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Universal Image Format (UIF)

IEEE-ISTO Printer Working Group
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ftp://ftp.pwg.org/pub/pwg/QUALDOCS/uif-spec-0~~5~~6.pdf, .doc, .rtf

Abstract

This standard specifies the Universal Image Format (UIF). The UIF requirements [7] are derived from the requirements for IPPFAX [8] and Internet Fax [9].

In summary UIF is a raster image data 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. UIF is based on the TIFF-FX specification [4], which describes the TIFF (Tag Image File Format) representation of image data specified by the ITU-T Recommendations for black-and-white and color facsimile.

This document (1) formally defines a series of "UIF profiles" distinguished primarily by the method of compression employed and color space used; (2) describes the use of CONNEG in capabilities communication between two UIF-enabled ~~Device~~Implementations; and (3) defines a set of baseline capabilities that permits a CONNEG implementation to be ~~optional~~OPTIONAL.

This document is a draft of an IEEE-ISTO PWG Proposed Standard and is in full conformance with all provisions of the PWG Process (see: ftp//ftp.pwg.org/pub/pwg/general/pwg-process.pdf). PWG Proposed Standards are working documents of the IEEE-ISTO PWG and its working groups. The list of current PWG projects and drafts can be obtained at http://www.pwg.org.

When approved as a PWG standard, this document will be available from:

ftp://ftp.pwg.org/pub/pwg/standards/pwg510x.y.pdf, .doc, .rtf

Title: Universal Image Format

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1 Introduction

This document specifies an image data format based on TIFF-FX [4] especially suited for use with synchronous protocols (e.g., IPPFAX[10]). The increased conformance requirements found in this UIF specification reflect the need for a data format where quality document transmission is the primary concern. The complete support for TIFF-FX in this way is called Universal Image Format (UIF). There are several pieces to this support:

- A specification of precisely what parts of the TIFF-FX specification are to be supported.
- How the UIF-capable Sender uses CONNEG to discover the UIF characteristics (resolution, drawing surface, etc.) of a potential UIF Receiver.
- How the Sender specifies options for the transmission (reducing for example).

2 Terminology

This section defines the following additional terms that are used throughout this standard.

2.1 Conformance Terminology

The key words **MUST**, **MUST NOT**, **REQUIRED**, **SHOULD**, **SHOULD NOT**, **RECOMMENDED**, **MAY**, and **OPTIONAL** in this document are to be interpreted as described in RFC 2119 [18].

2.2 Model

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

Baseline Field – One of the core set of TIFF fields introduced by the TIFF specification [19]

~~**Device**~~**Implementation** – A Sender or Receiver

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

Extension Field – One of the TIFF extension fields introduced by the current TIFF specification [19], specification, the set of ~~Pagemaker~~PageMaker TIFF Technical Notes [20], or TIFF Technical Note 2 [21].

New Field – One of the new TIFF fields introduced by the TIFF-FX specification [4]. Note that the UIF specification does not introduce any new TIFF tags.

Receiver – This is the agent (software, hardware or some combination) that receives the Document sent by the Sender.

Sender – This is the agent (software, hardware or some combination) that is used to create and transmit a Document to a Receiver.

~~3Indicating Support using MIME~~

~~[22] describes the registration of the MIME content-type image/tiff to refer to TIFF-encoded image data. In addition, an optional "application" parameter is defined for image/tiff to identify a particular application's subset of TIFF and TIFF extensions for the encoded image data, if it is known. Typically, this would be used to assist the recipient in dispatching a suitable rendering package to handle the display or processing of the image file.~~

~~*3.1MIME content type type*~~

~~When transported by MIME, the TIFF content defined by this document MUST be encoded within an 'image/tiff' content type.~~

~~*3.2MIME application parameter*~~

~~The MIME content type application parameter indicates the UIF profiles used within the UIF Document. The two values of the image/tiff application parameter as defined for UIF are 'uifbw' and 'uifcolor'.~~

~~The "uifbw" application parameter is suitable for use by Senders that can process one or more UIF profiles used for the encoding of black and white facsimile data.~~

~~The "uifcolor" application parameter is suitable for use by Senders that can process one or more UIF profiles or subsets that can be used for the encoding of black and white, AND color facsimile data.~~

~~Since this document defines several UIF profiles, the following rules MUST be followed when setting the application parameter value.Senders that use UIF Profiles S, F, or J, MUST set the value of the application parameter to "uifbw". Senders which use UIF Profiles C, L, or M, MUST set the value of the application parameter to "uifcolor".~~

~~An example of the use of the image/tiff MIME Content-type with the application parameter set with the value 'uifbw' follows:~~

~~Content-type: image/tiff; application=uifbw~~

~~In this example, use of this parameter value will enable a Receiver to identify the content as being within a profile or subset of UIF that is suitable for encoding black and white image data, before attempting to process the image data.~~

~~In a similar respect, an example of the image/tiff MIME Content-type with the application parameter setting suitable for handling a color subset or profile of TIFF for facsimile is shown below:~~

~~Content-type: image/tiff; application=uifcolor~~

3 TIFF-FX support

A UIF Document is a TIFF file that adheres to the requirements of (1) Baseline TIFF (see [19]) and (2) one or more UIF profiles. A UIF profile is based on a collection of ITU-T facsimile coding methods. The UIF profiles listed below have been derived from TIFF-FX [4]. The reader is referred to this document for a complete description of each profile, as the subsections below briefly summarize each

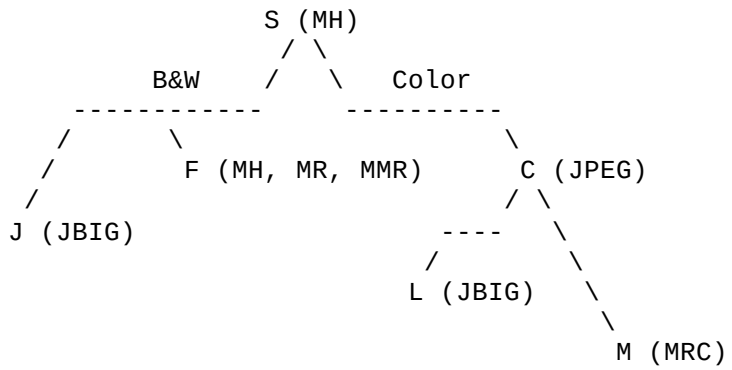
profile and list only the differences between the UIF version of the profile and TIFF-FX profile on which it is based.

Pages within a UIF Document MAY be encoded using different UIF profiles.

An ~~printer~~ Implementation that supports UIF ~~must~~ MUST support at least UIF Profile S. Note that for the TIFF fields "ImageDescription", "DocumentName", "Software", and "DateTime", Adobe Baseline TIFF specifies only ASCII and does not provide a language tag or alternate character set facility.

3.1 Relationships among UIF Profiles ~~Relationships~~

The following tree diagram, which is adapted from TIFF-FX[4], shows the relationship among UIF profiles and between UIF profiles and coding methods.



All ~~implementations~~ UIF Senders and/or Receivers~~of UIF~~ MUST implement UIF Profile S, which is the root node of the tree. All color ~~implementations~~ Senders and/or Receivers of UIF MUST implement UIF Profile C. Senders and/or Receivers that ~~The~~ implement~~ation of~~ a particular profile MUST also implement those profiles on the path that connect it to the root node, and MAY optionally implement profiles not on the path connecting it to the root node. For example, a~~n~~ Sender and/or Receiver that implement~~ation of~~s UIF Profile M ~~must~~ MUST also implement UIF Profiles C and S, and ~~may~~ MAY optionally implement UIF Profile F, J or L. For another example, a~~n~~ Sender/Receiver that implement~~ation of~~s UIF Profile C ~~must~~ MUST also implement UIF Profile S, and ~~may~~ MAY optionally implement UIF Profile F or J.

3.2 Summary of UIF Profiles

The following subsections summarize Implementation requirements for each of the UIF profiles and describe the differences between a given UIF profile and the corresponding TIFF-FX profile. Each subsection contains one or more tables that show the TIFF fields and field values that are REQUIRED, RECOMMENDED, or OPTIONAL for UIF Implementations. For profiles other than UIF Profile S, single asterisks (*) and double asterisks (**) indicate the level of Receiver conformance (see the legend below each table). For profiles other than UIF Profile S, the rightmost column is used to indicate Sender conformance, i.e., those fields that a user MUST, SHOULD, or MAY include in the Image File Directory (IFD) of a UIF Document. For fields that a Receiver MUST support, note that a Sender MUST support at least one of the REQUIRED field values that the Receiver MUST support.

If there is a default value associated with a TIFF field, and the default value is a legal value for the given UIF profile, then the Sender MAY choose to physically omit this field from the UIF file, as the presence of the TIFF field and its value are implied. The Tables in the following subsections show default values for TIFF fields only when the default values are permitted.

3.2.1 UIF Profile S

UIF Profile S is modeled after Profile S of TIFF-FX[4], which describes the minimal black-and-white subset of TIFF for facsimile. Tables 1 and 2 summarize the fields and field values that are REQUIRED for all Implementations of UIF Profile S. A UIF Profile S Implementation ~~UIF Profile S~~ MUST use~~s~~ 1-dimensional Modified Huffman (MH) compression as defined in ITU-T T.4 [11] and MUST adopt the same requirements and restrictions for Baseline Fields, Extension Fields, byte order, bit order, and image file directory (IFD) placement as stated in Section 3 of TIFF-FX[4] with the exception of the following:

1) ImageWidth is not constrained.
2) XResolution is not constrained, but 200, 300, and 600dpi MUST be supported.
3) YResolution is not constrained, but 200, 300, and 600dpi MUST be supported.

Note that 'XResolution' and 'YResolution' values refer to the resolutions that the Receiver is capable of processing, not necessarily the resolutions that the Receiver is physically capable of producing (e.g., printer engine delivery).

~~The~~ All UIF Receivers MUST support the following Baseline and Extension Fields and field values ~~MUST be supported by all UIF implementations~~. All UIF Senders MUST be capable of creating a UIF Document that contains the following Baseline and Extension Fields or MUST be otherwise capable of verifying that these fields are present before sending a Document. For a complete description of the Baseline and Extension Fields shown below, see the TIFF-FX specification [4].

Table 1. UIF Profile S Baseline Fields

Baseline Fields	Values
BitsPerSample	1
Compression	3: 1D Modified Huffman coding set T4Options = 0 or 4
FillOrder	2: least significant bit first
ImageWidth	m: width of image in pixels
ImageLength	n: length of image in pixels (total number of scanlines)
NewSubFileType	2: Bit 1 identifies single page of a multi-page Document
PhotometricInterpretation	0: pixel value 1 means black
ResolutionUnit	2: inch (Default = 2)
RowsPerStrip	number of scanlines per strip = ImageLength, with one strip
SamplesPerPixel	1
StripByteCounts	number of bytes in TIFF strip
StripOffsets	offset from beginning of file to single TIFF strip
XResolution	200, 300, 600, other resolutions are ~~optional~~OPTIONAL (written in pixels per inch)
YResolution	200, 300, 600, other resolutions are ~~optional~~OPTIONAL

	(written in pixels per inch)

Table 2. UIF Profile S Extension Fields

Extension Fields	Values
PageNumber	n,m: page number n followed by total page count m
T4Options	0: MH coding, EOLs not byte aligned (Default = 0) 4: MH coding, EOLs byte aligned

3.2.2 UIF Profile F

This section defines UIF Profile F, which uses Modified Read and Modified Modified Read (MMR) compression (described in ITU-T T.4 [11] and ITU-T T.6 [12]) in addition to the Modified Huffman compression used for UIF Profile S. UIF Profile F is based on TIFF-FX Profile F. ~~The table that follows~~Tables 3, 4, and 5 summarize~~s~~ the fields and field values that are REQUIRED / RECOMMENDED / OPTIONAL for UIF Profile F. Asterisks are used to denote levels of Receiver conformance, while the rightmost column indicates Sender conformance, i.e., those fields that a Sender MUST, SHOULD, or MAY include in an image file directory (IFD) of a UIF Document. For a complete description of the Baseline, Extension, and New Fields shown below, see the TIFF-FX specification [4]. A ~~Device~~Sender/Receiver implementing this profile is REQUIRED to also implement UIF Profile S.

Here are the differences between TIFF-FX Profile F and UIF Profile F. For UIF Profile F,

1) ImageWidth is not constrained.
2) XResolution is not constrained, but a Receiver MUST support 200, 300, and 600dpi ~~MUST be supported~~.
3) YResolution is not constrained, but a Receiver MUST support 200, 300, and 600dpi ~~MUST be supported~~.
4) A Receiver MUST support MMR coding (Compression=4) ~~MUST be supported~~and the associated T4Options field, while a Receiver MAY support MH (Compression=3)~~ is optional~~.
5) The following TIFF-FX RECOMMENDED fields have been om~~m~~itted: 'BadFaxLines', 'CleanFaxData', 'ConsecutiveBadFaxLines', and 'ProfileType'~~, and 'FaxProfile'~~.
6) UIF Implementations MUST support the GlobalParametersIFD field.
7) The 'FaxProfile' TIFF tag introduced in [4] is re-interpreted as the 'UIFProfile' TIFF tag for UIF Documents. The TIFF tag 'UIFProfile' uses the same TIFF field identifier (401) and the same data type (Byte) as the TIFF tag 'FaxProfile'. The values for this field are redefined as follows:

    0: does not conform to a profile defined for UIF
    1: minimal black & white lossless, UIF Profile S
    2: extended black & white lossless, UIF Profile F
    3: lossless JBIG black & white, UIF Profile J
    4: lossy color and grayscale, UIF Profile C
    5: lossless color and grayscale, UIF Profile L
    6: Mixed Raster Content, UIF Profile M

~~Recommended fields are shown with an asterisk *.~~

~~REQUIRED fields or values are shown with a double asterisk **. If the double asterisk is on the field name, then all the listed values are REQUIRED of implementations; if the double asterisks are in the Values column, then only the values suffixed with a double asterisk are REQUIRED of implementations.~~

~~Optional fields have no asterisks in either the field name or the Values column, however, the Values field may contain a condition which REQUIRES the field~~.

Table 3. UIF Profile F Baseline Fields

Baseline Fields	Values	Sender Conformance
BitsPerSample	1**	MUST
Compression	3: 1D Modified Huffman and 2D Modified Read coding 4**: 2D Modified Modified Read coding	MUST
DateTime*	{ASCII}: date/time in 24-hour format "YYYY:MM:DD HH:MM:SS"	SHOULD
FillOrder**	1: most significant bit first 2: least significant bit first (Default = 2)	MUST
ImageDescription*	{ASCII}: A string describing the contents of the image	SHOULD
ImageWidth**	n: width of image in pixels	MUST
ImageLength**	n: length of image in pixels (total number of scanlines)	MUST
NewSubFileType	2**: Bit 1 identifies single page of a multi-page Document	MUST
Orientation	1**-8, (Default ~~is~~= 1)	MUST
PhotometricInterpretation**	0: pixel value 1 means black 1: pixel value 1 means white	MUST
ResolutionUnit**	2: inch (Default = 2) 3: centimeter	MUST
RowsPerStrip**	n: number of scanlines per TIFF strip	MUST
SamplesPerPixel	1**	MUST
Software*	{ASCII}: name & release number of creator software	SHOULD
StripByteCounts**	n: number of bytes in TIFF strip	MUST
StripOffsets**	n: offset from beginning of file to each TIFF strip	MUST
XResolution	200**, 300**, 600**, other resolutions are ~~optional~~OPTIONAL (written in pixels per inch)	MUST
YResolution	200**, 300**, 600** in pixels per inch with x-y aspect ratio (XResolution / YResolution) equal to 1;~~,~~ other resolutions and aspect ratios are	MUST

	~~optional~~OPTIONAL (written in pixels per inch)	

* Receiver SHOULD support this field.
** (If double asterisk is in 'Baseline Fields' column) Receiver MUST support the given field and all values shown in 'Values' column.
(If double asterisk is in 'Values' column) Receiver MUST support the given field and the value immediately preceding the double asterisk.

Table 4. UIF Profile F Extension Fields

Extension Fields	Values	Sender Conformance
T4Options	0**: REQUIRED if Compression is Modified Huffman (MH), EOLs are not byte aligned (Default = 0) 1: REQUIRED if Compression is 2D Modified Read (MR), EOLs are not byte aligned 4**: REQUIRED if Compression is Modified Huffman, EOLs are byte aligned 5: REQUIRED if Compression is 2D Modified Read, EOLs are byte aligned	MUST if Compression=3
T6Options	0**: REQUIRED if Compression is 2D Modified Modified Read (MMR) (Default = 0)	MUST if Compression=4
DocumentName*	{ASCII}: name of UIF Document	SHOULD
PageNumber**	n,m: page number followed by total page count	MUST

* Receiver SHOULD support this field.
** (If double asterisk is in 'Extension Fields' column) Receiver MUST support the given field and all values shown in 'Values' column.
(If double asterisk is in 'Values' column) Receiver MUST support the given field and the value immediately preceding the double asterisk.

Table 5. UIF Profile F New Fields

New Fields	Values	Sender Conformance
GlobalParametersIFD**	IFD: global parameters IFD	MUST
UIFProfile*	n: ITU-compatible UIF profile	SHOULD
CodingMethods*	n: compression algorithms used in file	SHOULD

* Receiver SHOULD support this field.
** (If double asterisk is in 'New Fields' column) Receiver MUST support the given field and all values shown in 'Values' column.

3.2.3 UIF Profile J

This section defines Profile J for UIF, which uses lossless JBIG compression as it is defined in ITU-T T.82 [16] subject to the application rules given in ITU-T T.85 [17]. UIF Profile J is based on TIFF-FX Profile J. ~~The following table~~Tables 6, 7, and 8 summarize~~s~~ fields and field values that are REQUIRED / RECOMMENDED / OPTIONAL. Asterisks are used to denote levels of Receiver conformance, while the rightmost column indicates levels of Sender Conformance, i.e., those fields

that a Sender MUST, SHOULD, or MAY include in an IFD of a UIF document. For a complete description of the Baseline, Extension, and New Fields shown below, see the TIFF-FX specification [4]. A ~~Device~~Sender/Receiver implementing this profile is REQUIRED to also implement UIF Profile S.

Here are the differences between TIFF-FX Profile J as defined in [4] and UIF Profile J. For UIF Profile J,

1) ImageWidth is not constrained.
2) XResolution is not constrained, but a Receiver MUST support 200, 300, and 600dpi ~~MUST be supported~~.
3) YResolution is not constrained, but a Receiver MUST support 200, 300, and 600dpi ~~MUST be supported~~.
4) The following TIFF-FX RECOMMENDED field~~s have~~ has been om~~m~~itted: 'ProfileType' ~~and 'FaxProfile'~~.
5) UIF Implementations MUST support the GlobalParametersIFD field.
6) The 'FaxProfile' TIFF tag introduced in [4] is re-interpreted as the 'UIFProfile' TIFF tag for UIF Documents. The TIFF tag 'UIFProfile' uses the same TIFF field identifier (401) and the same data type (Byte) as the TIFF tag 'FaxProfile'. The values for this field are redefined as follows:
   0: does not conform to a profile defined for UIF
   1: minimal black & white lossless, UIF Profile S
   2: extended black & white lossless, UIF Profile F
   3: lossless JBIG black & white, UIF Profile J
   4: lossy color and grayscale, UIF Profile C
   5: lossless color and grayscale, UIF Profile L
   6: Mixed Raster Content, UIF Profile M

~~Recommended fields are shown with an asterisk *.~~

~~REQUIRED fields or values are shown with a double asterisk **. If the double asterisk is on the field name, then all the listed values are REQUIRED of implementations; if the double asterisks are in the Values column, then the attribute and only the values suffixed with a double asterisk are REQUIRED of implementations.~~

~~Optional fields have no asterisks in either the field name or the Values column, however, the Values field may contain a condition which REQUIRES the field~~.

Table 6. UIF Profile J Baseline Fields

Baseline Fields	Values	Sender Conformance
BitsPerSample	1**	MUST
Compression	9**: JBIG coding	MUST
DateTime*	{ASCII}: date/time in 24-hour format "YYYY:MM:DD HH:MM:SS"	SHOULD
FillOrder**	1: most significant bit first	MUST

	2: least significant bit first	
ImageDescription*	{ASCII}: A string describing the contents of the image	SHOULD
ImageWidth**	n: width of image in pixels	MUST
ImageLength**	n: length of image in pixels (total number of scanlines)	MUST
NewSubFileType**	2: Bit 1 identifies single page of a multi-page Document	MUST
Orientation	1**-8, (Default ~~is~~= 1)	MUST
PhotometricInterpretation**	0: pixel value 1 means black 1: pixel value 1 means white	MUST
ResolutionUnit**	2: inch (Default = 2) 3: centimeter	MUST
RowsPerStrip**	n: number of scanlines per TIFF strip	MUST
SamplesPerPixel**	1	MUST
Software*	{ASCII}: name & release number of creator software	SHOULD
StripByteCounts**	n: number of bytes in TIFF strip	MUST
StripOffsets**	n: offset from beginning of file to each TIFF strip	MUST
XResolution	200**, 300**, 600**, other resolutions are ~~optional~~OPTIONAL (written in pixels per inch)	MUST
YResolution	200**, 300**, 600**~~,~~ in pixels per inch with x-y aspect ratio (XResolution / YResolution) equal to 1; other resolutions and aspect ratios are ~~optional~~OPTIONAL ~~(written in pixels per inch)~~	MUST

* Receiver SHOULD support this field.
** (If double asterisk is in 'Baseline Fields' column) Receiver MUST support the given field and all values shown in 'Values' column.
(If double asterisk is in 'Values' column) Receiver MUST support the given field and the value immediately preceding the double asterisk.

Table 7. UIF Profile J Extension Fields

Extension Fields	Values	Sender Conformance
DocumentName*	{ASCII}: name of UIF Document	SHOULD
PageNumber**	n,m: page number followed by total page count	MUST

* Receiver SHOULD support this field.
** Receiver MUST support the given field and all values shown in 'Values' column.

Table 8. UIF Profile J New Fields

New Fields	Values	Sender Conformance
GlobalParametersIFD**	IFD: global parameters IFD	MUST
UIFProfile*	n: ITU-compatible UIF profile	SHOULD

T82Options**	0: T.85 profile of T.82	MUST
CodingMethods*	n: compression algorithms used in file	SHOULD

* Receiver SHOULD support this field.
** Receiver MUST support the given field and all values shown in 'Values' column.

3.2.4 UIF Profile C

This section defines Profile C for UIF, which uses lossy JPEG compression as it is defined in ITU-T T.81 [15]. UIF Profile C is based on TIFF-FX Profile C. ~~The following table~~ Tables 9, 10, and 11 summarize~~s~~ fields and field values that are REQUIRED / RECOMMENDED / OPTIONAL. Asterisks are used to denote levels of Receiver conformance, while the rightmost column indicates levels of Sender Conformance, i.e., those fields that a Sender MUST, SHOULD, or MAY include in an IFD of a UIF document. For a complete description of the Baseline, Extension, and New Fields shown below, see the TIFF-FX specification [4]. A Sender/Receiver ~~Device~~ that implements this profile is REQUIRED to also implement UIF Profile S.

Here are the differences between TIFF-FX Profile C as defined in [4] and UIF Profile C. For UIF Profile C,

1) ImageWidth is not constrained.
2) XResolution is not constrained, but a Receiver MUST support 200 and 300dpi ~~MUST be supported~~.
3) YResolution MUST match XResolution, but it is otherwise not constrained~~,~~; ~~but~~ a Receiver MUST support 200 and 300dpi ~~MUST be supported~~.
4) The following TIFF-FX RECOMMENDED field~~s~~ ~~have~~has been ~~ommitted~~omitted: 'ProfileType' ~~and 'FaxProfile'~~.
5) A Receiver MUST support the TIFF Extension Field 'JPEGTables' per [21]. A Sender MAY send this field.
6) UIF Implementations MUST support the GlobalParametersIFD field.
7) The 'FaxProfile' TIFF tag introduced in [4] is re-interpreted as the 'UIFProfile' TIFF tag for UIF Documents. The TIFF tag 'UIFProfile' uses the same TIFF field identifier (401) and the same data type (Byte) as the TIFF tag 'FaxProfile'. The values for this field are redefined as follows:

    0: does not conform to a profile defined for UIF
    1: minimal black & white lossless, UIF Profile S
    2: extended black & white lossless, UIF Profile F
    3: lossless JBIG black & white, UIF Profile J
    4: lossy color and grayscale, UIF Profile C
    5: lossless color and grayscale, UIF Profile L
    6: Mixed Raster Content, UIF Profile M

~~Recommended fields are shown with an asterisk *.~~

~~REQUIRED fields or values are shown with a double asterisk **. If the double asterisk is on the field name, then all the listed values are REQUIRED of implementations; if the double asterisks are in the Values column, then only the values suffixed with a double asterisk are REQUIRED of implementations.~~

~~Optional fields have no asterisks in either the field name or the Values column, however, the Values field may contain a condition which REQUIRES the field.~~

Table 9. UIF Profile C Baseline Fields

Baseline Fields	Values	Sender Conformance
BitsPerSample	8**: 8 bits per color sample 12: ~~optional~~OPTIONAL 12 bits/sample	MUST
Compression**	7: JPEG	MUST
DateTime*	{ASCII}: date/time in 24-hour format "YYYY:MM:DD HH:MM:SS"	SHOULD
FillOrder**	1: most significant bit first 2: least significant bit first	MUST
ImageDescription*	{ASCII}: A string describing the contents of the image	SHOULD
ImageWidth**	n: width of image in pixels	MUST
ImageLength**	n: length of image in pixels (total number of scanlines)	MUST
NewSubFileType**	2: Bit 1 identifies single page of a multi-page Document	MUST
Orientation	1**-8, (Default ~~is~~= 1)	MUST
PhotometricInterpretation	10**: ITULAB	MUST
ResolutionUnit**	2: inch (Default = 2) 3: centimeter	MUST
RowsPerStrip**	n: number of scanlines per TIFF strip	MUST
SamplesPerPixel**	1**: L* (lightness) 3: LAB	MUST
Software*	{ASCII}: name & release number of creator software	SHOULD
StripByteCounts**	n: number of bytes in TIFF strip	MUST
StripOffsets**	n: offset from beginning of file to each TIFF strip	MUST
XResolution	200**, 300** other resolutions are ~~optional~~OPTIONAL (written in pixels per inch). XResolution and YResolution fields MUST be equal.	MUST
YResolution	~~200**, 300** other resolutions are optional (written in pixels per inch)~~equal to XResolution (pixels MUST be square)	MUST

* Receiver SHOULD support this field.

** (If double asterisk is in 'Baseline Fields' column) Receiver MUST support the given field and all values shown in 'Values' column.

(If double asterisk is in 'Values' column) Receiver MUST support the given field and the value immediately preceding the double asterisk.

Table 10. UIF Profile C Extension Fields

Extension Fields	Values	Sender Conformance
DocumentName*	{ASCII}: name of UIF Document	SHOULD
PageNumber**	n,m: page number followed by total page count	MUST
ChromaSubSampling	(1,1), (2, 2)** (1, 1): equal numbers of lightness and chroma samples horizontally and vertically (2, 2): twice as many lightness samples as chroma samples horizontally and vertically	MUST
ChromaPositioning	1**: centered	MUST
JPEGTables**	n: file pointer to JPEG quantization and/or Huffman tables	MAY

* Receiver SHOULD support this field.

** (If double asterisk is in 'Extension Fields' column) Receiver MUST support the given field and all values shown in 'Values' column.
(If double asterisk is in 'Values' column) Receiver MUST support the given field and the value immediately preceding the double asterisk.

Table 11. UIF Profile C New Fields

New Fields	Values	Sender Conformance
Decode**	minL, maxL, mina, maxa, minb, maxb: minimum and maximum values for L*a*b*	MUST
GlobalParametersIFD**	IFD: global parameters IFD	MUST
UIFProfile*	n: ITU-compatible UIF profile	SHOULD
CodingMethods*	n: compression algorithms used in file	SHOULD
VersionYear*	byte sequence: year of ITU std	SHOULD

* Receiver SHOULD support this field.

** (If double asterisk is in 'New Fields' column) Receiver MUST support the given field and all values shown in 'Values' column.
(If double asterisk is in 'Values' column) Receiver MUST support the given field and the value immediately preceding the double asterisk.

3.2.5 UIF Profile L

This profile is modeled after TIFF-FX Profile L. It uses JBIG compression (see [16]), subject to the application rules specified in ITU-T Recommendation T.43 [13] to losslessly code three types of color and grayscale images: one bit per color CMY, CMYK and RGB images; a ~~palettized~~palletized (i.e. mapped) color image; and continuous tone color and grayscale images.

Here are the differences between TIFF-FX Profile L as defined in [4] and UIF Profile L. For UIF Profile L,

1) ImageWidth is not constrained.
2) XResolution is not constrained, but a Receiver MUST support 200 and 300dpi ~~MUST be supported~~.
3) YResolution ~~must~~MUST match XResolution, but it is not otherwise constrained; a Receiver MUST support 200 and 300dpi ~~MUST be supported~~.
4) The following TIFF-FX RECOMMENDED field~~s have~~ has been ~~ommitted~~omitted: 'ProfileType' ~~and 'FaxProfile'~~.
5) UIF Implementations MUST support the GlobalParametersIFD field.
6) The 'FaxProfile' TIFF tag introduced in [4] is re-interpreted as the 'UIFProfile' TIFF tag for UIF Documents. The TIFF tag 'UIFProfile' uses the same TIFF field identifier (401) and the same data type (Byte) as the TIFF tag 'FaxProfile'. The values for this field are redefined as follows:

    0: does not conform to a profile defined for UIF
    1: minimal black & white lossless, UIF Profile S
    2: extended black & white lossless, UIF Profile F
    3: lossless JBIG black & white, UIF Profile J
    4: lossy color and grayscale, UIF Profile C
    5: lossless color and grayscale, UIF Profile L
    6: Mixed Raster Content, UIF Profile M

~~The table that follows~~Tables 12, 13, and 14 summarize~~s~~ fields and field values that are REQUIRED / RECOMMENDED / OPTIONAL for ~~i~~implementations of UIF Profile L. Asterisks are used to denote levels of Receiver conformance, while the rightmost column indicates levels of Sender Conformance, i.e., those fields that a Sender MUST, SHOULD, or MAY include in an IFD of a UIF document. For a complete description of the Baseline, Extension, and New Fields shown below, see the TIFF-FX specification [4]. A ~~Device~~ Sender / Receiver that chooses to implement this profile is REQUIRED to also implement UIF Profile S, and UIF Profile C.

~~Recommended fields are shown with an asterisk *.~~

~~REQUIRED fields or values are shown with a double asterisk **. If the double asterisk is on the field name, then all the listed values are REQUIRED of implementations; if the double asterisks are in the Values column, then only the values suffixed with a double asterisk are REQUIRED of implementations.~~

Optional fields have no asterisks in either the field name or the Values column, however, the Values field may contain a condition which REQUIRES the field.

Table 12. UIF Profile L Baseline Fields

Baseline Fields	Values	Sender Conformance

BitsPerSample	1: Binary RGB, CMY(K) 8**: 8 bits per color sample 9-16: ~~optional~~OPTIONAL	MUST
Compression~~**~~	10**: JBIG, per T.43	MUST
DateTime*	{ASCII}: date/time in 24-hour format "YYYY:MM:DD HH:MM:SS"	SHOULD
FillOrder**	1: most significant bit first 2: least significant bit first	MUST
ImageDescription*	{ASCII}: A string describing the contents of the image	SHOULD
ImageWidth**	n: width of image in pixels	MUST
ImageLength**	n: length of image in pixels (total number of scanlines)	MUST
NewSubFileType~~**~~	2**: Bit 1 identifies single page of a multi-page Document	MUST
Orientation	1**-8, (Default ~~is~~= 1)	MUST
PhotometricInterpretation	2: RGB 5: CMYK 10**: ITULAB	MUST
ResolutionUnit**	2: inch (Default = 2)	MUST
RowsPerStrip**	n: number of scanlines per TIFF strip	MUST
SamplesPerPixel~~**~~	1**: L* (lightness) 3: LAB, RGB, CMY 4: CMYK	MUST
Software*	{ASCII}: name & release number of creator software	SHOULD
StripByteCounts**	n: number of bytes in TIFF strip	MUST
StripOffsets**	n: offset from beginning of file to each TIFF strip	MUST
XResolution	200**, 300** other resolutions are ~~optional~~OPTIONAL (written in pixels per inch)	MUST
YResolution	equal to XResolution (pixels MUST be square)	MUST

* Receiver SHOULD support this field.

** (If double asterisk is in 'Baseline Fields' column) Receiver MUST support the given field and all values shown in 'Values' column.
(If double asterisk is in 'Values' column) Receiver MUST support the given field and the value immediately preceding the double asterisk.

Table 13. UIF Profile L Extension Fields

Extension Fields	Values	Sender Conformance
DocumentName*	{ASCII}: name of UIF Document	SHOULD
PageNumber**	n,m: page number followed by total page count	MUST
Indexed	0: not a palette-color image (Default = 0) 1: palette-color image	MUST if image uses palette color;

		otherwise, MAY

* Receiver SHOULD support this field.
** Receiver MUST support the given field and all values shown in 'Values' column.
Note: Fields that the Receiver MAY support have no asterisks in either the field name or the values column

Table 14. UIF Profile L New Fields

New Fields	Values	Sender Conformance
Decode**	minL, maxL, mina, maxa, minb, maxb: minimum and maximum values for L*a*b*	MUST if PhotoMetric-Interpretation is set to ITULAB
GlobalParametersIFD**	IFD: global parameters IFD	MUST
UIFProfile*	n: ITU-compatible UIF profile	SHOULD
CodingMethods*	n: compression algorithms used in file	SHOULD
VersionYear*	byte sequence: year of ITU std	SHOULD

* Receiver SHOULD support this field.
** Receiver MUST support the given field and all values shown in 'Values' column.

3.2.6 UIF Profile M

This profile is modeled after TIFF-FX Profile M, which uses Mixed Raster Content (MRC), defined in ITU-T Recommendation T.44 [14]. MRC enables different coding methods and resolutions within a single page. For a more detailed description of MRC and the Baseline, Extension, and New Fields shown below, see [4] and [14].

Here are the differences between TIFF-FX Profile M as defined in [4] and UIF Profile M. For UIF Profile M,

1) ImageWidth is not constrained.
2) XResolution is not constrained, but a Receiver MUST support 200 and 300dpi ~~MUST be supported~~ for the bi-level mask, foreground, and background layers.
3) YResolution ~~must~~MUST match XResolution, but it is not otherwise constrained; a Receiver MUST support 200 and 300 dpi ~~MUST be supported~~ for the bi-level mask, foreground, and background layers.
4) A Receiver MUST support Modified Modified Read coding (Compression=4) and the associated T6Options field; Receiver support for Modified Huffman and Modified Read coding (Compression=3) and the associated T4Options field is OPTIONAL.
5) The following TIFF-FX RECOMMENDED field~~s~~ ~~have~~has been ~~ommitted~~omitted: 'ProfileType' ~~and 'FaxProfile'~~.
6) A Receiver MUST support the TIFF Extension Field 'JPEGTables' per [21]. A Sender MAY send this field.

7) UIF Implementations MUST support the GlobalParametersIFD field.

8) The 'FaxProfile' TIFF tag introduced in [4] is re-interpreted as the 'UIFProfile' TIFF tag for UIF Documents. The TIFF tag 'UIFProfile' uses the same TIFF field identifier (401) and the same data type (Byte) as the TIFF tag 'FaxProfile'. The values for this field are redefined as follows:

    0: does not conform to a profile defined for UIF
    1: minimal black & white lossless, UIF Profile S
    2: extended black & white lossless, UIF Profile F
    3: lossless JBIG black & white, UIF Profile J
    4: lossy color and grayscale, UIF Profile C
    5: lossless color and grayscale, UIF Profile L
    6: Mixed Raster Content, UIF Profile M

9) Receivers are REQUIRED to support the following fields: 'RowsPerStrip', 'StripRowCounts', 'Decode', 'SubIFD', 'XPosition', 'YPosition', 'ImageLayer', 'ImageBaseColor', and 'ChromaPositioning'.

~~The table that follows~~Tables 15, 16, and 17 summarize~~s~~ fields and field values that are REQUIRED / RECOMMENDED / OPTIONAL for ~~i~~Implementations of UIF Profile M.. Asterisks are used to denote levels of Receiver conformance, while the rightmost column indicates levels of Sender Conformance, i.e., those fields that a Sender MUST, SHOULD, or MAY include in an IFD of a UIF document. A ~~device~~Sender/Receiver that chooses to implement this profile is REQUIRED to also implement UIF Profile S, and UIF Profile C.

~~Recommended fields are shown with an asterisk *.~~

~~REQUIRED fields or values are shown with a double asterisk **. If the double asterisk is on the field name, then all the listed values are REQUIRED of implementations; if the double asterisks are in the Values column, then only the values suffixed with a double asterisk are REQUIRED of implementations.~~

Optional fields have no asterisks in either the field name or the Values column, however, the Values field may contain a condition which REQUIRES the field.

Table 15. UIF Profile M Baseline Fields

Baseline Fields	Values	Sender Conformance
BitsPerSample	1**: binary mask, RGB, CMY(K) 2-8**: bits per color sample 9-16: ~~optional~~OPTIONAL 12 bits/sample	MUST
Compression~~**~~	1: None (ImageBaseColor IFD only) 3~~**~~: Modified Huffman and Modified Read 4**: Modified Modified Read 7**: JPEG 9: JBIG, per [16] 10: JBIG, per [13]	MUST

DateTime*	{ASCII}: date/time in 24-hour format "YYYY:MM:DD HH:MM:SS"	SHOULD
FillOrder**	1: most significant bit first 2: least significant bit first	MUST
ImageDescription*	{ASCII}: A string describing the contents of the image	SHOULD
ImageWidth**	n: width of image in pixels	MUST
ImageLength**	n: length of image in pixels (total number of scanlines)	MUST
NewSubFileType**	16, 18: Bit 1 indicates single page of a multi-page Document on Primary IFD Bit 4 indicates MRC model	MUST
Orientation	1**-8, (Default ~~is~~= 1)	MUST
PhotometricInterpretation	0**: WhiteIsZero (Mask Layer) 2: RGB 5: CMYK 10**: ITULAB	MUST
ResolutionUnit**	2: inch (Default = 2)	MUST
RowsPerStrip**	n: number of scanlines per TIFF strip	MUST
SamplesPerPixel**	1**: L* (lightness) 3: LAB, RGB, CMY 4: CMYK	MUST
Software*	{ASCII}: name & release number of creator software	SHOULD
StripByteCounts**	n: number of bytes in TIFF strip	MUST
StripOffsets**	n: offset from beginning of file to each TIFF strip	MUST
XResolution	200**, 300**: background & foreground layers; ~~600**: binary mask layer;~~ other resolutions are ~~optional~~OPTIONAL	MUST
YResolution	200**, 300**: background & foreground layers; ~~600**: binary mask layer;~~ other resolutions are ~~optional~~OPTIONAL; ~~must~~MUST be equal to XResolution (pixels MUST be square)	MUST

* Receiver SHOULD support this field.

** (If double asterisk is in 'Baseline Fields' column) Receiver MUST support the given field and all values shown in 'Values' column.
(If double asterisk is in 'Values' column) Receiver MUST support the given field and the value immediately preceding the double asterisk.

Table 16. UIF Profile M Extension Fields

Extension Fields	Values	Sender Conformance
T4Options	0**: REQUIRED if Compression is Modified Huffman, EOLs not byte aligned (Default =	MUST if Compression=3

	0) 1: REQUIRED if Compression 2D Modified Read, EOLs are not byte aligned 4**: REQUIRED if Compression Modified Huffman, EOLs byte aligned 5: REQUIRED if Compression 2D Modified Read, EOLs are byte aligned	
T6Options	0**: REQUIRED if Compression is 2D Modified Modified Read (Default = 0)	MUST if Compression=4
DocumentName*	{ASCII}: name of scanned Document	SHOULD
PageNumber**	n,m: page number followed by total page count	MUST
ChromaSubSampling	(1,1), (2, 2)** (1, 1): equal numbers of lightness and chroma samples horizontally & vertically| (2, 2): twice as many lightness samples as chroma horizontally and vertically	MUST if Compression=7 and Photometric-Interpretation=10
ChromaPositioning**	1: centered (default = 1)	MAY if Compression=7 and Photometric-Interpretation=10
Indexed	0: not a palette-color image (Default = 0) 1: palette-color image	MUST if image uses palette color; otherwise, MAY
SubIFDs**	<IFD>: byte offset to FG/BG IFDs	MAY
XPPosition**	horizontal offset in primary IFD resolution units	MAY
YPPosition**	vertical offset in primary IFD resolution units	MAY
JPEGTables**	n: file pointer to JPEG quantization and/or Huffman tables	MAY

* Receiver SHOULD support this field.

** (If double asterisk is in 'Extension Fields' column) Receiver MUST support the given field and all values shown in 'Values' column.

(If double asterisk is in 'Values' column) Receiver MUST support the given field and the value immediately preceding the double asterisk.

Note: Fields that the Receiver MAY support have no asterisks in either the field name or the values column

Table 17. UIF Profile M New Fields

New Fields	Values	Sender Conformance
Decode**	minL, maxL, mina, maxa, minb, maxb: minimum and maximum values for L*a*b*	MUST if Photometric-Interpretation=10
ImageBaseColor**	a,b,c: background color in ITULAB	MAY
StripRowCounts**	n: number of scanlines in each strip	MAY
ImageLayer**	n, m: layer number, imaging sequence (e.g., strip number)	MAY
T82Options	0: T.85 profile of T.82 coding	MUST if

		Compression=9
GlobalParametersIFD**	IFD: global parameters IFD	MUST
UIFProfile*	n: ITU-compatible UIF profile	SHOULD
CodingMethods*	n: compression algorithms used in file	SHOULD
ModeNumber*	n: version of T.44 standard	SHOULD
VersionYear*	byte sequence: year of ITU std	SHOULD

* Receiver SHOULD support this field.

** Receiver MUST support the given field and all values shown in 'Values' column.

3.3 Potential UIF profiles

While this specification was being written, a new profile, designated 'T', was being introduced as an extension to TIFF-FX. This new TIFF-FX profile would allow JBIG2 to be used for the lossless and lossy coding of black-and-white image data. JBIG2 coding can be used for UIF Documents as soon as the RFC for TIFF-FX Profile T is published, and the IPPFAX Working Group publishes the additional requirements that are needed for UIF Profile T.

4 Capabilities communication

A Sender needs to discover what a potential UIF-compatible Receiver supports in terms of resolution, encoding, drawing surface etc. To do this, a UIF Sender MUST query in a protocol-specific manner either the UIF profiles supported (see section 4.2) or the Receiver capabilities string (see section 4.1). If the Sender wants to send a UIF file using any OPTIONAL features outside the profile-specific baseline level (see section 4.1.2), then the Sender MUST query the Receiver for the capabilities string. ~~use a protocol-specific means of communication to determine a Receiver capabilities string using CONNEG [5], the UIF profiles supported,~~ The Sender MUST also query the Receiver to determine the media that is supported, and the media that is not only supported but ready. The UIF profiles supported, media supported, and media ready ~~latter three parameters~~ are excluded from the Receiver capabilities string so that a full Sender-side implementation of CONNEG is unnecessary if a UIF Sender decides to support only the minimum capabilities for a given profile (see ~~section~~ Section ~~4~~5.1.2).

4.1 Receiver capabilities string

A valid Receiver capabilities string MUST be any well-formed CONNEG string obeying the syntax of RFC2879 [5]. A UIF Sender MAY request the Receiver capabilities string. A UIF Receiver MUST return a Receiver capabilities string if a Sender requests it.

This string is not expected to be more than 32Kb in length. The capabilities announced by the Receiver SHOULD indicate those things that it can do without operator intervention. For example if the Receiver ~~is a Device that~~ has a manually interchangeable print cartridge with only the black cartridge loaded, it SHOULD only indicate support for "color=binary". The method of transport is protocol-dependent and beyond the scope of this document.

4.1.1 New CONNEG ~~T~~tags and values

Section 3.7 of CONNEG[5] describes the feature tag names that have to do with image coding. The "image-file-structure" CONNEG tag describes how the coded image data is wrapped and formatted. In

addition to the legal values for the "image-file-structure" tag presented in CONNEG[5], UIF formatted data MAY also use "tiff-limited-uif". The "tiff-limited-uif" tag MUST be interpreted as "tiff-limited", except the ~~requirement~~ recommendation for one TIFF strip per page is relaxed.

4.1.2 Minimum Receiver capabilities

Requiring a minimum set of Receiver capabilities on a profile-specific basis is useful because it guarantees a baseline level of ~~compatability~~compatibility between a Sender and a Receiver.

The CONNEG expressions listed in the following subsections summarize the minimum set of capabilities that a Receiver MUST support before advertising support for a given profile. See the CONNEG specification [5] for a complete description of the feature tags tokens.

4.1.2.1 Minimum capabilities for UIF Profile S

```
(& (image-file-structure=TIFF-minimal)
   (MRC-mode=0)
   (image-coding=MH)
   (color=Binary)
   (dpi=[200,300,600])
   (dpi-xyratio=1) )
   ~~(MRC-mode=0) )~~
```

4.1.2.2 Minimum capabilities for UIF Profile F

```
(| (& (image-file-structure=TIFF-minimal)
      (MRC-mode=0)
      (image-coding=MH)
      (color=Binary)
      (dpi=[200,300,600])
      (dpi-xyratio=1) )
      ~~(MRC-mode=0) )~~
   (& (image-file-structure=TIFF-limited-uif)
      (MRC-mode=0)
      (image-coding=MMR)
      (color=Binary)
      (dpi=[200,300,600])
      (dpi-xyratio=1) ) )
      ~~(MRC-mode=0) ) )~~
```

4.1.2.3 Minimum capabilities for UIF Profile J

```
(| (& (image-file-structure=TIFF-minimal)
      (MRC-mode=0)
      (image-coding=MH)
      (color=Binary)
      (dpi=[200,300,600])
      (dpi-xyratio=1) )
      ~~(MRC-mode=0) )~~
   (& (image-file-structure=TIFF-limited-uif)
      (MRC-mode=0)
      (image-coding=JBIG)
      (image-coding-constraint=JBIG-T85)
      (color=Binary)
      (JBIG-stripe-size=128)
      (dpi=[200,300,600])
```

```
      (dpi-xyratio=1) ) )
      (MRC-mode=0) ) )
```

4.1.2.4 Minimum capabilities for UIF Profile C

```
(| (& (image-file-structure=TIFF-minimal)
      (MRC-mode=0)
      (image-coding=MH)
      (color=Binary)
      (dpi=[200,300,600])
      (dpi-xyratio=1) )
      (MRC-mode=0) )
   (& (image-file-structure=TIFF-limited-uif)
      (MRC-mode=0)
      (color=full)
      (image-coding=JPEG)
      (image-coding-constraint=JPEG-T4E)
      (color-subsampling="4:1:1")
      (color-levels<=16777216)
      (color-space=CIELAB)
      (color-illuminant=D50)
      (CIELAB-L-min>=0)
      (CIELAB-L-max<=100)
      (CIELAB-a-min>=-85)
      (CIELAB-a-max<=85)
      (CIELAB-b-min>=-75)
      (CIELAB-b-max<=125)
      (dpi=[200,300])
      (dpi-xyratio=1) ) )
      (MRC-mode=0) )
```

4.1.2.5 Minimum capabilities for UIF Profile L

```
(| (& (image-file-structure=TIFF-minimal)
      (MRC-mode=0)
      (color=Binary)
      (image-coding=MH)
      (dpi=[200,300,600])
      (dpi-xyratio=1) )
      (MRC-mode=0) )
   (& (image-file-structure=TIFF-limited-uif)
      (MRC-mode=0)
      (& (color=grey)
         (| (& (image-coding=JPEG)
               (image-coding-constraint=JPEG-T4E) )
            (& (image-coding=JBIG)
               (image-coding-constraint=JBIG-T43)
               (JBIG-stripe-size=128)
               (image-interleave=stripe) ) )
         (color-space=CIELAB)
         (color-levels<=256)
         (color-illuminant=D50)
         (CIELAB-L-min>=0)
         (CIELAB-L-max<=100)
         (dpi=[200,300]) (dpi-xyratio=1) ) ) )
      (MRC-mode=0) ) )
```

4.1.2.6 Minimum capabilities for UIF Profile M

```
(| (& (image-file-structure=TIFF-minimal)
      (MRC-mode=0)
      (color=Binary)
      (image-coding=MH)
      ~~(MRC-mode=0)~~
      (dpi=[200,300,600])
      (dpi-xyratio=1) )
   (& (image-file-structure=TIFF-limited-uif)
      (MRC-mode=0)
      (color=full)
      (image-coding=JPEG)
      (image-coding-constraint=JPEG-T4E)
      (color-subsampling="4:1:1")
      (color-levels<=16777216)
      (color-space=CIELAB)
      (color-illuminant=D50)
      (CIELAB-L-min>=0)
      (CIELAB-L-max<=100)
      (CIELAB-a-min>=-85)
      (CIELAB-a-max<=85)
      (CIELAB-b-min>=-75)
      (CIELAB-b-max<=125)
      (dpi=[200,300])(dpi-xyratio=1)
      ~~(MRC-mode=0)~~
   (& (image-file-structure=TIFF-MRC-limited)
      (MRC-mode=1)
      (MRC-max-stripe-size<=256)
      (| (& (image-file-structure=TIFF-minimal)
            (color=Binary)
            (image-coding=MH)
            (dpi=[200,300])
            (dpi-xyratio=1) )
         (& (image-file-structure=TIFF-limited-uif)
            (color=full)
            (image-coding=JPEG)
            (image-coding-constraint=JPEG-T4E)
            (color-subsampling="4:1:1")
            (color-levels<=16777216)
            (color-space=CIELAB)
            (color-illuminant=D50)
            (CIELAB-L-min>=0)
            (CIELAB-L-max<=100)
            (CIELAB-a-min>=-85)
            (CIELAB-a-max<=85)
            (CIELAB-b-min>=-75)
            (CIELAB-b-max<=125)
            (dpi=[200,300])
            (dpi-xyratio=1) ) ) ) )
```

4.2 UIF profiles supported

A UIF Sender MUST query the potential UIF Receiver for the UIF profiles supported by the Receiver. A UIF Receiver MUST respond with the UIF profiles that it supports. ~~Possible values MUST be among the UIF profiles described in this document, namely, UIF Profile S, F, J, C, L, and M.~~ When a

Receiver indicates the document formats / profiles that are supported, the list MUST include all the UIF profiles described in this document that are supported and, if UIF Profile M is supported, all of the combinations with UIF-Profile M that are supported. The Sender MUST interpret a missing or otherwise invalid response as an indication that the Receiver does not support UIF. The method of transport and the actual data values used to indicate supported UIF profiles are protocol-specific and beyond the scope of this document.

4.3 Media supported

A UIF Sender MUST query the potential UIF Receiver for media supported. A UIF Receiver MUST respond with the media supported by the Receiver (e.g., letter, legal, A4, etc.). The method of transport, the valid range of media, and the actual data values used to indicate supported media are protocol-specific and beyond the scope of this document; however, the Sender MUST be able to infer actual dimensions from the media values used.

4.4 Media ready

A UIF Sender MUST query the potential UIF Receiver for media ready. A UIF Receiver MUST respond with the subset of media supported that is ready to print with no user intervention. The method of transport, the valid range of media, and the actual data values used to indicate ready media are protocol-specific and beyond the scope of this document; however, the Sender MUST be able to infer actual dimensions from the media values used.

4.5 Image reduction supported

A UIF Sender MAY query the potential UIF Receiver to determine whether or not image reduction is supported. A Receiver MUST be capable of indicating whether or not it supports image reduction. The method by which this query occurs is protocol-specific and beyond the scope of this document.

5 Sender requirements

5.1 Indicating ~~Support~~ Document format using MIME

If the underlying transport protocol uses MIME as defined by RFC2046 [23], then a Sender MUST adhere to the requirements found here in Section 5.1 and its subsections.

[22] describes the registration of the MIME content-type image/tiff to refer to TIFF encoded image data. In addition, an ~~optional~~ "application" parameter is defined for image/tiff to identify a particular application's subset of TIFF and TIFF extensions for the encoded image data, if it is known. Typically, this would be used to assist the Receiver in dispatching a suitable rendering package to handle the display or processing of the image file.

5.1.1 MIME content ~~type~~ type

~~When transported by MIME~~If the underlying transport protocol uses MIME, the TIFF content defined by this document MUST be ~~encoded within~~described by an ‘image/tiff’ content type.

5.1.2 MIME content type application parameter

The MIME content type application parameter indicates the UIF profiles used within the UIF Document. All letters after the application parameter "uif-" are reserved for use with UIF documents. ~~The two values of the image/tiff application parameter as defined for UIF are 'uifbw' and 'uifcolor'.~~

~~The "uifbw" application parameter is suitable for use by Senders that can process one or more UIF profiles used for the encoding of black and white facsimile data.~~

~~The "uifcolor" application parameter is suitable for use by Senders that can process one or more UIF profiles or subsets that can be used for the encoding of black and white, AND color facsimile data.~~

~~Since this document defines several UIF profiles, the following rules MUST be followed when setting the application parameter value.~~

5.1.2.1 Application parameter with non-MRC UIF profiles

The MIME application value for all non-MRC-structured UIF Documents MUST be "uif-" followed by one or more single lower case letters representing the UIF profiles (i.e., 's', 'f', 'j', 'c', or 'l') that are used in the Document. For example, the Sender would use

Content type: image/tiff; application=uif-s

to represent a Document of one or more pages in which only UIF Profile S is used. To reduce the number of permutations, the lower case letters following "uif" MUST be arranged in alphabetical order. For example, a Sender would use

Content type: image/tiff; application=uif-cf

to represent a Document in which one or more pages are encoded using UIF Profile C, and one or more pages are encoded using UIF Profile F.

5.1.2.2 Application parameter with UIF Profile M

The MIME application value for all UIF Documents encoded using UIF Profile M MUST be "uif-m" followed by one or more lower case letters representing the UIF profiles that are used in the Document. UIF Profile M does not introduce any new types of encoding. Rather, UIF Profile M prescribes a way to use other UIF profiles within the same page of a Document. Thus, one or more letters MUST follow the lower case 'm' to indicate which UIF profiles are used within the UIF Profile M file. To reduce the number of permutations, the lower case 'm' MUST appear before the lower-case letter(s) used to indicate the profiles used within the MRC file structure, and letters following the lower case 'm' MUST be arranged alphabetically. For example, the Sender would use

Content type: image/tiff; application=uif-mcf

to represent a Document in which there are one or more UIF Profile M-structured pages that use UIF Profile C to code the foreground/background layers and UIF Profile F to code the binary mask layer. As another example, the Sender would use

Content type: image/tiff; application=uif-mcls

to represent a Document in which there are one or more UIF Profile M-structure pages that use UIF Profile C or L to code the foreground/background layers and UIF Profile S to code the binary mask layer.

~~Senders that use UIF Profiles S, F, or J, MUST set the value of the application parameter to "uifbw". Senders which use UIF Profiles C, L, or M, MUST set the value of the application parameter to "uifcolor".~~

~~An example of the use of the image/tiff MIME Content-type with the application parameter set with the value 'uifbw' follows:~~

~~Content-type: image/tiff; application=uifbw~~

~~In this example, use of this parameter value will enable a Receiver to identify the content as being within a profile or subset of UIF that is suitable for encoding black and white image data, before attempting to process the image data.~~

~~In a similar respect, an example of the image/tiff MIME Content-type with the application parameter setting suitable for handling a color subset or profile of TIFF for facsimile is shown below:~~

~~Content-type: image/tiff; application=uifcolor~~

5.2 Image-Reduction

It is possible that a Sender might send an image that does not match the announced drawing surface of the Receiver (for example a Sender may have an image that it cannot change). In this case the Sender MAY indicate to the Receiver in a protocol-specific manner whether or not the ~~RECEIVER~~ Receiver is to reduce the image.

If the Receiver does not support image reduction (see section ~~45~~.5) and the received image dimensions are larger than what is allowed by the supported media, then the Receiver MUST flow extra data to the next page. If the Receiver does support image reduction, then the Sender MAY request in a protocol-specific manner that the Receiver use image-reduction if necessary. If the Receiver receives such a request, and the received image dimensions are larger than what is allowed by the supported media, then the Receiver MUST reduce the image so as to fit it to the page while maintaining the aspect ratio. If the Receiver uses image reduction, the Receiver ~~must~~MUST determine if reduction is necessary for each page and if so, apply reduction. The scaling is calculated separately for each page. The scaling applies to all pages of the ~~job~~Document unless the protocol used by the Sender and Receiver supports a means of specifying image reduction on a page-by-page basis (e.g., IPPFAX's potential use of page level overrides[6]).

5.3 Intra-~~job~~Document media selection

When the image dimensions are different on a page-by-page basis such that use of a single type of media is not possible without scaling, the Sender / Receiver protocol MUST arbitrate media selection. The ImageWidth and ImageLength TIFF tags MUST NOT select the media.

6 Conformance Requirements

For the listed operations, Table 18 below shows conformance requirements that apply to the protocol used to transport UIF data.

Table 18. Underlying Protocol Conformance.

Operation	UIF-capable Sender	UIF-capable Receiver	Section
Receiver capabilities string	MAY	MUST	4.1
UIF profiles supported	MUST	MUST	4.1.2
Media supported	MUST	MUST	4.1.3
Media ready	MUST	MUST	4.1.4
Image reduction supported	MAY	MUST	4.1.5

7 References

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[17] ITU-T Recommendation T.85, Application profile for Recommendation T.82 - Progressive bi-level image compression (JBIG coding scheme) for facsimile apparatus, August 1995

[18] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

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Note: [22] is being progressed as BCP and is expected to be issued prior to the issuing of TIFF-FX as a Draft Standard.~~Issues~~

[23] Freed, N. and N. Borenstein, "Multipurpose Internet Mail Extensions (MIME) Part Two: Media Types", RFC 2046, November 1996.

8 Issues

8.1 Outstanding Issues

~~1.Should the MIME types "image/tiff; application=uif" and "image/tiff; application=uifcolor" be changed to the following?~~

~~image/tiff; application=uif-s~~
~~image/tiff; application=uif-f~~
~~image/tiff; application=uif-j~~
~~image/tiff; application=uif-c~~
~~image/tiff; application=uif-l~~
~~image/tiff; application=uif-m~~

1. Should the capabilities discovery portion of this spec be removed and placed into a specification that deals solely with how IPPFAX uses capabilities discovery? Advantages: other applications interested in using UIF simply as a data format can do so (no prohibitive excess baggage).
2. Should we break UIF Profile C into two profiles—one to represent a baseline grayscale configuration and the other to represent a baseline color configuration? This way, a greater number of device capabilities configurations would be allowed without requiring an implementation of CONNEG. (The same could apply to UIF Profile L)
3. Should we add the CONNEG tag "profile" and tag values "uif-s", "uif-f", "uif-c", etc., to represent the incremental differences between minimum capabilities strings listed in sections 4.1.2.1 through

4.1.2.5? This would cut down on the length of the CONNEG strings, especially for the composite UIF profile M) and would make it immediately apparent from a human's perspective any OPTIONAL features that are advertised.

Define "profile=uif-s" to mean

```
(& (image-file-structure=TIFF-minimal)
   (MRC-mode=0)
   (image-coding=MH)
   (color=Binary)
   (dpi=[200,300,600])
   (dpi-xyratio=1) )
```

Define "profile=uif-f" to mean

```
(& (image-file-structure=TIFF-limited-uif)
   (MRC-mode=0)
   (image-coding=MMR)
   (color=Binary)
   (dpi=[200,300,600])
   (dpi-xyratio=1) )
```

Define "profile=uif-j" to mean

```
(& (image-file-structure=TIFF-limited-uif)
   (MRC-mode=0)
   (image-coding=JBIG)
   (image-coding-constraint=JBIG-T85)
   (color=Binary)
   (JBIG-stripe-size=128)
   (dpi=[200,300,600])
   (dpi-xyratio=1) )
```

Define "profile=uif-c" to mean

```
(& (image-file-structure=TIFF-limited-uif)
   (MRC-mode=0)
   (color=full)
   (image-coding=JPEG)
   (image-coding-constraint=JPEG-T4E)
   (color-subsampling="4:1:1")
   (color-levels<=16777216)
   (color-space=CIELAB)
   (color-illuminant=D50)
   (CIELAB-L-min>=0)
   (CIELAB-L-max<=100)
   (CIELAB-a-min>=-85)
   (CIELAB-a-max<=85)
   (CIELAB-b-min>=-75)
   (CIELAB-b-max<=125)
   (dpi=[200,300])
   (dpi-xyratio=1) )
```

Define "profile=uif-l" to mean

```
(& (image-file-structure=TIFF-limited-uif)
```

```
        (MRC-mode=0)
        (color=grey)
        (image-coding=JBIG)
        (image-coding-constraint=JBIG-T43)
        (JBIG-stripe-size=128)
        (image-interleave=stripe)
        (color-space=CIELAB)
        (color-levels<=256)
        (color-illuminant=D50)
        (CIELAB-L-min>=0)
        (CIELAB-L-max<=100)
        (dpi=[200,300])
        (dpi-xyratio=1) )
```

Then, for example, we can rewrite the minimum capabilities string for UIF Profile M shown in Section 4.1.2.6 as

```
   (| (profile=[uif-s,uif-c])
      (& (image-file-structure=TIFF-MRC-limited)
         (MRC-mode=1)
         (MRC-max-stripe-size<=256)
         (profile=[uif-s,uif-c])
         (dpi=[200,300]) ) )
```

As another example, if we would like to advertise a Receiver that can support UIF Profiles S, F, J with optional resolution of 1200 dpi for the black & white profiles and optional resolution of 600dpi for the color profile, we can say

```
   (| (& (profile=[uif-s,uif-f])
         (dpi=[200,300,600,1200]) )
      (& (profile=uif-c)
         (dpi=[200,300,600]) ) )
```

8.2 Resolved Issues

1. Add description of new CONNEG tag used to indicate capabilities that are available *with* user intervention? We're going to use media ready.
2. What should be done concerning media selection when the TIFF image sizes are different on a page by page basis? Either determine media size by media size attribute or let the Receiver determine for itself the media to be used on each page

   At the May 30 telecon, We agreed that for now, the TIFF "ImageWidth" and "ImageLength" tags do NOT select the media, but that the IPPFAX "media" Job Template attribute does. This decision works fine for documents where the image size is the same for all pages in the document. For documents that have differing image sizes within the same document, we'll wait for a future requirement/extension to see whether to add another Job Template attribute so that the Sender can request that the TIFF image tags be used to select media (or not). We also agreed NOT to bring in the IPP "page-overrides" attribute to allow the protocol to select media on a page by page basis (though an IPP Printer ~~implementation~~ might support such a thing). Incorporate this information into the IPPFAX spec.
3. Should the IPP attribute descriptions be moved to the IFX spec so that UIF can be made independent of the IPPFAX protocol in case other protocols would like to use it? Yes.

Definitions of IPP attributes have been removed from the UIF spec, and requirements have been restated in a non protocol-specific manner.

Now the IPPFAX document will include two levels of conformance: 'uif-only' and 'authenticated'. The level being used needs to be reflected in a Printer Description attribute. Make the appropriate changes to the IFX document.

4. Change "uif-scale" attribute name to "uif-reduce"? Yes. The IFX spec should be changed to reflect this. The UIF spec has been changed using more generic terminology to reflect this.
5. Rename "uif-conneg" IPP attribute to "uif-receiver-capabilities"? Yes. The IFX spec should be changed to reflect this. The UIF spec has been changed using more generic terminology to reflect this.
6. Should additional resolutions be made mandatory? Yes. X & Y Resolution values of 200 & 300 (in addition to 600dpi) are now also REQUIRED for UIF Profiles S, F, and J. X & Y Resolution values of 200dpi (in addition to 300 dpi) are now REQUIRED for UIF Profiles C and L. For UIF Profile M, REQUIRED binary, foreground, and background X &Y resolutions have been changed to include only 200 and 300 dpi.
7. Should we change the minimum required compression for Profile F from MH to MMR? Yes, this has been done to reflect industry practice. The minimum CONNEG expressions have been changed to reflect this.
8. Should we change the minimum required color space for Profile C from grayscale to color? Yes, this has been done to reflect industry practice. The minimum CONNEG expressions have been changed to reflect this.
9. The term "default conneg" is a different meaning for "default", than used in IPP. In IPP, "default" means what the Printer does if the Sender doesn't supply some attribute. The "default conneg" is what the ~~implementation~~Implementation MUST support for a given profile if the implementer doesn't choose do to more.

   Resolution: the spec has been changed so "Minimum" is used instead of "default".

9 Actions

~~1.Teleconference scheduled on June 27, 2001 for 10:00am – 12:00pm (Pacific Time) to review updated spec.~~

1. Tom Hastings will investigate whether it is acceptable to use a comma-separated list of values for the MIME content type application parameter. If we can use a comma-separated list, this would allow us to avoid potentially confusing single values like 'Content type: image/tiff; application=uif-clsmcs' to indicate support for Profile C, L, S, and M, where only profiles C and S are allowed inside a Profile M structure.

2. The following UIF usage of the MIME application value must be registered with the ABNF :

```
"uif-" (lowalpha | "m" +lowalpha)
   lowalpha = "a" | "b" | "c" | "d" | "e" | "f" | "g" | "h" | "i" |
              "j" | "k" | "l" | "m" | "n" | "o" | "p" | "q" | "r" |
              "s" | "t" | "u" | "v" | "w" | "x" | "y" | "z"
```

3. Need to register CONNEG tags and tag values introduced with UIF. Namely, the tag value 'tiff-limited-uif' must be registered as a legal value for the feature tag "image-file-structure".

Next meeting: Toronto. Wednesday, August 1, 2001.

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

Revision	Date	Author	Notes
1	1/16/01	Paul Moore, Netreon	Initial version
2	1/28/01	Gail Songer, Netreon	Added formal definition of new attributes
3	4/11/01	John Pulera, Minolta	Added UIF-specific Profile U and described UIF support for other TIFF-FX profiles
4	5/07/01	John Pulera, Minolta	Modifications made at Portland meeting.
5	6/14/01	John Pulera, Minolta	Added description of UIF profiles and minimal capabilities strings; generalized document so there is no dependence on IPP.
6	7/25/01	John Pulera, Minolta	Expanded Sender conformance requirements for UIF profiles and MIME; other modifications per June teleconference.