Advanced Function Presentation Consortium

Presentation Object Subsets for AFP

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Chapter 1. Introduction

Advanced Function Presentation (AFP) datastreams allow inclusion of non-AFP objects. In some cases, such as TIFF, the formats can contain a wide variety of features and data formats. Some of these features may not be well defined, while others may be rarely used in practice. Popular formats may also be extended in various ways to support particular applications, or privately enhanced or modified by different vendors. A definitive list of features and extensions may not exist, which makes it very hard or impossible for AFP products to support all the possible features of each non-AFP object type.

This book describes *AFPC Subsets* for some of the object types that can be embedded in AFP. The members of the AFP Consortium (AFPC) have agreed that their products will support all the features and processing instructions described in each subset.

Each subset is a minimum set of functions supported by all the AFPC members. AFP products may support additional features that are not part of a subset. There is no guarantee, however, that a different product, even from the same vendor, will support these additional features in the same way.

Each subset is described in a separate chapter. Subsets are defined relative to the underlying object type. The specification assumes the reader is familiar with the object type that is the basis for the subset. In addition to the subset specification, each chapter will list the relevant Object-type Object IDs (OIDs) that can be used for the conformant objects and main references describing the object type. Appendix A, Related Publications, lists references that apply to multiple object types.

Chapter 2. Tagged Image File Format (TIFF)

Tagged Image File Format (TIFF) is a rich image format that is also easily extended by using private tags. This makes TIFF a difficult format to process. Most of the image applications, however, use a contained TIFF subset. The purpose of this chapter is to define a TIFF subset that would be relatively straightforward to process, but still meet the needs of most printing applications, as well as cover most TIFF images encountered in practice. This subset is called the *AFPC TIFF Subset*.

AFPC TIFF Subset is defined relative to the whole TIFF 6.0 Specification. It is not defined relative to the "baseline TIFF" described in the specification, since the baseline subset is much too restrictive to be useful.

Overview

This section describes the main TIFF features included in the subset. The purpose is to give an overview and explain the rationale for some of the main restrictions. The Specification section describes the details from the technical perspective.

This TIFF subset is tuned for printing, with the assumption that the TIFF objects are included in the AFP data stream using the object container mechanism. Both single and multiple-page TIFFs are supported in this subset. Please see Multi-page TIFFs below.

Thumbnails (reduced resolution images) are not supported in this subset, since thumbnails are not meant for printing.

Transparency mask images are not supported, since popular image processing programs used to generate and view images do not support them. Instead, transparency masks are supported via the **ExtraSamples** tag, as explained in the Transparency Masks section below.

Tiled images are not supported, since they are seldom encountered in practice.

The old-style JPEG data (compression 6) has well-documented problems and is not supported. JPEG-compressed data is supported via the compression 7 mechanism defined in TIFF Tech Note 2. Any image conforming to the JPEG object subset is supported under compression 7.

TIFF allows private tags. Applications can obtain reserved tag IDs from Adobe for their private tags. If a receiver encounters an unknown tag, TIFF specification instructs it to ignore it. If a receiver encounters private tag that it understands and whose values conflict with a standard tag, AFPC TIFF Subset gives priority to the standard tag.

Subset Specification

This subset is based on the TIFF Release 6.0 specification, combined with the TIFF Tech Note 2, which defines a new way of incorporating JPEG-compressed data. Note that a *standard* tag means a tag described in TIFF Release 6.0 specification, not a tag in the baseline TIFF subset.

Fully Supported Standard Tags

The following standard TIFF tags are fully supported:

Table 1. Fully Supported Standard TIFF Tags

Hex Tag ID	Tag Name
X'FF'	SubfileType
X'100'	ImageWidth
X'101'	ImageLength
X'10A'	FillOrder
X'111'	StripOffsets
X'112'	Orientation
X'116'	RowsPerStrip
X'117'	StripByteCounts
X'11A'	XResolution
X'11B'	YResolution
X'11C'	PlanarConfiguration
X'11E'	XPosition
X'11F'	YPosition
X'122'	GrayResponseUnit
X'123'	GrayResponseCurve
X'124'	T4Options
X'125'	T6Options
X'13D'	Predictor
X'140'	ColorMap
X'211'	YCbCrCoefficients
X'212'	YCbCrSubsampling
X'214'	ReferenceBlackWhite

Standard Tags Supported with Restrictions

X'FE' - NewSubfileType

Thumbnail and transparency mask images are skipped. Please see the Multi-page TIFFs and Transparency Masks sections below.

X'102' - BitsPerSample

1 and 8 bits per color channel. If the image has multiple channels, all channels must have the same bit depth. 1 bit data is supported only for Photometric Interpretations of 0 and 1 (i.e. black and white). All multichannel images must be 8 bits per channel.

Note: Extra samples that describe transparency masks can be 1-bit in planar images, regardless of the bit depth of the main color channels.

X'103' - Compression

Old-style JPEG compression (6) is not supported. JPEG compression 7 (see TIFF Tech Note 2) is supported instead.

X'106' - PhotometricInterpretation

CIELab is assumed to have the D65 illuminant, which follows from the TIFF specification.

The YCbCr color space is treated as a device-dependent RGB color space that has been transformed using the default weights from the TIFF specification (ITU-R Recommendation BT.601, which was CCIR Recommendation 601-1 when the TIFF Specification was published). The YCbCrCoefficients tag is supported if the application has used different weights.

RGB and CMYK images that are otherwise unqualified are treated as device-dependent and receivers can interpret the color information as they deem appropriate.

Please see Appendix B on issues related to processing of JPEG-compressed images generated by Adobe products.

X'115' - SamplesPerPixel
Only certain extra samples are supported. See the Transparency Masks section below.

X'128' - ResolutionUnit
Relative resolution treated as inches (i.e., 1 treated as 2).

X'129' - PageNumber
The second value, indicating the total number of images in the file, is ignored.

X'152' - ExtraSamples
Only certain extra samples, carrying associated alpha data denoting transparency mask, are supported. See the Transparency Masks section below.

Unsupported Standard Tags

The following unsupported tags are ignored:

Table 2. Unsupported Standard TIFF Tags

Hex Tag ID	Tag Name
X'107'	Thresholding
X'108'	CellWidth
X'109'	CellLength
X'10D'	DocumentName
X'10E'	ImageDescription
X'10F'	Make
X'110'	Model
X'118'	MinSampleValue
X'119'	MaxSampleValue
X'11D'	PageName
X'120'	FreeOffsets
X'121'	FreeByteCounts
X'12D'	TransferFunction
X'131'	Software
X'132'	DateTime

Table 2. Unsupported Standard TIFF Tags (continued)

Hex Tag ID	Tag Name
X'13B'	Artist
X'13C'	HostComputer
X'13E'	WhitePoint
X'13F'	PrimaryChromaticities
X'141'	HalftoneHints
X'142'	TileWidth
X'143'	TileLength
X'144'	TileOffsets
X'145'	TileByteCounts
X'14C'	InkSet
X'14D'	InkNames
X'14E'	NumberOfInks
X'150'	DotRange
X'151'	TargetPrinter
X'153'	SampleFormat
X'154'	SMinSmpleValue
X'155'	SMaxSampleValue
X'156'	TransferRange
X'200'	JPEGProc
X'201'	JPEGInterchangeFormat
X'202'	JPEGInterchangeFormatLength
X'203'	JPEGRestartInterval
X'205'	JPEGLosslessPredictors
X'206'	JPEGPointTransforms
X'207'	JPEGQTables
X'208'	JPEGDCTables
X'209'	JPEGACTables
X'213'	YCbCrPositioning
X'8298'	Copyright

Additional Supported Tags

X'8773' - ICCProfile

If the receiving product can color manage, it must use the ICC Profile provided in the file.

Note: The receivers can use the information as appropriate in their color management scheme. For example, it is valid for the product to let the user override the embedded profile. It should also be noted that support of embedded ICC Profiles is a system-level requirement, not a transform requirement. A print server can extract the ICC Profile from the data, make an audit Color Management Resource (CMR)

based on it and send the TIFF to the printer with the profile removed and the CMR attached instead.

Multi-page TIFFs

TIFF files may contain multiple pages or images. If the TIFF file is being processed in a context where multiple images are not meaningful, the receiver will process only the first image. The “first” is defined according to the order described below.

If the TIFF file has multiple pages, the pages are ordered in the ordering specified by the **PageNumber** tag. Any images that do not contain the **PageNumber** tag are processed in the order in which they occur in the file, after the images that do contain the **PageNumber** tag. If no image in the file has a **PageNumber** tag, the images are processed in order.

The page numbers in **PageNumber** tags of different images do not have to be consecutive, but must be unique. If two images have the same **PageNumber** tag, the receiver should report an error.

Any thumbnail and transparency mask images found in processing are ignored and the above rules are applied by skipping them.

Transparency Masks

TIFF has two mechanisms for specifying the transparency mask. One is by using the **NewSubfileType** tag, where the image may be marked as a transparency mask. This tag has potential ambiguities and is not supported by image processing packages such as Gimp or Adobe Photoshop. Transparency Mask images are not supported by this TIFF subset.

The second mechanism for specifying the transparency mask is via the extra samples. It is known that at least Photoshop can generate such data. This subset supports the transparency masks specified via extra samples with the following conditions and restrictions:

- Both planar and interleaved data are supported.
- **ExtraSamples** tag must be marked with 1, *Associated alpha data (with pre-multiplied color)*.
- If the image is interleaved, the mask channel must have the same bit depth as the other data.
- If the data is planar, the mask data may also be 1-bit.
- Image must be compressed using a lossless algorithm.
- If the mask value is nonzero for a pixel, that pixel is treated as foreground. Only the pixels that have the extra sample of zero are treated as background.
- Foreground pixels knock out the background. There is no blending, regardless of the extra sample mask value for the pixel.

Resources

Object-type OID

Images that conform to the TIFF Subset are marked with the following OID:

X'06072B120004010142'
AFPC TIFF Subset.

Note: If a TIFF containing a transparency mask defined via the alpha channel is marked by one of the other TIFF OIDs, the receiver will ignore the transparency mask.

References

- *TIFF Revision 6.0 Specification*, Adobe Systems Incorporated, June 3, 1993. Available at

  http://partners.adobe.com/public/developer/en/tiff/TIFF6.pdf
- *DRAFT TIFF Technical Note 2*, March 17, 1995. Available at

  http://www.remotesensing.org/libtiff/TIFFTechNote2.html

Chapter 3. Joint Photographic Experts Group (JPEG)

Joint Photographic Experts Group (JPEG) defines a number of image compression schemes and several ways to organize the data. This subset is designed to cover all of the parts of the JPEG specification that the receivers can reasonably expect to encounter in practice. This subset is called the *AFPC JPEG Subset*.

JPEG is primarily defined as a compression format, but is also being widely used as a file format. Using JPEG as a file format depends on all emitters and receivers making common assumptions on image parameters, such as the color space, that are not explicitly defined in the data. These assumptions will be explicitly described in the specification of this subset.

Overview

This section describes the main JPEG features included in the subset. The purpose is to give an overview and explain the rationale for some of the main restrictions. The Specification section describes the details from the technical perspective.

JPEG-compressed data can be either sequential or hierarchical. The data can be compressed using either losseless or lossy algorithms. Hierarchical JPEG and lossless compression are not in widespread use and are not supported.

JPEG supports two types of entropy coding: Huffman and arithmetic. Arithmetic coding is rarely encountered in practice and is not supported. Arithmetic coding was subject to several patents, believed since expired. Intellectual property issues, complexity of the arithmetic coding and potential performance penalty resulted in Huffman coding being used almost exclusively for images meant for interchange among different applications.

JPEG allows underlying image data to be either 8 or 12 bits per color channel. 12 bit images, used mainly for medical imaging, are not supported.

A number of file formats, like JPEG Interchange File Format (JFIF) and Exchangeable File Format (EXIF), use application markers to provide additional image information, such as resolution and thumbnail. Some may impose additional requirements on the data, such as the color space and gamma correction. This subset does not require support for such file formats.

Specification

Color Spaces

Images with one, three and four components are supported. Single component images are assumed to be grayscale i.e., zero is black, 255 is white.
Three-component images are assumed to be RGB data encoded as YCbCr using the luma red, luma green, and luma blue values of 0.299, 0.587, and 0.114 respectively, as specified in ITU-R Recommendation BT.601, which was previously known as CCIR Recommendation 601-1.

Four-component images are assumed to be CMYK. CMYK may be present in a transformed form if the Adobe APP14 marker is present in the data.

If the receiving product can color manage, it must use the ICC Profile provided via the APP2 (X'FFE2') marker. The receivers can use the information as appropriate in their color management scheme. For example, it is valid for the product to let the user override the embedded profile. It should also be noted that support of embedded ICC Profiles is a system-level requirement, not a transform requirement. A print server can extract the ICC Profile from the data, make an audit Color Management Resource (CMR) based on it and send the JPEG to the printer with the profile removed and the CMR attached instead.

Please see Appendix B on issues related to processing of JPEG-compressed images generated by Adobe products.

Start of Frame (SOF) Markers

Start of Frame Markers are X'FFC0–3' , X'FFC5–7' , X'FFC9–B' and X'FFCD–F'. Each marker corresponds to a particular data organization (sequential or hierarchical), compression type (lossy or lossless), entropy coding (Huffman or arithmetic) and scan organization (sequential or progressive).

Start of Frame Marker contains the frame header describing the image. The frame header contains the following fields:

frame header length
This value depends on the number of the color components.

sample precision
Must be 8.

number of lines
Must be nonzero. JPEG also allows a zero value, meaning that the image length will be specified later using the DNL marker. The DNL marker and zero length are not supported in the subset.

number of samples per line
Subset places no restrictions on this field. Any values allowed by JPEG are valid.

number of components in frame
Must be 1, 3 or 4.

frame component specification
Subset places no restrictions on the fields in the component specification. Any values allowed by JPEG are valid. In particular, there are no restrictions on the subsampling factors.

AFPC JPEG Subset supports the following SOF markers:

- X'FFC0' – Baseline DCT.
- X'FFC1' – Huffman Extended Sequential DCT.
- X'FFC2' – Huffman Progressive DCT.

Other SOF markers are not supported.

For the Huffman Progressive DCT data, both spectral selection and successive approximation are supported.

Note: If the "Progressive" option is chosen on saving a JPEG image, Adobe Photoshop will often generate an image that has been compressed using both progressive selection and successive approximation.

Other Issues

The viewers that present images on a display will generally scale a JPEG image to some reasonable output size, so the image resolution is irrelevant. Some of the applications that convert JPEG images to other formats will assume that the images were generated for displays and have the resolution of 72dpi. There are scanner products, however, that package scanned images as high-quality JPEGs that may have a resolution of 300dpi or higher.

AFP generators should include the Image Resolution Triplet X'9A' to describe the resolution of the input JPEG image. Alternatively, the output mapping option can be set to scale-to-fit or scale-to-fill to get the output of the desired size. If neither of these are specified for a JPEG image, the receivers should assume that the image has been produced at the device output resolution.

Resources

Object-type OID

The generators should mark the images known to conform to the JPEG Subset with the following OID:

X'006072B120004010117'
JPEG

References

- Pennebaker, William B., and Mitchell, Joan L., *JPEG: Still Image Data Compression Standard*. Van Nostrand Reinhold, New York, 1992. ISBN 0-442-01272-01.
- *ISO/IEC International Standard 10918-1.*
- *ITU–TSS Recommendation T.81.*

Appendix A. Related Publications

This Appendix lists references that are of interest for more than one object type. The following are the related AFP architecture documents, available at the AFP Consortium Web site at

http://www.afpcinc.org

- Mixed Object Document Content Architecture (MO:DCA) Reference
- Intelligent Printer Data Stream (IPDS) Reference
- Color Management Object Content Architecture (CMOCA) Reference

Appendix B. Adobe APP14 JPEG Marker

Adobe products use the APP14 (X'FFEE') JPEG marker to describe the actual color information in the compressed JPEG data. The following description is based on researching the information publicly available and by experiment, since Adobe does not publicly document the data placed in the APP14 marker.

The marker has the length of 14, meaning there are 12 data bytes following the length. The data bytes are as follows:

Table 3. Adobe Application Tag 14 Syntax

Byte Offset	Name	Value	Meaning
0-4		Adobe	APP14 marker contains Adobe data.
5-6	Encoder identifier tag	X'0064'	Photoshop
7-8	flag0	X'0000', X'8000'	**X'0000'** nothing specified **X'8000'** blend subsampling
9-10	flag1	X'0000'	**X'0000'** nothing specified
11	Transform flag	X'00' - X'02'	**X'00'** Unknown. 4-component data is assumed CMYK, 3-component RGB **X'01'** YCbCr **X'02'** YCCK

Notes:

1. flag0 contains hepful but optional data for the decoder (i.e., the decoder may safely ignore).
2. flag1 contains required decoder data (i.e., the decoder must use the information).

YCCK is obtained from CMYK by converting CMY to “YCC” using the RGB-to-YCbCr conversion formulas with the ITU-R Recommendation BT.601 (CCIR Recommendation 601-1) lumas:

lumaRed = 0.299

lumaGreen = 0.587

lumaBlue = 0.114

Y = lumaRed * cyan + lumaBlue * magenta + lumaGreen * yellow

Cb = (magenta – Y) / (2 – 2 * lumaBlue)

Cr = (cyan – Y) / (2 – 2 * lumaRed)

These formulas lead to “reverse video” Y, Cb and Cr. The K channel is also reversed (i.e., “K” in YCCK is really 255-K). Thus, a YCCK value of 255,0,0,0 is black and a value of 0,0,0,255 is white.

This mechanism is the same regardless of whether the data is carried within TIFF or as standalone JPEG.

The meaning of “CMYK” (transform flag value of X'00' for 4-channel data) depends on whether the JPEG is standalone, or carried within TIFF. If carried within TIFF, CMYK is standard CMYK (0,0,0,0 is white). If within standalone JPEG, CMYK is reverse video i.e., each component must be inverted via 255- before using (0,0,0,0 is black).

Note: This means that 4-component JPEG images that contain an Adobe APP14 marker with a transform flag value of zero cannot be converted to TIFF just by prepending the appropriate TIFF header to JPEG data. CMYK values must be transcoded and inverted, or the TIFF will be reverse-video.

Glossary

A

addressable position. A position in a presentation space or on a physical medium that can be identified by a coordinate from the coordinate system of the presentation space or physical medium. See also *picture element*. Synonymous with *position*.

all points addressable (APA). The capability to address, reference, and position data elements at any addressable position in a presentation space or on a physical medium. Contrast with character cell addressing, in which the presentation space is divided into a fixed number of character-size rectangles in which characters can appear. Only the cells are addressable. An example of all points addressability is the positioning of text, graphics, and images at any addressable point on the physical medium. See also *picture element*.

B

background. The part of a presentation space that is not occupied with object data. Contrast with *foreground*.

background color. The color of a background. Contrast with *foreground color*.

band. An arbitrary layer of an image. An image can consist of one or more bands of data.

C

CMOCA. See *Color Management Object Content Architecture*.

CMR. See *Color Management Resource*.

CMYK color space. The primary colors used together in printing to effectively create a multitude of other colors: cyan, magenta, yellow, and black. Based on the subtractive color theory; the primary colors used in four color printing processes.

color management resource. Objects that provide color management in presentation environments.

color model. The model by which a color is specified. For example, the RGB model specifies color in terms of three intensities for red (R), green (G), and blue (B).

Color Management Object Content Architecture (CMOCA). An architected collection of constructs used for the interchange and presentation of the color management information required to render a print file, document, group of pages or sheets, page, overlay, or data object with color fidelity.

coordinate system. A Cartesian coordinate system. An example is the image coordinate system that uses the fourth quadrant with positive values for the Y axis. The origin is the upper left-hand corner of the fourth quadrant. A pair of (x,y) values corresponds to one image point. Each image point is described by an image data element.

D

data element. A unit of data that is considered indivisible.

data stream. A continuous stream of data that has a defined format.

device dependent. Dependent upon one or more device characteristics.

device-independent color space. CIE-based color space that allow color to be expressed in a device-independent way. It ensures colors to be predictably and accurately matched among various color devices.

digital image. An image whose image data was sampled at regular intervals to produce a digital representation of the image. The digital representation is usually restricted to a specified set of values.

E

exchange. The predictable interpretation of shared information by a family of system processes in an environment where the characteristics of each process must be known to all other processes. Contrast with *interchange*.

F

foreground. The part of a presentation space that is occupied with object data. See also *pel*. Contrast with *background*.

foreground color. A color attribute used to specify the color of the foreground of a >primitive. Contrast with *background color*.

H

hexadecimal. A number system with a base of sixteen. The decimal digits 0 through 9 and characters A

through F are used to represent hexadecimal digits. The hexadecimal digits A through F correspond to the decimal numbers 10 through 15, respectively. An example of a hexadecimal number is X'1B', which is equal to the decimal number 27.

I

image. An electronic representation of a picture produced by means of sensing light, sound, electron radiation, or other emanations coming from the picture or reflected by the picture. An image can also be generated directly by software without reference to an existing picture.

image point. A discrete X,Y coordinate in the image presentation space. See also *addressable position*.

Intelligent Printer Data Stream (IPDS). An architected host-to-printer data stream that contains both data and controls defining how the data is to be presented.

interchange. The predictable interpretation of shared information in an environment where the characteristics of each process need not be known to all other processes. Contrast with *exchange*.

International Organization for Standardization (ISO). An organization of national standards bodies from various countries established to promote development of standards to facilitate international exchange of goods and services, and develop cooperation in intellectual, scientific, technological, and economic activity.

interoperability. The capability to communicate, execute programs, or transfer data among various functional units in a way that requires the user to have little or no knowledge of the unique characteristics of those units.

IPDS. See *Intelligent Printer Data Stream*.

ISO. See *International Organization for Standardization*.

J

JFIF. JPEG File Interchange Format. Three-component JPEG images. RGB data is assumed without gamma correction and the APP0 marker is used to specify the resolution and optionally the thumbnail.

JPEG. Joint Photographic Experts Group. An image compression standard.

L

lossless. A form of image transformation in which all of the data is retained. Contrast with *lossy*.

lossy. A form of image transformation in which some of the data is lost. Contrast with *lossless*.

M

Mixed Object Document Content Architecture (MO:DCA). An architected, device-independent data stream for interchanging documents.

O

orientation. The angular distance a presentation space or data block is rotated in a specified coordinate system, expressed in degrees and minutes. For example, the orientation of printing on a physical medium, relative to the X_m axis of the X_m,Y_m coordinate system.

P

physical medium. A physical entity on which information is presented. Examples of a physical medium are a sheet of paper and a display screen. See also *medium*.

pel. The smallest printable or displayable unit on a physical medium. In computer graphics, the smallest element of a physical medium that can be independently assigned color and intensity. Picture elements per inch is often used as a measurement of presentation granularity. Synonymous with *pixel* and *picture element*.

picture element. The smallest printable or displayable unit on a physical medium. In computer graphics, the smallest element of a physical medium that can be independently assigned color and intensity. Picture elements per inch is often used as a measurement of presentation granularity. Synonymous with *pel* and *pixel*.

pixel. The smallest printable or displayable unit on a physical medium. In computer graphics, the smallest element of a physical medium that can be independently assigned color and intensity. Picture elements per inch is often used as a measurement of presentation granularity. Synonymous with *pel* and *picture element*.

presentation space. A conceptual address space with a specified coordinate system and a set of addressable positions. The coordinate system and addressable positions can coincide with those of a physical medium.

R

rotation. The orientation of a presentation space with respect to the coordinate system of a containing presentation space. Rotation is measured in degrees in

a clockwise direction. Zero-degree rotation exists when the angle between a presentation space's positive X axis and the containing presentation space's positive X axis is zero degrees.

row. A subarray that consists of all elements that have an identical position within the high dimension of a regular two-dimensional array.

T

TIFF. Tagged Image File Format. A rich and flexible image format.

Y

YCCK. CMYK data carried in the luminance-chrominance form. **YCC** are computed from CMY, while K is the black channel carried in the reverse-video form (**K** = 255 - K). See Appendix B, Adobe APP14 JPEG marker.

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