The Printer Working Group

Standard for PDF Image-Streamable Format – “PDF/is”

(Formerly “PDFax”)

Proposed Standard - Working Draft 510n.y-P0.5

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The Printer Working Group Standard for PDF Image-Streamable Format (PDF/is) Proposed Standard - Working Draft 510n.y-P0.5

Abstract: This standard specifies a subset of PDF (Portable Document Format) 1.4 known as the PDF Image-Streamable Format (PDF/is) by formally defining a series of PDF/is "profiles" distinguished primarily by the method of image compression employed and color space used.
In summary PDF/is is an image document format intended for use by, but not limited to, the IPPFAX protocol, which is used to provide a synchronous, reliable exchange of image Documents between Senders and Receivers. PDF/is makes reference to the PDF 1.4 Reference [pdf], which describes the PDF representation of image data specified by the ITU-T Recommendations for black-and-white facsimile (see [t.4], [t.6]), the ISO/IEC Specifications for Digital Compression and Coding of Continuous-Tone Still Images (see [jpeg]), and Lossy/Lossless Coding of Bi-Level Images (see [jbig2]), and the general purpose Flate compression methods (see [rfc1950] and [rfc1951]).

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1 Introduction

In summary, PDF/is is a raster image data format intended for use by, but not limited to, the IPPFAX protocol. IPPFAX is used to provide a synchronous, reliable exchange of image Documents between Senders and Receivers. PDF/is makes reference to the PDF 1.4 specification [pdf], which describes the PDF (Portable Document Format) representation of image data specified by the ITU-T Recommendations for black-and-white facsimile (see [t.4], [t.6]), the ISO/IEC Specifications for Digital Compression and Coding of Continuous-Tone Still Images (see [jpeg]), and Lossy/Lossless Coding of Bi-Level Images (see [jbig2]), and the general purpose Flate compression methods (see [rfc1950] and [rfc1951]).

PDF/is is an image-only, streamable, subset specification of PDF 1.4 [pdf] and, as such, follows all of the specification requirements of PDF.

As a streamable version of PDF, it is not required that a Consumer of a PDF/is document be able to randomly access the PDF. The format has been adopted in such a way as to allow a Consumer the ability to read the PDF/is document from the beginning to end without the necessity to cache more data than is necessary to print the current page with some exceptions, as noted.

If a Document adhering to this specification is not encrypted (does not Implement Profiles 'STD-ENC' nor 'PPK-ENC') it will Implement a conforming subset of the "PDF/X-3" specification (See [pdf-x3]) for use in digital prepress data exchange.

2 Terminology

This section defines terminology used throughout this document.

2.1 Conformance Terminology

Capitalized terms, such as **MUST, MUST NOT, REQUIRED, SHOULD, SHOULD NOT, MAY, NEED NOT, OPTIONAL,** and **PROHIBITED**, have special meaning relating to conformance as defined in RFC 2119 [rfc2119] and [rfc2911] section 12.1. If an implementation supports the extension defined in this document, then these terms apply; otherwise, they do not. These terms define conformance to *this document (and [rfc2911]) only*; they do not affect conformance to other documents, unless explicitly stated otherwise. To be more specific:

REQUIRED (REQ) - an adjective used to indicate that a conforming PDF/is Producer or Consumer's implementation MUST support the indicated operation, object, attribute, or attribute value. See [rfc2911] "Appendix A - Terminology for a definition of "support".

RECOMMENDED (REC) - an adjective used to indicate that a conforming PDF/is Producer or Consumer's implementation SHOULD support the indicated operation, object, attribute, or attribute value.

OPTIONAL (OPT) - an adjective used to indicate that a conforming PDF/is Producer or Consumer's implementation MAY support the indicated operation, object, attribute, or attribute value.

PROHIBITED (PROH) - an adjective used to indicate that a conforming PDF/is Producer or Consumer's implementation MUST NOT support the indicated operation, object, attribute, or attribute value.

IGNORED – an adjective used to indicate that a conforming PDF/is Producer or Consumer implementation NEED NOT support the indicated operation, object, attribute, or attribute value; but this feature MAY be added to a future version of this specification.

AS SPECIFIED – is used to indicate that a conforming PDF/is Producer or Render implementation MUST, MAY, or MUST NOT support the indicated operation, object, attribute, or attribute value as is defined in the indicated specification.

OR – a conjunction that specifies a logical 'or', implying that a choice of one or more of the choices specified.

XOR – a conjunction that specifies a logical 'exclusive or', implying that a choice of one and only one of the choices specified.

2.2 Other Terminology

The following terms are introduced and capitalized in order to indicate their specific meaning:

Implement – The specified feature is present in the Document.

Support – A Producer has the capability of Implementing the feature specified, or the Consumer has the capability of understanding and acting on the Implementation.

Document – The PDF/is-formatted electronic representation of a set of one or more pages that the Sender sends to the Receiver.

Consumer – This is the agent (software, hardware or some combination) that converts the Document into a displayed or printed form.

Producer -- This is the agent (software, hardware or some combination) that creates the Document.

Interpolation – See 'Interpolation' in [pdf] pg. 273.

Forward-Reference – In indirect object reference (See [pdf] Section 3.2.9) to an object that appears later in the Document.

Cache – Consumer's storage, either memory, disk, or the like, to hold Document data as it's received from the Producer.

Page-Relative Objects – Objects that are indirectly referenced (See [pdf] Section 3.2.9) by either a 'Page' object or through a chain of object references that start with a reference from a 'Page' object.

Discarded – An adjective that describes a PDF object. An object is 'Discarded' when the Consumer no longer has access to the data within the object in question.

3 PDF/is Support

3.1 Profiles

3.1.1 Image Profiles

The following table defines the Profile names used to describe various image compression filters and techniques.

Table 3-1: Image Profiles

Profile	Image Implementation	Reference
<G4>	'CCITTFaxDecode' Filter	[pdf] Section 3.3.5
<FLATE>	'FlateDecode' Filter	[pdf] Section 3.3.3
<JBIG2>	'JBIG2Decode' Filter	[pdf] Section 3.3.6
<MASK>	Masked Images	[pdf] Section 4.8.5
<JPEG>	'DCTDecode' Filter	[pdf] Section 3.3.7
<JP2K>	JPEG2000 Filter	Not Currently Supported

3.1.2 Security Profiles

There are several options that MAY be Supported by a Producer or Consumer with regard to security:

Table 3-2: Security Profiles

Profile	Security Implementation	Reference
<STD-ENC>	'Standard' Encryption	[pdf] Section 3.5.2
<PPK-ENC>	PPK Encryption	[pdf-ppk] Section 3
<DIG-SIG>	Digital Signature	[pdf-ppk] Section 2.2

3.1.3 Color Profiles

Table 3-3: Color Profiles

Profile	Color Space Implementation	Reference
<GRAY>	'DeviceGray'	[pdf] Page 182
<RGB>	'DeviceRGB'	[pdf] Page 184
<LAB>	'Lab'	[pdf] Page 187
<ICC>	'ICCBased'	[pdf] Page 189
<IDX>	'Indexed'	[pdf] Page 199

3.2 PDF Object Requirements

For the table shown below, if an Object/Filter is not Implemented then its associated Profile is not Implemented.

315 Key:

316 **Producer**: Producer Requirement.

317 **Consumer**: Consumer Requirement.

318 **Profile**: If the indicated 'PDF Object/Filter' is Implemented then the Document Implements the
319 indicated Profile.

320 **Dependencies**: In order to Implement the 'PDF Object/Filter' the Profiles indicated in the
321 Dependencies column MUST also be implemented. Note that a comma ',' in this column
322 indicates an 'and'.

323 **Table 3-4: PDF Object Requirements**

PDF Object/Filter	Producer	Consumer	Reference
'ASCIIHexDecode' Filter	PROH	PROH	[pdf] Section (3.3.1)
'ASCII85Decode' Filter	PROH	PROH	[pdf] Section (3.3.2)
'LZWDecode' Filter	PROH	PROH	[pdf] Section (3.3.3)
'RunLengthDecode' Filter	PROH	PROH	[pdf] Section (3.3.4)
Incremental Updates	PROH	PROH	[pdf] Section (3.4.5)
Functions	PROH	PROH	[pdf] Section (3.9)
Files	PROH	PROH	[pdf] Section (3.10)
Graphics State	PROH	PROH	[pdf] Section (4.3)
Path objects	PROH	PROH	[pdf] Section (4.4)
'DeviceGray' Color Space	PROH	PROH	[pdf] Section (4.5.3)
'DeviceRGB' Color Space	PROH	PROH	[pdf] Section (4.5.3)
'DeviceCMYK' Color Space	PROH	PROH	[pdf] Section (4.5.3)
Pattern Color Space	PROH	PROH	[pdf] Section (4.5.5)
Separation Color Space	PROH	PROH	[pdf] Section (4.5.5)
DeviceN Color Space	PROH	PROH	[pdf] Section (4.5.5)
Pattern Objects	PROH	PROH	[pdf] Section (4.6)
Inline Image Objects	PROH	PROH	[pdf] Section (4.8.6)
Form Xobjects	PROH	PROH	[pdf] Section (4.9)
Postscript Xobjects	PROH	PROH	[pdf] Section (4.10)
Text Objects	PROH	PROH	[pdf] Section (5)
Transparency	PROH	PROH	[pdf] Section (7)
'CCITTFaxDecode' Filter (Image Profile <G4>)	REQ	REQ	[pdf] Section (3.3.5)
File Header	REQ	REQ	[pdf] Section (3.4.1)
Cross-Reference Table	REQ	REQ	[pdf] Section (3.4.3)
File Trailer	REQ	REQ	[pdf] Section (3.4.4)
Document Catalog	REQ	REQ	[pdf] Section (3.6.1)
Page Tree Nodes	REQ	REQ	[pdf] Section (3.6.2)
Page Objects	REQ	REQ	[pdf] Section (3.6.2)
Content Streams	REQ	REQ	[pdf] Section (3.7.1)
Resource Dictionaries	REQ	REQ	[pdf] Section (3.7.2)
Image XObjects	REQ	REQ	[pdf] Section (4.8)
'FlateDecode' Filter (Image Profile <FLATE>)	OPT	REQ	[pdf] Section (3.3.3)
'JBIG2Decode' Filter (Image Profile <JBIG2>)	OPT	OPT	[pdf] Section (3.3.6)
'DCTDecode' Filter (Image Profile <JPEG>)	OPT	REQ	[pdf] Section (3.3.7)
Encryption Dictionary 'Standard' Encryption (Security Profile <STD-ENC>)	OPT	OPT	[pdf] Section (3.5)

Encryption Dictionary PPK Encryption (Security Profile <PPK-ENC>)	OPT	OPT	[pdf-ppk] Section (3)
'DeviceGray' Color Space (Color Profile <GRAY>)	OPT	REQ	[pdf] pg. 182
'DeviceRGB' Color Space (Color Profile <RGB>)	OPT	REQ	[pdf] pg. 184
'Lab' Color Space (Color Profile <LAB>)	OPT	REQ	[pdf] pg. 187
'ICCBased' Color Space (Color Profile <ICC>)	OPT	OPT	[pdf] pg. 189
'Indexed' Color Space (Color Profile <IDX>)	OPT	REQ	[pdf] pg. 199
Masked Images (Image Profile <MASK>)	OPT	REQ	[pdf] Section (4.8.5)
Interactive Form Dictionary and Annotation Field Dictionary and Signature Dictionary (Security Profile <DIG-SIG>)	OPT	OPT	[pdf] Section (8.6.1-3) [pdf-ppk] Section (2)
Cached Objects	OPT	REQ	Section 3.4
Tiling	REQ	REQ	Section 3.3.11.3

3.3 PDF Field Specification

The following list describes the object field values of the REQUIRED and OPTIONAL PDF objects in PDF/is. The numbers in '( )'s refer to section numbers in the PDF Specifications [pdf], unless otherwise noted. 'AS SPECIFIED' refers to [pdf] unless otherwise noted.

3.3.1 'PDF/is' object

A new 'PDF Name Registry' (See [pdf] – Appendix E) object that is REQUIRED for a PDF/is document. The existence of this dictionary object is the one and only way to determine if the PDF in question is a PDF/is. Spec:

Table 3-5: PDF/is Object

Field	Type	Specification
'Fis_Profiles'	Array of Numeric Objects	REQUIRED: An array consisting of [**MAJ_VER MIN_VER IMAGES SECURITY MEMORY**]
'Encrypt'	Dictionary	MUST have same value as 'Encrypt' field in the 'Document Trailer'. See [pdf] table 3.12 for specification.
'Root'	Dictionary	MUST have same value as 'Root' field in the 'Document Trailer'. See [pdf] Table 3.12 for specification.
'Info'	Dictionary	MUST have same value as 'Info' field in the 'Document Trailer'. See [pdf] Table 3.12 for specification.
'ID'	Array	MUST have same value as 'ID' field in the 'Document Trailer'. See [pdf] Table 3.12 for specification.
'Fis_NextPage'	Dictionary	REQUIRED: An Indirect Object Reference to the first 'Page' object.

See [pdf] Section 3.2.5 for definition of an 'Array Object'. See [pdf] Section 3.2.2 for definition of a 'Numeric Object'.

3.3.1.1 Fis_Profiles Key

3.3.1.1.1 MAJ_VER:

The 'major' version number of this PDF/is specification to which the Producer conforms to at the time the Document was created. The 'major' version of this specification is currently '0'.

3.3.1.1.2 MIN_VER:

The 'minor' version number of this PDF/is specification to which the Producer conforms to at the time the Document was created. The 'minor' version of this specification is currently '5'.

3.3.1.1.3 IMAGES, SECURITY:

Each value in the array MUST be a 'Numeric Integer Object' (See [pdf] Section 3.2.2) that is the sum of all of the Integer equivalents of the binary 'Bit Positions' for the Profiles that are Implemented in the Document, as indicated under the appropriate section below. The 'Bit Positions' are numbered from 1 (low-order) to 32 (high-order). A '1' in a 'Bit Position' indicates the Profile in indicated. All other Bit Positions for each element MUST be 0. Note that PDF Numeric Integer Objects in fact are represented in signed twos-complement form.

For example, to indicate that the IMAGES Profiles 'FLATE' (bit position 3 or 100 binary) and 'MASK' (bit position 5, or 10000 binary), the value of '20' (10100 binary) should be used as the value for the 'IMAGES' field.

The Producer of the Document MUST NOT Implement a Profile that is not indicated in this field. The Producer of the Document MAY Implement all Profiles indicated in this field, but is NOT REQUIRED.

> Rationale: Since this object must be Implemented at the beginning of the Document, it may not be known for certain which Profiles will be Implemented. This field is an advisory indicator to a Consumer as to which Profiles they MUST Support in order to be able to render the Document for certain. If all Profiles indicated are not Supported, the Document may still be rendered if a non-Supported Profile is indicated but is not actually Implemented in the Document.

Note that even though a Profile is higher in the Image Profile tree it SHOULD NOT be indicated in this object unless that feature is Implemented in the document. For example, if the document contained 'FLATE' (FlateDecode) images but no 'JPEG' (DCTDecode) images, only Profile 'FLATE' should be indicated.

Table 3-6: PDF/is Object 'IMAGES' Element

Profile	Bit Position
<JBIG2>	1
<JP2K>	2

Table 3-7: PDF/is Object 'SECURITY' Element

Profile	Bit Position
<STD-ENC>	1
<PPK-ENC>	2
<DIG-SIG>	3

3.3.1.1.4 MEMORY:

A 'Numeric Object' that is the decimal value of the minimum amount of cache memory the Consumer will need to cache all objects necessary to render any particular page.

This memory MUST be available for PDF/is data file caching and MUST not be part of any image processing or page buffer memory.

The value specified for 'MEMORY' is in Megabytes and is in addition to a base memory requirement of 2 Megabytes (2^21 bytes).

The value of the memory requirement MUST be agreed upon between the Producer and the Consumer before the Document is generated. This value is usually the minimum of the cache memory available to either the Producer or the Consumer. The usage of this memory is to cache objects as specified in the "Object Lifetime" section of this specification. It should be noted that an 'Image XObjects' data stream typically won't be 'cached' into this memory since these streams can often be rendered into a page buffer as they are received, even if masked. This is true since all image masks and color profile data MUST occur in the Document before the 'Image XObject's that reference them.

3.3.1.1.5 Example

An example of the PDF/is object for a Document containing a CalRGB color space (Profile <RGB>), masked (Profile <MASK>), JPEG image (Profile <JPEG>) that's Standard encrypted (Profile <STD-ENC>) would look like this:

```
1 0 obj
<<
        /Fis_Profiles [0 5 24 0]
        /Encrypt 2 0 R
        /Root 3 0 R
        /Info 4 0 R
        /Fis_NextPage 5 0 R
>>
endobj
```

3.3.2 'FlateDecode' Filter

See [pdf] Section 3.3.3, [rfc1950], and [rfc1951].

Table 3-8: FlateDecode Filter

Field	Specification
<All Fields>	AS SPECIFIED

3.3.3 'CCITTFaxDecode' Filter

See [pdf] Section 3.3.5, [t.4], and [t.6]. Note that only Group 4 images are Supported by PDF/is, see 'K', below.

Table 3-9: CCITTFaxDecode Filter

Field	Specification
'K'	MUST have a value of -1.
'EndOfLine'	AS SPECIFIED
'EncodedByteAlign'	AS SPECIFIED
'Columns'	AS SPECIFIED
'Rows'	AS SPECIFIED
'EndOfBlock'	AS SPECIFIED

'BlackIs1'	AS SPECIFIED
'DamagedRowsBeforeError'	AS SPECIFIED

3.3.4 'JBIG2Decode' Filter

See [pdf] Section 3.3.6, [jbig2], and [t.89].

Table 3-10: JBIG2Decode Filter

Field	Specification
<All Details>	AS SPECIFIED, except as noted below.

- The Producer MUST Implement ONLY JBIG2 **Profile 1** (0x00000101 BASE) OR **Profile 4** (0x00000104 Medium lossy/lossless arithmetic) of [t.89].
- All Consumers MUST support at least "Level 2" Memory (See [t.89], Table 1, Item 18).
- The Producer MUST adhere to the Function and Memory constraints as specified in [t.89].

3.3.5 'DCTDecode' Filter

See http://partners.adobe.com/asn/developer/acrosdk/docs/filefmtspecs/PDFReference.pdf[pdf] Section 3.3.7, [ps-jpeg], [ps], and [jpeg]. PDF/is supports both the JPEG Baseline DCT and Extended sequential DCT compressed image formats.

Table 3-11: DCTDecode Filter

Field	Specification
<All Details>	AS SPECIFIED, except as noted below.

- Images MUST NOT have interleaved scans.
- Images MUST NOT be encoded using 'Progressive JPEG'.
- The Consumer MUST adhere to the Memory requirements specified in Section 11 "RAM Requirements" of [ps-jpeg] for the Consumers Supported image resolution(s).

3.3.6 File Trailer

See [pdf] Table 3.12.

Table 3-12: File Trailer

Field	Specification
'Size'	AS SPECIFIED
'Prev'	PROHIBITED
'Root'	AS SPECIFIED
'Encrypt'	AS SPECIFIED, but PROHIBITED if the Document is to be PDF/X-3 Compliant (See

	[pdf-x3]).
'Info'	REQUIRED.
'ID'	REQUIRED. MUST use a pseudo-random number in place of 'File Size' when generating this value. See [pdf] Section 9.3 for guidelines on how to generate this value. Rationale: Using a random number in place of file size is due to the requirements of using this field in generating the encryption key for the 'standard encryption' algorithm ([pdf] Step 5 of Algorithm 3.2, pg. 78): file size will not be known at the time this field is needed.

3.3.7 Encryption Dictionary

See [pdf] Table 3.13 and [pdf-ppk] Table 3.

Note that if a Document is Standard encrypted (Profile <STD-ENC>), the 'ID' field of the File Trailer MUST be calculated before the Encryption Dictionary is written. The 'ID' MUST then be cached until the 'File Trailer' is written.

Table 3-13: Encryption Dictionary

Field	Specification
'Filter'	REQUIRED: MUST have a value of 'Standard' if <STD-ENC> is Implemented, otherwise AS SPECIFIED.
'V'	MUST have a value of '2'.
'Length'	AS SPECIFIED
'R'	AS SPECIFIED
'O'	REQ if <STD-ENC>, PROH otherwise
'U'	REQ if <STD-ENC>, PROH otherwise
'P'	REQ if <STD-ENC>, PROH otherwise
'SubFilter'	MUST be 'adbe.pkcs7.s4' if <PPK-ENC>, PROH otherwise
'Recipients'	REQ if <STD-ENC>, PROH otherwise

3.3.8 Document Catalog

See [pdf] Table 3.16.

Table 3-14: Document Catalog

Field	Specification
'Type'	AS SPECIFIED
'Version'	AS SPECIFIED
'Pages'	AS SPECIFIED
'PageLabels'	IGNORED
'Names'	IGNORED.
'Dests'	IGNORED.
'ViewerPreferences'	IGNORED.
'PageLayout'	IGNORED.
'PageMode'	IGNORED.
'Outlines'	IGNORED.
'Threads'	IGNORED.
'OpenAction'	IGNORED.
'AA'	IGNORED.

'URI'	IGNORED.
'AcroForm'	REQ if <DIG-SIG>, PROH otherwise
'Metadata'	IGNORED.
'StructTreeRoot'	IGNORED.
'MarkInfo'	AS SPECIFIED., See below.
'Lang'	IGNORED.
'SpiderInfo'	IGNORED.
'OutputIntents'	PROHIBITED.

'Tagged PDF' ([pdf] Section 9.7) MAY be used to enter searchable text in a Document. A Producer MAY apply Optical Character Recognition (OCR) on the images of each page in a Document to generate searchable text. Since 'Tagged PDF' information can be used for Document searching and does not affect printed output, its usage is OPTIONAL for the Producer and MAY be IGNORED by a conforming Consumer.

3.3.9 Page Tree Nodes

See [pdf] Table 3.17.

Table 3-15: Page Tree Nodes

Field	Specification
'Type'	AS SPECIFIED
'Parent'	AS SPECIFIED
'Kids'	AS SPECIFIED
'Count'	AS SPECIFIED
<All 'Page Object' Fields, see [pdf] Table 3.18>	PROHIBITED

3.3.10 Page Objects

See [pdf] Table 3.18.

Table 3-16: Page Objects

Field	Specification
'Type'	AS SPECIFIED
'Parent'	AS SPECIFIED
'LastModified'	AS SPECIFIED
'Resources'	MUST NOT be inherited
'MediaBox'	MUST NOT be inherited
'CropBox'	MUST NOT be inherited. If Present, the TrimBox MUST NOT extend beyond the boundaries of the CropBox.
'BleedBox'	AS SPECIFIED. If Present, the TrimBox MUST NOT extend beyond the boundaries of the BleedBox.
'TrimBox'	REQUIRED.
'ArtBox'	PROHIBITED.
'BoxColorInfo'	PROHIBITED.
'Contents'	AS SPECIFIED.
'Rotate'	MUST NOT be inherited
'Group'	PROHIBITED.
'Thumb'	IGNORED.
'B'	IGNORED.
'Dur'	IGNORED.

'Trans'	IGNORED.
'Annots'	IGNORED.
'AA'	IGNORED.
'Metadata'	IGNORED.
'PieceInfo'	IGNORED.
'StructParents'	IGNORED.
'ID'	IGNORED.
'PZ'	IGNORED.
'SeparationInfo'	PROHIBITED.
'Fis_NextPage'	REQUIRED: An Indirect Object Reference to the next 'Page' object or a 'Page Node' if this is the last page.

The size of the current page can be determined by the value of the 'MediaBox'. The value associated with 'MediaBox' is an array of the coordinates of the page rectangle in default user space units (1/72 of an inch). An 8.5 X 11 inch page, oriented Portrait, would be:

/MediaBox [0 0 612 792]

3.3.11 Content Stream Operators

See [pdf] Table 4.1. A conforming Consumer MUST be able to parse the Content Stream operators listed below, but only must be able to act upon the operators that are not listed as IGNORED.

Table 3-17: Content Stream Operators

Operators	Specification	Reference
'q'	AS SPECIFIED	[pdf] Table 4.7
'Q'	AS SPECIFIED	[pdf] Table 4.7
'cm'	MUST be [Sx 0 0 Sy Tx Ty], See Below	[pdf] Table 4.7
'Do'	AS SPECIFIED	[pdf] Table 4.34
'MP'	IGNORED	[pdf] Table 9.8
'DP'	IGNORED except for 'Tiling operator' and 'Cache operator', see below	[pdf] Table 9.8
'BMC'	IGNORED	[pdf] Table 9.8
'BDC'	IGNORED	[pdf] Table 9.8
'EMC'	IGNORED	[pdf] Table 9.8
'BX'	AS SPECIFIED	[pdf] Table 3.20
'EX'	AS SPECIFIED	[pdf] Table 3.20
<All elements between a 'BMC' or 'BDC' and an 'EMC'>	IGNORED	[pdf] Table 9.8
<All other Operators>	PROHIBITED	

3.3.11.1 cm:

See [pdf] Table 4.7 for definition of ‘cm’ operator.

Given:

Wi = Width (X-direction) of the Image in inches.

Hi = Height (Y-direction) of the Image in inches.

Xi = Horizontal translation, in inches, from the left edge of the page to the top of the image.

Yi = Vertical translation, in inches, from the top edge of the page to the top of the image.

The Producer MUST ensure that the following is true:

Sx = Wi * 72

Sy = Hi * 72

Tx = Xi * 72

Ty = Yi * 72

3.3.11.2 Do:

See [pdf] Table 4.34 for definition of ‘Do’ operator.

Given:

Img = The ‘Image XObject’ associated with the ‘Do’ operator.

Cm = The current ‘cm’ operation in effect for ‘Img’.

Wp = ‘Width’ field of ‘Img’.

Hp = ‘Height’ field of ‘Img’.

Sx = ‘Sx’ value of ‘Cm’.

Sy = ‘Sy’ value of ‘Cm’.

The following MAY be assumed by either the Producer or the Consumer:

Rx = (Wp * 72 / Sx) = The resolution, in the X-direction, of ‘Img’, in dots per inch.

Ry = (Hp * 72 / Sy) = The resolution, in the Y-direction, of ‘Img’, in dots per inch.

3.3.11.3 DP:

See [pdf] Table 9.8 for a definition of the ‘DP’ Operator.

The only ‘Marked Content’ flags that are not ignored in a PDF/is Document are the ‘Tiling Operator’ and the ‘Cache operator’.

3.3.11.3.1 The Tiling Operator:

Tiling facilitates the creation of a complex series of images on a PDF/is page to a Producer or Consumer that may be memory constrained and unable to otherwise create

or display the page. If the Producer of the Document is able to determine that the current page will violate the cache memory constraints of the Consumer; the Consumer MUST break up the current page into non-overlapping regions to be displayed (Tiling) or free up resources using the 'Cache Operator' (see below). Tiling is specified in the content stream of the page. Tiling indicates that all previous images or masks in the stream up to the "Tiling operator" do not overlay, and are not overlaid by, any images or masks that follow in the stream.

To indicate that a new 'tile' is beginning, the content stream MUST contain the following operator syntax, exactly as shown:

/Fis_tile <</Fis_tile [X Y]>> DP

Where:
X: The user-space relative direction with regard to the X-axis that will not be overlapped.
Y: The user-space relative direction with regard to the Y-axis that will not be overlapped.
X and **Y** MUST only have values of '-1', '0', or '1'.

A value of '0' indicates that the entire width of this axis will not be overlapped by images and masks to follow in the content stream. This value would be used if each 'Tile' were a full width 'band' of the page or it was the last tile on a row or column. For example, if a band spanned the width (the X axis) of the page, the 'X' value should be '0'.

A value of '-1' indicates that all remaining images and masks in the content stream have lesser values of this axis. For example, for a band that spanned the top of a page, the 'Y' value would be '-1' (since Y values decrease as you move down the page).

A value of '1' indicates that all remaining images and masks in the content stream have greater value for this axis. For example, for a band that spanned the left edge of a page, the 'X' value would '1' (X axis values increase as you move to the right).

It should be noted that tiles may progress from the top to the bottom, bottom to top, left to right, or right to left as necessary. The order and progression of the Tiles SHOULD be determined by either the capabilities of the Producer or the Consumer. The specification of how this should be done is outside the scope of this specification.

See the following examples to help illuminate this feature. The shaded area is the area that is specified to be non-overlapping by the parameters of the /Fis_tile operator of the tile in **Bold**. The number before the colon is the order in which the tile appears in the content stream.

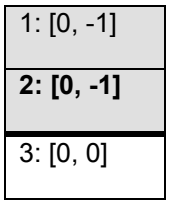
Example #1, Tile #1 is detailed:

1: [1, -1]	2: [0, -1]
3: [0, -1]	4: [0, 0]

Example #2:

3: [1, 0]	6: [1, 0]	9: [0, 0]
2: [1, 1]	**5: [1, 1]**	8: [0, 1]
1: [1, 1]	4: [1, 1]	7: [0, 1]

Example #3:



A 'Tile Operator' MUST only occur between displayed images on a page, and MUST NOT occur at the beginning and/or end of the content stream. A 'Tile Operator' occurring immediately before any **Do** operators in the content stream MUST be IGNORED. A 'Tile Operator' that occurs after all **Do** operators MUST also be IGNORED.

To illustrate this feature:
A page with two tiles, each tile running across the page, might have a content stream that looks like this:

```
500 0 0 100 25 767 cm  % region of first 'tile'.  500 units wide, 100 units high,
                       % 25 units from top left corner (page is 11" tall, 792 units high).
/Im1 Do                % Display image in first band.
/Fis_tile <</Fis_tile [0 -1]>> DP% 'Tile Operator' .
500 0 0 100 25 667 cm  % Second region, does not overlap first band-- notice Y offset of
                       % 667 does not overlap bottom of first band.
/Im2 Do                % Display image in second band.
```

3.3.11.3.2 The Cache Operator:

The 'Cache Operator' allows the Producer of the Document to specify that certain 'cached' objects (See 'Cached Objects' section in this specification) may be released from the cache at a certain point in the content stream. See 'Cache Release' section in this document for use of this operation. This operation would allow a Consumer to Discard specified objects to free resources for image operations. This operator has the following syntax:

/Fis_cache <</**Fis_cache** [OBJECTS]>> DP

3.3.12 Resource Dictionaries

See [pdf] Table 3.21.

The Resource Dictionary MUST reference all Image XObjects and ColorSpaces that are used on the current page. The position of the image objects, their masks, and color spaces with respect to each other is defined in the Image XObject section of this specification.

Table 3-18: Resource Dictionaries

Field	Specification
'ExtGState'	PROHIBITED.
'ColorSpace'	AS SPECIFIED.
'Pattern'	PROHIBITED.
'Shading'	PROHIBITED.
'XObject'	AS SPECIFIED.
'Font'	PROHIBITED.
'ProcSet'	'Text' Proc Sets PROHIBITED, all others AS SPECIFIED.

'Properties'	IGNORED.

592

593 **3.3.13 Color Spaces**

594 See [pdf] Section 4.5.

595 **Table 3-19: Color Spaces**

Field	Specification
'Lab'	AS SPECIFIED
'DeviceGray'	AS SPECIFIED
'DeviceRGB'	AS SPECIFIED, but see below.
'DeviceCMYK'	PROHIBITED
'CalGray'	PROHIBITED
'CalRGB'	PROHIBITED
'ICCBased'	AS SPECIFIED, but see below.
'Indexed'	AS SPECIFIED, but see below.
'Pattern'	PROHIBITED
'Separation'	PROHIBITED
'DeviceN'	PROHIBITED

596

597 **3.3.13.1 DeviceRGB Color Space**

598 The Producers who uses 'DeviceRGB' color space, and Consumers that interpret them,
599 SHOULD Implement the color values assuming 'DeviceRGB' to be the 'sRGB' standard IEC
600 61966-2-1 (1999-10) (See [srgb]).
601

602 **3.3.13.2 ICCBased Color Space**

603 See [pdf] Table 4.16
604 Note that to minimize ICC profile data size, **FlateDecode** Filter compression MAY be used.
605 It should also be noted that a Document with an ICCBased color space can be decoded by a
606 Consumer that does not support ICCBased color spaces. In this case, the Consumer should use
607 the 'Alternate' color space as defined by the Field of the same name.
608

609 **Table 3-20: ICCBased Color Space**

Field	Specification
'N'	MUST be either '1' or '3'.
'Alternate'	MUST be either '/DeviceGray', '/DeviceRGB', or '/Lab'
'Range'	AS SPECIFIED.
'Metadata'	AS SPECIFIED.

610

611 **3.3.13.3 Indexed Color Space**

612 An Index may be applied to any other supported color space, although it has limited value when
613 applied to 'DeviceGray'. The Producer of a Document that used an Indexed color space MAY
614 apply the **FlateDecode** filter to the color space data to minimize data size.

3.3.14 Image XObjects

See [pdf] Table 4.35 for description of the following table.

Table 3-21: Image XObjects

Field	Specification
'Type'	MUST be 'XObject'
'Subtype'	MUST be 'Image'
'Width'	AS SPECIFIED
'Height'	AS SPECIFIED
'ColorSpace'	AS SPECIFIED, and see below.
'BitsPerComponent'	AS SPECIFIED
'Intent'	PROHIBITED.
'ImageMask'	AS SPECIFIED, if Profile <MASK>
'Mask'	AS SPECIFIED, if Profile <MASK>, and see below.
'SMask'	PROHIBITED.
'Decode'	AS SPECIFIED.
'Interpolate'	MUST be 'true'
'Alternates'	IGNORED
'Name'	IGNORED.
'StructParent'	IGNORED.
'ID'	IGNORED.
'OPI'	PROHIBITED.
'Metadata'	IGNORED.

- An 'ImageMask', if indicated in an Image XObject, MUST appear in the Document before the Image XObject that references it.
- If an 'ICCBased' or 'Indexed' color space is indicated in an Image XObject, the data for the color space MUST appear in the Document before the Image XObject that references it.

3.3.15 Masked Images

See [pdf] Section 4.8.5.

Table 3-22: Masked Images

Field	Specification
<All Fields>	AS SPECIFIED

3.3.16 Interactive Form Dictionary

See [pdf] Table 8.47.

632 **Table 3-23: Interactive Form Dictionary**

Field	Specification
'Fields'	MUST be an indirect object of an 'Annotation Field Dictionary'.
'NeedAppearances'	PROHIBITED
'SigFlags'	MUST be '3'
'CO'	PROHIBITED
'DR'	PROHIBITED
'DA'	PROHIBITED
'Q'	PROHIBITED

633

634 **3.3.17 Annotation Field Dictionary**

635 See [pdf] Tables 8.10 & 8.49. This dictionary consists of entries from both a 'Annotation
636 Dictionary (Table 8.10) and a 'Field Dictionary' (Table 8.49).

637 **Table 3-24: Annotation Field Dictionary**

Field	Specification
'Type'	MUST be 'Annot'
'Subtype'	MUST be 'Widget'
'Contents'	IGNORED
'P'	IGNORED
'Rect'	MUST be '[0 0 0 0]'
'NM'	IGNORED
'F'	IGNORED
'BS'	IGNORED
'Border'	IGNORED
'AP'	IGNORED
'AS'	IGNORED
'C'	IGNORED
'CA'	IGNORED
'T'	IGNORED
'Popup'	IGNORED
'A'	IGNORED
'AA'	IGNORED
'StructParent'	IGNORED
'FT'	MUST be 'Sig'
'Parent'	PROHIBITED.
'Kids'	PROHIBTED.
'T'	AS SPECIFIED.
'TU'	AS SPECIFIED.
'TM'	IGNORED.
'Ff'	MUST be '1'.
'V'	MUST be an indirect object to a 'Signature Dictionary'.
'DV'	IGNORED.
'AA'	IGNORED.

638
639

640 **3.3.18 Signature Dictionary**

641 See [pdf] Table 8.60 and [pdf-ppk] Table 2.

642 The Digital Signature format MUST only be in the 'Raw Format', see [pdf-ppk] Section 2.2.

643 **Table 3-25: Signature Dictionary**

Field	Specification
'Type'	MUST be 'Sig'
'Filter'	AS SPECIFIED.
'SubFilter'	MUST be 'adbe.x509.rsa_sha1'
'Name'	AS SPECIFIED.
'Reason'	AS SPECIFIED.
'Location'	AS SPECIFIED.
'M'	AS SPECIFIED.
'ByteRange'	PROHIBITED (Implies all bytes in the Document with the exclusion of the bytes represented by the value of the 'Cert' field. See [pdf] for this field)
'Contents'	AS SPECIFIED.
'Cert'	AS SPECIFIED.
'R'	AS SPECIFIED.
'V'	AS SPECIFIED.
'ADBE_Build'	AS SPECIFIED.
'ADBE_AuthType'	AS SPECIFIED.
'ADBE_PwdTime'	AS SPECIFIED.

644

645 ### 3.3.19 Document Information Dictionary

646 See [pdf] Table 9.2.

647 **Table 3-26: Document Information Dictionary**

Field	Specification
'Title'	REQUIRED*
'Author'	REQUIRED*
'Subject'	AS SPECIFIED
'Keywords'	AS SPECIFIED
'Producer'	AS SPECIFIED
'Producer'	AS SPECIFIED
'CreationDate'	REQUIRED*
'ModDate'	REQUIRED*
'Trapped'	REQUIRED, MUST be either 'TRUE' or 'FALSE'. Partially Trapped files are PROHIBITED.
'GTS_PDFXVersion'	PROHIBITED if Profile <STD-ENC> or <PPK-ENC> is Implemented; otherwise MUST be "(PDF/X-3:2002)"

648 *Some fields in this object are required due to the specification of PDF/X-3 (See [pdf-x3]).

649

650 ## 3.4 Object Lifetime

651 Some Consumer's may be limited in the amount of storage they may have to cache the
652 Document as it's received from the Producer. This storage limitation may prohibit the Consumer
653 from holding the entire Document before beginning to render the first page. To facilitate this

storage constraint, PDF/is has a mechanism of “object lifetime”. This mechanism defines how long an object must be held in storage before it is no longer needed.

If a Document can be fully maintained in the Consumer’s storage, the Document’s Cross-Reference table should be used to access objects as they are needed. In this case, the Consumer should follow the parsing model as spelled out in the PDF Reference [pdf].

If a Document cannot be fully maintained within the Consumers storage, the Document MUST be linearly parsed and the following parsing rules MUST be adhered to:

1) Documents MUST be parsed in order, from beginning to end.
2) The first object, the “PDF/is” object MUST never be Discarded.
3) All non-IGNORED objects that are referenced from other Cached objects MUST not be Discarded.
4) All Cached non-Page-Relative Objects (See Terminology) MUST be not be Discarded until the Document rendering is complete.
5) All ‘Page-Relative’ Objects MUST NOT be Discarded until the next ‘Page’ object or the ‘Document Catalog’ is reached; unless the object is held in the ‘Cache Hold’ (See next section). This also implies that all rendering of the current page MUST be complete before “reaching” the next ‘Page’ object or the ‘Document Catalog’.
6) If rendering of a “Band” (See Section 3.3.11.3) is complete, objects that are referenced in the ‘content stream’ of the completed ‘band’ may be Discarded, if the object is not referenced in the remainder of the ‘content stream’ and is not ‘Cached’ (See next section).

3.5 Cached Objects

If a ‘Page-Relative’ object MAY be used on more than one page, it will be necessary to specify the object as ‘Cached’. Once an object is cached, it no longer has to abide by ‘Object Lifetime’ requirements 5 and 6. This will allow an object to be used throughout the Document that otherwise would be discarded.

An object that is held in the Consumers cache by the ‘Cache Hold’ mechanism MUST be maintained in the cache until one of the following conditions is met:

The ‘Cache Release’ mechanism is invoked.

The ‘Document Catalog’ is reached.

3.5.1 Cache Hold

To specify that an object should not be discarded once the current page is rendered, the object to be ‘cached’ should have the following ‘Dictionary Object’ (See [pdf] Section 3.2.6):

/Fis_Cache [ ]

3.5.2 Cache Release

To release an object from the Consumer’s memory; the following ‘Dictionary Object’ MUST be placed in the ‘Page Object’ of the first page in which the object is no longer needed. For example, if the object is question was first found on page 1 and was last used on page 3, the ‘Cache Release’ should occur in the ‘Page Object’ for page 4.

/Fis_Cache [OBJECTS]

Where:

OBJECTS: is an array (contained in ‘[]’s) of indirect object references of the objects that were previously cached and are no longer needed. Indication of an object number that was never cached MUST be ignored.

Example:

```
3 0 obj
<<
/Fis_Cache []                    %First object to be cached.
…
>>
endobj
…
7 0 obj                          %Second object to be cached.
<<
/Fis_Cache []
…
>>
endobj
…                                %One or more Page objects in between.
45 0 obj
<<
/Type /Page                      %Page object
/Fis_Cache [3 0 R 7 0 R]         %Objects 3 and 7 are no longer needed.
. . .
>>
endobj
```

4 Conformance Requirements

This section specifies the conformance requirements for Consumers and Producers.

4.1 Producer conformance requirements

In order to conform to this specification, a Document Producer:

1. MUST specify the version of PDF (See [pdf] Section 3.4.1) as being ‘PDF 1.4’.
2. MUST place the ‘PDF/is’ object as the first object in the PDF.
3. MUST place any ‘Encryption Dictionary’ object as the second object in the PDF/is Document, if the Document is encrypted.
4. MUST NOT include any private ‘PDF Name Registry’ values/objects (See [pdf] – Appendix E) that affect printed output.
5. MUST place the objects: ‘Interactive Form Dictionary’, ‘Field Dictionary’ and ‘Digital Signature’ object as the last three objects (in that order) in the Document, if the Document is Digitally Signed. Note that in a situation where the Consumer cannot cache the entire document before rendering, the detection of a valid or invalid Digital Signature will only occur after rendering of the entire Document.
6. MUST ensure that there is at least one Forward-Reference to each object. The only object that does not have to follow this rule is the ‘PDF/is Object’. Rationale: This will aid the Consumer with knowing which objects will need to be cached and which can be ignored.

7. MUST ensure that all objects appear in the PDF AFTER the object in which they are first referenced (Satisfied by Requirement 6) and BEFORE the next 'Page Object' unless the object is a Cached Object (See Section 3.4).

8. MUST ensure that all object identifiers ([pdf] Section 3.2.9) start at the beginning of a line.

9. MUST ensure that all 'endobj' keywords ([pdf] Section 3.2.9) start at the beginning of a line.

10. MUST ensure that all 'stream' data ([pdf] Section 3.2.7) does not contain a line beginning with the word "endstream", aside from the required "endstream" that delimits the end of the stream.

4.2 Consumer conformance requirements

In order to conform to this specification, a Document Consumer:

1. MUST Support all of the REQUIRED PDF/is objects.

2. MUST Interpolate images up or down in resolution, as required, to properly match the Documents image resolution(s) to the Consumer's device capabilities.

3. MAY ignore all IGNORED objects that the Producer added to the PDF/is Document.

4. MUST indicate to the Producer, which OPTIONAL features the Consumer Supports.

5. MUST abide by the "Object Lifetime" rules in Section 3.5 if unable to Cache the entire Document.

4.3 File Layout

Given that a Document is fully compliant with this specification, a PDF/is Document will, nominally, take on the following format:

Table 4-1: File Layout

	Object
A	'PDF/is' object.
B	Encryption Object (if Profile <STD-ENC> XOR <PPK-ENC>)
C	Document Information Dictionary
D	Page object for page 1
E	Resources for page 1
F	Content object for page 1
G	Color Space(s) for page 1
H	Image Mask(s) for page 1
I	Image XObject(s) for page 1
J	[Repeat D – I for all remaining pages, in order]
K	Document Catalog
L	Page Node(s)
M	Interactive Form Dictionary (if Profile <DIG-SIG>)
N	Annotation Field Dictionary (if Profile <SIG-SIG>)

O	Signature Dictionary (if Profile <DIG-SIG>)
P	File Trailer

5 Issues

1) In the interest of blind-interchange, should JBIG2 rendering support be required of all consumers?
The only other 'Optional' features in the spec, as it now stands are:
A) Standard Encryption.
B) PPK Encryption.
C) Digital Signaturing.
Here are my feelings on each of these:
A - May require licensing of RC4 encryption software. Standard encryption requires a target device that can query and take a password as input: this may not be practical for all types of devices. This should remain an option.
B - May require licensing of encryption software. PPK encryption requires that the consumer have a public key that the producer can retrieve via IPP. A 'profile' isn't necessary for this feature: if the producer is unable to get the consumer's public key, the producer will not be able to use this feature.
C - A Digital Signature may be applied to any document. The consumer doesn't have to validate the signature if they don't wish to, or are not able to do so.

2) Should the 'DeviceRGB' color space be defined to be some version of sRGB?

3) Should we "hard code" a buffer size for the memory cache value (Section 3.3.1.1.4)?

4) A proposal from Xerox that I'm not sure I can answer right now:
"General comment about DID and Annotation fields, and the possibility of using one or the other as a mechanism for including a "fax transmit header" or sender-uri value, per Sec. 9.5 in IPPFAX 1.0 Protocol Draft. Right now the recommendation is to burn it into the image data, but the DID or Annotation field could be used for this attribute value--consider text to this effect in 3.3.19 or 3.3.17."

6 Sample PDF/is PDFs

The ‘source’ of all of the sample documents in this section can be viewed with any text editor but should only be modified with a binary editor, as the stream data contained therein is not compatible with text editors. Comments on the format of the documents are contained within the documents themselves.

All of the samples are different versions of the same document.

1: The first sample is an unencrypted, single page, ‘CCITTFaxDecode’ masked, ‘DCTDecode’ color ICCBased color space foreground image with a ‘FlateDecode’ gray scale Indexed ICCBased color space background image. The images use ‘FlateDecode’ compression on the ‘ICCBased’ and ‘Indexed’ Color Spaces.
ftp://pwg.org/pub/pwg/QUALDOCS/SamplePDFax/base-02.pdf

2: The next sample has been encrypted with ‘Standard’ encryption. The ‘user’ password is ‘12345’; the ‘owner’ password is ‘54321’. The document has also been Digitally Signed: the

document will fail a digital signature check since it has been tampered with. To see the digital signature in Acrobat (or Acrobat Reader), select the 'Signature' tab on the left side of the screen.
ftp://pwg.org/pub/pwg/QUALDOCS/SamplePDFax/stdEncryptSigned-02.pdf

7 Normative References

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9 Revision History (to be removed when standard is approved)

Revision	Date	Author	Notes
1	10/9/02	Rick Seeler, Adobe Systems	Initial version
2	10/23/02	Rick Seeler, Adobe Systems	
3	11/19/02	Rick Seeler, Adobe Systems	
4	11/22/02	Rick Seeler, Adobe Systems	

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13 Appendix A

13.1 Intellectual Property Statement – Adobe Systems Incorporated

The following statement is in addition to the Intellectual Property Statement in the PDF Reference (See [pdf] Section 1.4).

Patent Clarification Notice Specific to Use of PDF for IPP G4 Protocol

Adobe has a number of patents covering technology that is disclosed in the Portable Document Format (PDF) Specification, version 1.4 and later, as documented in PDF Reference and associated Technical Notes (the "PDF Specification"). Adobe desires to promote the use of PDF as the file format for a future, IPP G4 Protocol to be proposed, recommended, finalized and published by the IEEE Printer Working Group (the "IPP G4 Standard").

This Patent Clarification Notice is in addition to the permissions statement set forth in Section 1.4 of the PDF Reference which shall also apply to Adobe's contribution to the IPP G4 Standard.

Accordingly, Adobe agrees to provide a Royalty Free License to all Essential Claims solely for the purpose of implementing the IPP G4 Standard. Adobe and the IEEE Printer Working Group will identify and establish, within the final, published release of the IPP G4 Standard, a process whereby implementers of the IPP G4 Standard can request and obtain the above license.

No license shall be extended to those implementing only draft versions of the IPP G4 Standard.

A "Royalty Free License" shall mean a license that:

i) shall be available to all implementers of the IPP G4 Standard worldwide, whether or not members of the IEEE Printer Working Group;
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iii) shall not be conditioned on payment of royalties, fees or other consideration except as described in (iv) and (v) below;
iv) may be conditioned on a grant of a reciprocal license on identical terms to all Essential Claims owned or controlled by the licensee and its Affiliates; and
v) may include reasonable, customary terms relating to operation or maintenance of the license

931 relationship including but not limited to the following: choice of law, dispute resolution, and
932 patent notices.
933
934 "Essential Claims" shall mean all claims in any patent or patent application, in any jurisdiction in the
935 world, that (A) Adobe and/or its Affiliates own and (B) that would be necessarily infringed by
936 implementation of the IPP G4 Standard. A claim is necessarily infringed hereunder only when a licensee
937 can prove that it is not possible to avoid infringing it because there is no non-infringing alternative for
938 implementing the required portions of the IPP G4 Standard. Existence of a non-infringing alternative shall
939 be judged based on the state of the art at the time a licensee implements the IPP G4 Standard.
940
941 The following are expressly excluded from and shall not be deemed to constitute Essential Claims:
942
943 1) any claims other than as set forth above even if contained in the same patent as Essential Claims;
944 and
945 2) claims that would be infringed only by
946 a) portions of an implementation that are not required by the IPP G4 Standard
947 b) enabling technologies that may be necessary to make or use any product or portion thereof
948 that complies with the IPP G4 Standard but are not themselves expressly set forth in the IPP
949 G4 Standard; or
950 c) the implementation of technology developed elsewhere and merely incorporated by reference
951 into the IPP G4 Standard.
952
953 For purposes of the Essential Claims definition, the "IPP G4 Standard" shall be deemed to include only
954 architectural and interoperability requirements and shall not include any implementation examples or any
955 other material that merely illustrates the requirements of the IPP G4 Standard.
956
957 An "Affiliate" of a first entity is a second entity that is controlled (greater than 50%) by, in control of, or
958 under common control with the first entity.
959

