference grid may carry an image sample due to the subsampling factors recorded in the CSIZ marker. The pixel dimensions are up to the image **capturing** process, any editing of the file will be reflected by an appropriate change of the Capture Resolution box to ensure that these dimensions remain unchanged. .

8) I.5.3.7.2 Default Display Resolution box

Replace:

This box specifies a desired display grid resolution. For example, this may be used to determine the size of the image on a page when the image is placed in a page-layout program. However, this value is only a default. Each application must determine an appropriate display size for that application.

With

If present, this box specifies a desired display grid resolution defining the intended reproduction of the file contents. The desired size of the reproduced physical image is then obtained by dividing the dimensions of the pixel grid, as given by the Image Header Box (see subclause I.5.3.1) by the horizontal and vertical resolutions as given by this box.

This box represents a default or recommended value, and applications may determine appropriate sizes for image reproduction by other means.

NOTE: This box may be used to determine the size of the image on a page when the image is placed in a page-layout program, and page layout programs may adjust the contents of this box to reflect edits performed by its users: e.g., to resize an image on a page as intended for printing or displaying on a monitor. In general, it is recommended that the pixel aspect ratio of the Capture Resolution Box and the Display Resolution Box should be the same. The following example may clarify the semantics of the Default Display Resolution box and the Capture Resolution box further: Consider an editing process that reduces the number of samples of the original image to one fourth by dropping every other horizontal and vertical pixel. One method of implementing this process would be to drop the highest resolution level and to double the horizontal and vertical subsampling factors in the CSIZ marker. Under this transformation, the dimension of the image reference grid remains unchanged, though only one fourth of the image samples remain in the image. Thus, the Capture Resolution box will remain unchanged. If it is desired to reproduce the image in half the size in each direction when displayed on

a screen or printed, the Default Display Resolution box should, however, be adjusted by multiplying the number of reference grid points per meter by two. Another method to implement this reduction in sample points might be to drop the finest resolution level and divide the dimensions of the reference grid, the canvas offsets, the tile offsets and the tile dimensions by two. Under this transformation, the dimensions of the reference grid change, and the spacing between two grid points is doubled. Thus, the number of grid points per meter in the Capture Resolution box would be divided by two. If it is desirable to reproduce the image then in one fourth its original size, the Display Resolution box would not require any change as the reference grid would contain only one fourth of the samples while the distance between each sample would remain unchanged, thus reproducing the image in a smaller scale. Note further that applications that do not honor the Default Display resolution box would reproduce the image to one fourth of the number of image **pixels** of the original image **for either editing process** by implementing the procedure of computing the number of image pixels from the number of reference grid points defined in subclause I.5.3.1.1.

9) J.9 Implementing the Restricted ICC method outside of a full ICC colour management engine

Replace the first paragraph of subclause J.9.1.1:

An ICC profile uses a tagged data format to organize its information. It is described in clause 6 of the ICC Profile Format Specification. The format consists of a 128-byte header, a tag table, and tag data. Each tag is identified by a 32-bit signature which usually corresponds to four ASCII characters. The data for each tag is stored in a format which specifies the various data elements. Each format is identified by a data type signature, which is the first 32 bits of the tag data. To get the data for a tag, first locate the signature for that tag in the tag table, which specifies the position and size of the data for that tag, and then retrieve the data based on its position and size within the tag data. Once retrieved, the tag data type signature specifies how to interpret the tag data.

With:

An ICC profile uses a tagged data format to organize its information. It is described in ISO 15076-1:2005. The format consists of a 128-byte header, a tag table, and tag data. Each tag is identified by a 32-bit signature which usually corresponds to four ASCII characters. The data for each tag is stored in a format which specifies the various data elements. Each format is identified by a data type signature, which is the first 32 bits of the tag data. To get the data for a tag, first locate the signature for that tag in the tag table, which specifies the position and size of the data for that tag, and then retrieve the data based on its position and size within the tag data. Once retrieved, the tag data type signature specifies how to interpret the tag data.

10) J9.6 Taking advantage of multiple colourspace specifications

Replace:

The JP2 format allows for a file to specify multiple methods to interpret the colourspace of an image. For example, one application may write images in which the pixel values have already been converted to the signals necessary for driving a particular output device. In that situation, it is useful for the application to provide a simple mechanism for the device to determine that additional colour processing is not required. This can be accomplished by specifying the name of the device colourspace using the Enumerated Colourspace method in one Colour specification box in the file.

With:

The JP2 format allows for a file to specify multiple methods to interpret the colourspace of an image. For example, one application might write images in which the pixel values have already been converted to the signals necessary for driving a particular output device. In that situation, it is useful for the application to provide a simple mechanism for the device to determine that additional colour processing is not required. This can be accomplished by specifying the device colourspace using the Enumerated Colourspace method in one Colour specification box in the file.

11) K.8 Colour

Replace:

[41] International Color Consortium (ICC), *ICC Profile Format Specification 1:1998-09*, (1998).

With: