A Project of the PWG IPPFAX Working Group

Universal Image Format (UIF)

IEEE-ISTO Printer Working Group
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ftp://ftp.pwg.org/pub/pwg/QUALDOCS/uif-spec-0~~8~~9.pdf, .doc

Abstract

This standard specifies an extension to TIFF-FX known as Universal Image Format (UIF) by formally defining a series of TIFF-FX "profiles" distinguished primarily by the method of compression employed and color space used. The UIF requirements [uif-req] are derived from the requirements for IPPFAX [ifx-req] and Internet Fax [RFC2542].

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 makes reference to the TIFF-FX specification [RFC2301], 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 (see [T.4], [T.6], [T.43], [T.44], [T.81], [T.82], and [T.85]). UIF also requires the use of certain TIFF-FX extenisions described ~~fully~~ in ~~[tiff-fx-ext1]~~Appendix B of this document ~~and summarized in this document~~. UIF does not specify any new TIFF tags or field values.

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/pwg5102.2.pdf , .doc, .rtf

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1 Introduction

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 makes reference to the TIFF-FX specification [RFC2301], 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 (see [T.4], [T.6], [T.43], [T.44], [T.81], [T.82], and [T.85]). UIF is different from TIFF-FX in that UIF requires the use of certain TIFF-FX extenisions ~~described fully in [tiff-fx-ext1] and~~ summarized in Appendix B of this document.

This document specifies a set of extensions to the TIFF-FX profiles defined in [RFC2301] that are especially suited for use with synchronous protocols (e.g., IPPFAX[ifx]). The increased conformance requirements found in this UIF specification reflect the need for a data format where quality document transmission is the primary concern. When the profiles described in [RFC2301] are used with the extensions summarized in Appendix B of this document ~~and formally defined in [TIFF-EXT1]~~, the data format is known as Universal Image Format (UIF). UIF does not specify any new TIFF tags or field values.

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 [RFC2119].

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 [TIFF]

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 [TIFF], ~~specification,~~ the set of PageMaker TIFF Technical Notes [TTN1], or TIFF Technical Note 2 [TTN2].

New Field – One of the new TIFF fields introduced by [RFC2301]. Note that the UIF specification does not introduce any new TIFF tags or field values.

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.

TIFF-FX Extension – one of the extensions to [RFC2301] specified in [tiff-fx-ext1] or Appendix B of this document.

UIF Profile – A TIFF-FX profile used with a specific combination of the TIFF-FX ~~extensions~~ Extensions that are described in section 3.1.

3 TIFF-FX support

A UIF Document is a TIFF-FX file that adheres to the requirements of [RFC2301] and specific TIFF-FX extensions as described in Appendix B~~(1) Baseline TIFF (see [TIFF]) and (2) one or more UIF Profiles~~. A UIF Profile uses a collection of ITU-T facsimile coding methods. The UIF Profiles listed in this section have been derived from [RFC2301]. The reader is referred to Appendix B of this document and ~~the TIFF-FX Extensions Set 1 document [tiff-fx-ext1]~~[RFC2301] for a complete description of each profile, as the subsections below briefly summarize each UIF Profile and list only the additional TIFF-FX extensions that MUST be used.

Pages within a single UIF Document MAY be encoded using different UIF Profiles.

An Implementation that supports UIF MUST support at least ~~UIF~~ TIFF-FX Profile S (see [RFC2301] for a complete description of TIFF-FX Profile S). Note that for the TIFF fields “ImageDescription”, “DocumentName”, “Software”, and “DateTime”, ~~Adobe Baseline TIFF~~[TIFF] specifies only ASCII and does not provide a language tag or alternate character set facility.

~~*3.1New TIFF-FX Extensions*~~

~~The following TIFF-FX extensions are formally defined in [tiff-fx-ext1] and summarized in the following subsections.~~

~~3.1.1TIFF-FX Extension 20: Relaxed Image Widths and Resolutions~~

~~The allowances shown below supersede the TIFF-FX requirements specified in [RFC2301] concerning the ImageWidth, XResolution, and YResolution TIFF fields:~~

~~? If this TIFF-FX Extension is supported, then the ImageWidth, XResolution, and YResolution TIFF fields are not constrained to the set of resolutions specified in [TIFF-FX]; however, the. Receiver MUST support the image width & length that are determined by the media size and resolutions supported.~~

~~3.1.2TIFF-FX Extensions 21 – Required Resolution~~

~~The requirement shown below supersedes the TIFF-FX requirements in [RFC2301] concerning the XResolution, YResolution, and ResolutionUnit TIFF fields:~~

~~? If this TIFF-FX Extension is supported, then Receivers MUST support XResolution=YResolution=200 and ResolutionUnit=2 (inches)~~

~~3.1.3TIFF-FX Extensions 22 – Required Resolution~~

~~The requirement shown below supersedes the TIFF-FX requirements in [RFC2301] concerning the XResolution, YResolution, and ResolutionUnit TIFF fields:~~

~~? If this TIFF-FX Extension is supported, then Receivers MUST support XResolution=YResolution=300 and ResolutionUnit=2 (inches)~~

~~3.1.4TIFF-FX Extensions 23 – Required Resolution~~

~~The requirement shown below supersedes the TIFF-FX requirements in [RFC2301] concerning the XResolution, YResolution, and ResolutionUnit TIFF fields:~~

~~? If this TIFF-FX Extension is supported, then Receivers MUST support XResolution=YResolution=400 and ResolutionUnit=2 (inches)~~

~~3.1.5TIFF-FX Extensions 24 – Required Resolution~~

~~The requirement shown below supersedes the TIFF-FX requirements in [RFC2301] concerning the XResolution, YResolution, and ResolutionUnit TIFF fields:~~

~~? If this TIFF-FX Extension is supported, then Receivers MUST support XResolution=YResolution=600 and ResolutionUnit=2 (inches)~~

~~3.1.6TIFF-FX Extensions 25 – Required Field~~

~~The requirement shown below supersedes the conformance found in [tiff-fx-ext1] concerning the JPEGTables field (see [TTN2] for a description of the JPEGTables field):~~

~~? If this TIFF-FX Extension is supported, then Receivers MUST support the use the JPEGTables Extension Field~~

~~3.1.7TIFF-FX Extension 26 – Required Compression~~

~~The requirement shown below supersedes TIFF-FX requirements in [RFC2301] concerning required the Compression TIFF field:~~

~~? If this TIFF-FX Extension is supported, Receivers MUST support Resolution=4 (2-dimensional MMR encoding as defined in [T.6]) and T6Options=0.~~

~~3.1.8~~3.1 *The 'TIFF-FXExtensions' Field*

[tiff-fx-ext1] defines a new TIFF field called 'TIFF-FXExtensions' which is used to identify all TIFF-FX extensions. This field MUST be present when extensions are used. TIFF-FX Extensions are identified by bit value assignment. ~~The table below~~Table 1 summarizes the TIFF-FX Extensions that directly pertain to UIF and indicates which Extensions the Receiver MUST support for each profile. Bit 0 corresponds to the least significant bit of the 32-bit 'TIFF-FXExtensions' field value. The 'UIF-Profiles' column indicates those UIF profiles for which a Receiver MUST implement a given extension number.

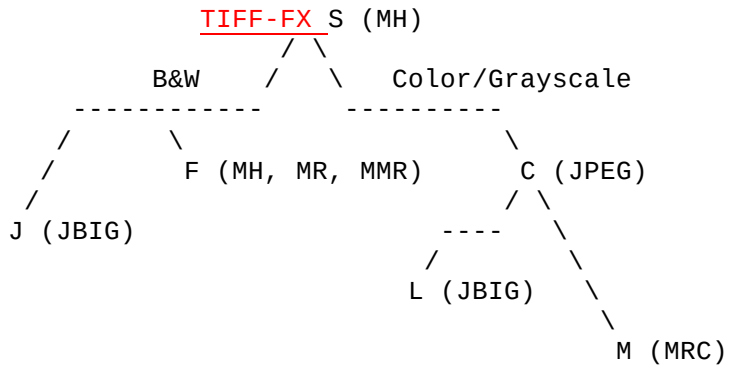
A new TIFF-FX extensions document will be separately published to describe the new TIFF-FX Extensions 20 through 26. Until this document is published, a description of TIFF-FX Extensions 20 through 26 appears in Appendix B.

Table 1. 'TIFF-FXExtension' Field Bit Description

Bit Number	Extension Number	Description	UIF Profiles
19	20	Relaxed Image Width & Resolutions. If Bit 19 is 1, then the ImageWidth, XResolution, and YResolution fields are not constrained; however, the Receiver MUST support the image width & length that are determined by media size and resolutions supported.	~~S,~~ F, J, C, L, M
20	21	Required Resolution: 200dpi. If Bit 20 is 1, then Receivers MUST support XResolution=YResolution=200 and ResolutionUnit=2 (inches)	~~S,~~ F, J, C, L, M
21	22	Required Resolution: 300dpi. If Bit 21 is 1, then Receivers MUST support XResolution=YResolution=300 and ResolutionUnit=2 (inches)	~~S,~~ F, J, C, L, M
22	23	Required Resolution: 400dpi. If Bit 22 is 1, then Receivers MUST support XResolution=YResolution=400 and ResolutionUnit=2 (inches)	M
23	24	Required Resolution: 600dpi. If Bit 23 is 1, then Receivers MUST support XResolution=YResolution=600 and ResolutionUnit=2 (inches)	~~S,~~ F, J
24	25	Required Field: 'JPEGTables' If Bit 24 is 1, then Receivers MUST support the use the 'JPEGTables' Extension Field	C, M
25	26	Required Compression: MMR If Bit 25 is 1, then Receivers MUST support Resolution=4 and T6Options=0.	F, M

3.2 Relationships among UIF Profiles

The following tree diagram, which is adapted from [RFC2301], shows the relationship among UIF Profiles and between UIF Profiles and coding methods.



All UIF Senders and/or Receivers MUST implement ~~UIF~~ TIFF-FX Profile S, which is the root node of the tree. All color Senders and/or Receivers of UIF MUST implement UIF Profile C. Senders and/or Receivers that implement 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 Sender and/or Receiver that implements UIF Profile M MUST also implement UIF Profiles C and S, and MAY optionally implement UIF Profile F, J or L. For another example, a Sender/Receiver that implements UIF Profile C MUST also implement ~~UIF~~ TIFF-FX Profile S, and MAY optionally implement UIF Profile F or J.

3.3 Summary of UIF Profiles

The following subsections summarize Implementation requirements and list the TIFF-FX extensions that MUST be supported for each of the UIF Profiles. 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 all UIF Profiles~~profiles other than UIF Profile S~~, single asterisks (*) and double asterisks (**) indicate the level of Receiver conformance (see the legend below each table). Also~~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. See [RFC2301] for TIFF-FX Profile S requirements.

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.

3.3.1UIF Profile S

When TIFF-FX Extensions 20, 21, 22, and 24 are applied to Profile S in [RFC2301], the result is UIF Profile S. UIF Profile S is modeled after Profile S of [RFC2301], which describes the minimal black-and-white subset of TIFF for facsimile. Tables 2, 3, and 4 summarize the fields and field values that are REQUIRED for all Implementations of UIF Profile S. A UIF Profile S Implementation MUST use 1-dimensional Modified Huffman (MH) compression as defined in [T.4] 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 [RFC2301] except where overridden by TIFF-FX Extensions 20,21,22, and 24.

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).

All UIF Receivers MUST support the following Baseline, Extension, and New Fields and accompanying field values. All UIF Senders MUST be capable of creating a UIF Document that contains the following Baseline, Extension, and New 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 [RFC2301] and [tiff-fx-ext1].

Table 2. 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 (written in pixels per inch)
YResolution	200, 300, 600, other resolutions are OPTIONAL (written in pixels per inch)

Table 3. 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~~

~~**Table 4. UIF Profile S New Fields**~~

~~New Fields~~	~~Values~~
~~GlobalParametersIFD~~	~~IFD: global parameters IFD~~
~~TIFF-FXExtensions~~	~~0xB80000**(Bits indicating use of TIFF-FX Extensions 20,21,22 and 24)~~

~~3.3.2~~3.3.1 UIF Profile F

This section defines UIF Profile F, which uses Modified Read and Modified Modified Read (MMR) compression (described in [T.4] and [T.6]) in addition to the Modified Huffman compression used for TIFF-FX~~UIF~~ Profile S. When TIFF-FX Extensions 20, 21, 22, 24, and 26 are applied to TIFF-FX Profile F in [RFC2301], the result is UIF Profile F. Tables ~~5~~2, ~~6~~3, and ~~7~~ 4 summarize 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 [RFC2301] and [tiff-fx-ext1]. A Sender/Receiver implementing this profile is REQUIRED to also implement ~~UIF~~ TIFF-FX Profile S.

Table ~~5~~2. 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 = 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 (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 (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 ~~6~~3. 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 ~~7~~4. UIF Profile F New Fields

New Fields	Values	Sender Conformance
GlobalParametersIFD**	IFD: global parameters IFD	MUST

TIFF-FXExtensions	0x2B80000** (Bits indicating use of TIFF-FX Extensions 20,21,22, 24, and 26)	MUST
FaxProfile*	n: ITU-compatible FAX profile	SHOULD
MultiProfiles*	n: profiles or profile(s) plus extension(s) applied within this file	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.
(If double asterisk is in 'Values' column) Receiver MUST support the given field and the value immediately preceding the double asterisk.

~~3.3.3~~3.3.2 UIF Profile J

This section defines Profile J for UIF, which uses lossless JBIG compression as it is defined in [T.82] subject to the application rules given in [T.85]. When TIFF-FX Extensions 20, 21, 22, and 24 are applied to TIFF-FX Profile J in [RFC2301], the result is UIF Profile J. Tables ~~8~~5, ~~9~~6, and ~~10~~ 7 summarize 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~~UIF Document. For a complete description of the Baseline, Extension, and New Fields shown below, see the TIFF-FX specification [RFC2301] and [tiff-fx-ext1]. A Sender/Receiver implementing this profile is REQUIRED to also implement ~~UIF~~ TIFF-FX Profile S.

Table ~~8~~5. 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 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 = 1)	MUST
PhotometricInterpretation**	0: pixel value 1 means black 1: pixel value 1 means white	MUST
ResolutionUnit**	2: inch (Default = 2)	MUST

	3: centimeter	
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 (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	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 ~~9~~6. 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 ~~10~~7. UIF Profile J New Fields

New Fields	Values	Sender Conformance
GlobalParametersIFD**	IFD: global parameters IFD	MUST
TIFF-FXExtensions	0xB80000** (Bits indicating use of TIFF-FX Extensions 20,21,22 and 24)	MUST
FaxProfile*	n: ITU-compatible FAX profile	SHOULD
MultiProfiles*	n: profiles or profile(s) plus extension(s) applied within this file	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.

~~3.3.4~~3.3.3 UIF Profile C

This section defines Profile C for UIF, which uses lossy JPEG compression as it is defined in [T.81]. When TIFF-FX Extensions 20, 21, 22, and 25 are applied to TIFF-FX Profile C in [RFC2301], the result is UIF Profile C. Tables ~~11~~8, ~~12~~9, and ~~13~~10 summarize 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 ~~d~~Document. For a complete description of the Baseline, Extension, and New Fields shown below, see [RFC2301] and [tiff-fx-ext1]. A Sender/Receiver that implements this profile is REQUIRED to also implement ~~UIF~~ TIFF-FX Profile S.

Table ~~11~~8. UIF Profile C Baseline Fields

Baseline Fields	Values	Sender Conformance
BitsPerSample	8**: 8 bits per color sample 12: 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 = 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 (written in pixels per inch). XResolution and YResolution fields MUST be equal.	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 ~~12~~9. 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 (see [TTN2])	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 asteris k.

Table ~~13~~10. 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
TIFF-FXExtensions	0x1380000** (Bits indicating use of TIFF-FX Extensions 20,21,22 and 25)	MUST
FaxProfile*	n: ITU-compatible FAX profile	SHOULD
MultiProfiles*	n: profiles or profile(s) plus extension(s) applied within this file	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.

~~3.3.5~~3.3.4 UIF Profile L

When TIFF-FX Extensions 20, 21, and 22 are applied to TIFF-FX Profile L in [RFC2301], the result is UIF Profile L. This profile uses JBIG compression (see [T.82]), subject to the application rules specified in [T.43] to losslessly code three types of color and grayscale images: one bit per color CMY, CMYK and RGB images; a palletized (i.e. mapped) color image; and continuous tone color and grayscale images.

Tables ~~14~~11, ~~15~~12, and ~~16~~13 summarize fields and field values that are REQUIRED / RECOMMENDED / OPTIONAL for 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~~UIF Document. For a complete description of the Baseline, Extension, and New Fields shown below, see [RFC2301] and [tiff-fx-ext1]. A Sender / Receiver that chooses to implement this profile is REQUIRED to also implement ~~UIF~~ TIFF-FX Profile S, and UIF Profile C.

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 ~~14~~11. 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	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 = 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 (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 ~~15~~12. 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 ~~16~~13. 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
TIFF-FXExtensions	0x380000** (Bits indicating use of TIFF-FX Extensions 20, 21, and 22)	MUST
FaxProfile*	n: ITU-compatible FAX profile	SHOULD
MultiProfiles*	n: profiles or profile(s) plus extension(s) applied within this file	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.

~~3.3.6~~3.3.5 UIF Profile M

When TIFF-FX Extensions 20, 21, 22, 23, 25, and 26 are applied to TIFF-FX Profile M in [RFC2301], the result is UIF Profile M. This profile is modeled after TIFF-FX Profile M, which uses Mixed Raster Content (MRC), defined in [T.44]. 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 [RFC2301], [T.44], and [tiff-fx-ext1].

Tables ~~17~~14, ~~18~~15, and ~~19~~ 16 summarize fields and field values that are REQUIRED / RECOMMENDED / OPTIONAL for 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~~UIF Document. A Sender/Receiver that chooses to implement this profile is REQUIRED to also implement ~~UIF~~ TIFF-FX Profile S~~,~~ and UIF Profile C.

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 ~~17~~14. 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 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 [T.82] 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**	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 = 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**, 400**: binary mask, background & foreground layers; other resolutions are OPTIONAL	MUST
YResolution	200**, 300**, 400**: binary mask, background & foreground layers; other resolutions are OPTIONAL; 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 ~~18~~15. UIF Profile M Extension Fields

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

	(1, 1): equal numbers of lightness and chroma samples horizontally & vertically| (2, 2): twice as many lightness samples as chroma horizontally and vertically	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
XPosition**	horizontal offset in primary IFD resolution units	MAY
YPosition**	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 ~~19~~16. 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
TIFF-FXExtensions	0x3780000** (Bits indicating use of TIFF-FX Extensions 20, 21, 22, 23, 25, and 26)	MUST
FaxProfile*	n: ITU-compatible FAX profile	SHOULD
MultiProfiles*	n: profiles or profile(s) plus extension(s) applied within this file	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.

3.4 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 Sender/Receiver protocol requirements

4.1 Indicating Document format using MIME

If the underlying transport protocol uses MIME as defined by [RFC2046], then a Sender MUST describe the TIFF-FX data using one of two possible MIME content types, depending on which UIF Profiles are included in the Document. If the Document contains only ~~UIF~~ TIFF-FX Profile S and/or UIF Profile F, then the UIF data content MUST be described by the 'image/tiff' content type/subtype. Registration of the MIME type/sub-type 'image/tiff' is described in the TIFF MIME Sub-type Registration document [TIFF-REG]*. If the Document contains any UIF Profiles besides ~~UIF~~ TIFF-FX Profile S and/or UIF Profile F, then the Sender MUST describe the UIF data using the 'image/tiffx" content type/subtype*. ~~Registration of the 'image/tiffx' content type is described~~

* Note: The IETF[RFC2301] will be registering a new MIME media type to accommodate profiles/codings that are not compatible with TIFF 6. TIFF-FX profiles that are not compatible with TIFF 6, namely profiles J, C, L, and M, will use the new MIME type. For the purposes of this draft, the 'image/tiffx' MIME type is shown as a working name, since it has been suggested through email by the Internet FAX Working Group. When the proper MIME type is agreed by the Internet FAX WG, this document will be updated.

4.2 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 is to reduce the image.

If the Receiver does not support image reduction 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 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 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[ipp-override]).

4.3 Intra-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.

5 References

[RFC2301] McIntyre, Zilles, Buckley, Venable, Parsons, Rafferty "File Format for Internet Fax", RFC2301, March 1998.

[RFC2879] Klyne, McIntyre. "Content Feature Schema for Internet Fax (V2)", RFC2879, August 2000.

[ipp-override] PWG Standard 5100.4-2001 "Internet Printing Protocol (IPP): Override Attributes for Documents and Pages". ftp://ftp.pwg.org/pub/pwg/standards/pwg5100.4.pdf, February 7, 2001.

[uif-req] Moore, P., "Universal Image Format requirements", October 16, 2000, ftp://ftp.pwg.org//pub/pwg/QUALDOCS/requirements/uif-requirements-01.pdf

[ifx-req] Moore, P., "IPP Fax transport requirements", October 16, 2000, ftp://ftp.pwg.org//pub/pwg/QUALDOCS/requirements/ifx-transport-requirements-01.pdf

[RFC2542] Masinter , "Terminology and Goals for Internet Fax", RFC2542, March 1999.

[ifx] Moore, Songer, Hastings, "IPP Fax Protocol" PWG Draft Standard D0.8, October 15, 2001.

[T.4] ITU-T Recommendation T.4, Standardization of group 3 facsimile apparatus for document transmission, October 1997

[T.6] ITU-T Recommendation T.6, Facsimile coding schemes and coding control functions for group 4 facsimile apparatus, November 1988

[T.43] ITU-T Recommendation T.43, Colour and gray-scale image representations using lossless coding scheme for facsimile, February 1997

[T.44] ITU-T Recommendation T.44, Mixed Raster Content (MRC), April 1999.

[T.81] ITU-T Recommendation T.81, Information technology - Digital compression and coding of continuous-tone still images - Requirements and guidelines, September 1992

[T.82] ITU-T Recommendation T.82, Information technology - Coded representation of picture and audio information - Progressive bi-level image compression, March 1995

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

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[TIFF] Tag Image File Format, Revision 6.0, Adobe Developers Association, June 3, 1992, http://partners.adobe.com/asn/developer/pdfs/tn/TIFF6.pdf

The TIFF 6.0 specification dated June 3, 1992 specification (c) 1986-1988, 1992 Adobe Systems Incorporated. All Rights Reserved.

[TTN1] Adobe PageMaker 6.0 TIFF Technical Notes, Sept. 14, 1995, http://partners.adobe.com/asn/developer/pdfs/tn/TIFFPM6.pdf

[TTN2] Draft TIFF Technical Note 2, Replacement TIFF/JPEG specification, March 17, 1995, ftp://ftp.sgi.com/graphics/tiff/TTN2.draft.txt

[TIFF-REG] Parsons, G., Rafferty J. and S. Zilles, "Tag Image File Format (TIFF) - image/tiff MIME Sub-type Registration", work in progress, draft-ietf-fax-tiff-regbis-??.txt.

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

[RFC2046] Freed, N. and N. Borenstein, "Multipurpose Internet Mail Extensions (MIME) Part Two: Media Types", RFC 2046, November 1996.

[tiff-fx-ext1] McIntyre, Abercrobie, Rucklidge, Buckley, “TIFF-FX Extension Set 1”, July 20, 2001.

[RFC2533] Klyne, G., “A Syntax for Describing Media Feature Sets”, RFC 2533, March 1999.

6 Outstanding Issues

1. Is it still OK for a Sender to describe UIF Profile S or F TIFF data using the "image/tiff" MIME subtype since UIF Profile S relies on several TIFF-FX extensions which require the use of two TIFF fields not recognized by TIFF 6 (namely, the GlobalParametersIFD and TIFF-FXExtensions fields)

   Resolution: IPPFAX Group decided it would be a good idea to revert to TIFF-FX Profile S as it is defined in [RFC2301], as all TIFF-FX Receivers MUST support this profile. Also, all TIFF readers are supposed to ignore unknown TIFF tags; therefore, use of the “image/tiff” MIME type is acceptable for use with both TIFF-FX Profile S and UIF Profile F.

2. Use of the ‘profile’ CONNEG tag is not syntactically valid in section A.1.2.2. Graham Kline, author of the CONNEG specification, recommended that we use the hash-based approach described in RFC2938 if the goal is a shorter CONNEG expression—there is a free Java implementation available from the IMC website (http://www.imc.org/ietf-medfree/Fsm110a.zip).

7 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.
D0.6	7/25/01	John Pulera, Minolta	Expanded Sender conformance requirements for UIF profiles and MIME; other modifications per June teleconference.
D0.7	10/16/01	John Pulera, Minolta	Redefined UIF Profiles to be TIFF-FX profiles using TIFF-FX extensions; moved capabilities communication to an informative appendix.
D0.8	10/30/01	John Pulera, Minolta Tom Hastings, Xerox	Clarified terminology to make clear that UIF is TIFF-FX plus specific TIFF-FX extensions; other editorial changes.
D0.9	01/29/02	John Pulera, Minolta	Moved definition of new TIFF-FX extensions to Appendix B; removed definition of UIF Profile S; changes to Appendix A CONNEG strings.

Appendix A. Capabilities communication (Informative)

This informative appendix is intended to suggest a means of capabilities communication that would allow a protocol using the UIF data format to discover what a potential UIF-compatible Receiver supports in terms of resolution, encoding, drawing surface, etc. As such, the conformance terminology used in this Appendix applies only to protocols that choose to implement capabilities communication as it is described in this Appendix. Section A.6 lists the Conformance requirements for protocols that implement capabilities communication as it is described in this appendix.

To discover a potential Receiver's capabilities, a UIF Sender MUST query in a protocol-specific manner either the UIF Profiles supported (see section A.2) or the Receiver capabilities string (see section A.1). If the Sender wants to send a UIF file using any OPTIONAL features outside the profile-specific baseline level (see baseline levels shown in section A.1.1), then the Sender MUST query the Receiver for the capabilities string. 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 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 4.1.2).

A.1 Receiver capabilities string

A valid Receiver capabilities string MUST be any well-formed CONNEG string obeying the syntax specified in [RFC2533] and using the feature tag and tag values described in [RFC2879]. A UIF Sender MAY request the Receiver capabilities string. A UIF Receiver MUST return a Receiver capabilities string if a Sender requests it. The Receiver capabilities 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 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.

A.1.1 Minimum Receiver capabilities

Requiring a minimum set of Receiver capabilities on a profile-specific basis is useful because it guarantees a baseline level of 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 [RFC2879] for a complete description of the feature tags tokens. The color profiles (UIF Profiles C and L) have been broken down further into minimum capabilities specification for both grayscale-only and full-color implementations.

A.1.1.1 Minimum capabilities for ~~UIF~~ TIFF-FX Profile S

```
(& (image-file-structure=TIFF-minimal)
   (MRC-mode=0)
   (image-coding=MH)
```

```
   (color=Binary)
   (| (& (dpi=200)
         (dpi-xyratio=[200/100,200/200]) )
      (& (dpi=204)
         (dpi-xyratio=[204/98,204/196]) ) ) )
   (dpi=[200,300,600])
   (dpi-xyratio=1) )
```

A.1.1.2 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) )

(| (& (image-file-structure=TIFF-minimal)
      (MRC-mode=0)
      (image-coding=MH)
      (color=Binary)
      (| (& (dpi=200)
            (dpi-xyratio=[200/100,200/200]) )
         (& (dpi=204)
            (dpi-xyratio=[204/98,204/196]) ) ) )
   (& (image-file-structure=TIFF-limited)
      (MRC-mode=0)
      (image-coding=MMR)
      (color=Binary)
      (dpi=[200,300,600])
      (dpi-xyratio=1) ) )
```

A.1.1.3 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) )
(| (& (image-file-structure=TIFF-minimal)
      (MRC-mode=0)
      (image-coding=MH)
      (color=Binary)
      (| (& (dpi=200)
            (dpi-xyratio=[200/100,200/200]) )
         (& (dpi=204)
            (dpi-xyratio=[204/98,204/196]) ) ) )
   (& (image-file-structure=TIFF-limited)
      (MRC-mode=0)
      (image-coding=JBIG)
      (image-coding-constraint=JBIG-T85)
      (color=Binary)
      (JBIG-stripe-size=128)
      (dpi=[200,300,600])
      (dpi-xyratio=1) ) )
```

A.1.1.4 Minimum capabilities for UIF Profile C

Minimum capabilities for UIF Profile C can be subdivided into a listing of minimum capabilities for a baseline grayscale implementation and a listing of minimum capabilities for a full color implementation. Subdividing the minimum capabilities in such a way gives the Sender the flexibility to encode grayscale and/or full color data without the need for a full CONNEG implementation.

A.1.1.4.1 Minimum grayscale 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) )
(| (& (image-file-structure=TIFF-minimal)
      (MRC-mode=0)
      (image-coding=MH)
      (color=Binary)
      (| (& (dpi=200)
            (dpi-xyratio=[200/100,200/200]) )
         (& (dpi=204)
            (dpi-xyratio=[204/98,204/196]) ) ) )
   (& (image-file-structure=TIFF-limited)
      (MRC-mode=0)
      (color=grey)
      (image-coding=JPEG)
      (image-coding-constraint=JPEG-T4E)
      (color-levels<=256)
      (color-space=CIELAB)
      (color-illuminant=D50)
      (CIELAB-L-min>=0)
      (CIELAB-L-max<=100)
      (dpi=[200,300])
      (dpi-xyratio=1) ) )
```

A.1.1.4.2 Minimum full color 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) )
(| (& (image-file-structure=TIFF-minimal)
      (MRC-mode=0)
      (image-coding=MH)
      (color=Binary)
      (| (& (dpi=200)
            (dpi-xyratio=[200/100,200/200]) )
         (& (dpi=204)
            (dpi-xyratio=[204/98,204/196]) ) ) )
   (& (image-file-structure=TIFF-limited)
      (MRC-mode=0)
      (color=grey)
```

```
      (image-coding=JPEG)
      (image-coding-constraint=JPEG-T4E)
      (color-levels<=256)
      (color-space=CIELAB)
      (color-illuminant=D50)
      (CIELAB-L-min>=0)
      (CIELAB-L-max<=100)
      (dpi=[200,300])
      (dpi-xyratio=1) )
   (& (image-file-structure=TIFF-limited)
      (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) ) )
```

A.1.1.5 Minimum capabilities for UIF Profile L

As with UIF Profile C, minimum capabilities for UIF Profile L can be subdivided into a listing of minimum capabilities for a baseline grayscale implementation and a listing of minimum capabilities for a full color implementation. Subdividing the minimum capabilities in such a way gives the Sender the flexibility to encode grayscale and/or full color data without the need for a full CONNEG implementation.

A.1.1.5.1 Minimum grayscale 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) )
(| (& (image-file-structure=TIFF-minimal)
      (MRC-mode=0)
      (image-coding=MH)
      (color=Binary)
      (| (& (dpi=200)
            (dpi-xyratio=[200/100,200/200]) )
         (& (dpi=204)
            (dpi-xyratio=[204/98,204/196]) ) ) )
   (& (image-file-structure=TIFF-limited)
      (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) ) )
```

A.1.1.5.2 Minimum full color 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) )
(| (& (image-file-structure=TIFF-minimal)
      (MRC-mode=0)
      (image-coding=MH)
      (color=Binary)
      (| (& (dpi=200)
            (dpi-xyratio=[200/100,200/200]) )
         (& (dpi=204)
            (dpi-xyratio=[204/98,204/196]) ) ) )
   (& (image-file-structure=TIFF-limited)
      (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) )
   (& (image-file-structure=TIFF-limited)
      (MRC-mode=0)
      (color=full)
      (| (& (image-coding=JPEG)
            (image-coding-constraint=JPEG-T4E)
            (color-subsampling=["1:1:1","4:1:1"]) )
         (& (image-coding=JBIG)
            (image-coding-constraint=JBIG-T43)
            (JBIG-stripe-size=128)
```

```
            (image-interleave=stripe) ) )
      (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=[100,200,300])
      (dpi-xyratio=1) ) )
```

A.1.1.6 Minimum capabilities for UIF Profile M

```
(| (& (image-file-structure=TIFF-minimal)
      (MRC-mode=0)
      (color=Binary)
      (image-coding=MH)
      (dpi=[200,300,600])
      (dpi-xyratio=1) )
(| (& (image-file-structure=TIFF-minimal)
      (MRC-mode=0)
      (image-coding=MH)
      (color=Binary)
      (| (& (dpi=200)
            (dpi-xyratio=[200/100,200/200]) )
         (& (dpi=204)
            (dpi-xyratio=[204/98,204/196]) ) ) )
   (& (image-file-structure=TIFF-limited)
      (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)
   (& (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=[200,300,400])
            (dpi-xyratio=1) )
         (& (image-file-structure=TIFF-limited)
            (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=[200,300,400])
            (dpi-xyratio=1) ) ) ) )
```

A.1.2 New CONNEG tags and values

In addition to the CONNEG tags and tag values defined in [RFC2879], the capabilities string MAY include tag and tag values defined in the following subsections.

A.1.2.1 Definition of ~~'profile' tag and tag values~~profile-related auxiliary predicates

The new CONNEG ~~tag 'profile' and accompanying tag~~ auxiliary predicate values 'profile-uif-s', 'profile-uif-f', 'profile-uif-j', 'profile-uif-cg', 'profile-uif-c', 'profile-uif-lg', 'profile-uif-l', and 'profile-uif-m' shall be registered with the relevant authoritative body. ~~This~~ These new ~~tag and its tag values~~ auxiliary predicates have been introduced to represent the *incremental* differences between minimum capabilities strings listed in sections A.1.1.1 through A.1.1.5 to reduce~~. This cuts down on~~ the length of the CONNEG strings ~~and makes it immediately apparent from a human's perspective any OPTIONAL features that are advertised~~.

The CONNEG string "profile-uif-s" is defined to expand as

```
   (& (image-file-structure=TIFF-minimal)
      (MRC-mode=0)
      (image-coding=MH)
      (color=Binary)
      (| (& (dpi=200)
            (dpi-xyratio=[200/100,200/200]) )
         (& (dpi=204)
            (dpi-xyratio=[204/98,204/196]) ) ) )
      (dpi=[200,300,600])
      (dpi-xyratio=1) )
```

The CONNEG string "profile-uif-f" is defined to expand as

```
   (& (image-file-structure=TIFF-limited)
      (MRC-mode=0)
      (image-coding=MMR)
      (color=Binary)
```

```
      (dpi=[200,300,600])
      (dpi-xyratio=1) )
```

The CONNEG string “profile-uif-j” is defined to expand as

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

The CONNEG string “profile-uif-cg” is defined to expand as

```
   (& (image-file-structure=TIFF-limited)
      (MRC-mode=0)
      (color=grey)
      (image-coding=JPEG)
      (image-coding-constraint=JPEG-T4E)
      (color-levels<=256)
      (color-space=CIELAB)
      (color-illuminant=D50)
      (CIELAB-L-min>=0)
      (CIELAB-L-max<=100)
      (dpi=[200,300])
      (dpi-xyratio=1) )
```

The CONNEG string “profile-uif-c” is defined to expand as

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

The CONNEG string “profile-uif-lg” is defined to expand as

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

The CONNEG string “profile-uif-l” is defined to expand as

```
   (& (image-file-structure=TIFF-limited)
      (MRC-mode=0)
      (color=full)
      (image-coding=JBIG)
      (image-coding-constraint=JBIG-T43)
      (JBIG-stripe-size=128)
      (image-interleave=stripe)
      (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=[100,200,300])
      (dpi-xyratio=1) )
```

A.1.2.2 Application of ‘profile’ tag and tag values

The ‘profile’ tag definition and its associated tag values allow the composite UIF Profile M to take the form shown below

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

```
(| (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=[200,300,400]) ) )
```

As another example, if a Receiver would like to advertise that it can support UIF Profiles S and F with the optional resolution of 1200 dpi and can support UIF Profile C with the optional resolution of 600dpi, then the Receiver can return the following if a Sender queries its capabilities string:

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

A.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. 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.

A.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.

A.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.

A.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.

A.6 Conformance Requirements Summary

For the listed operations, Table ~~20~~ 17 below shows conformance requirements that apply to the protocol used to transport UIF data.

Table ~~20~~17. Underlying Protocol Conformance.

Operation	UIF-capable Sender	UIF-capable Receiver	Section
Receiver capabilities string	MAY	MUST	A.1
UIF Profiles supported	MUST	MUST	A.2
Media supported	MUST	MUST	A.3
Media ready	MUST	MUST	A.4
Image reduction supported	MAY	MUST	A.5

Appendix B. UIF-related Extensions to TIFF-FX

This appendix describes TIFF-FX extensions intended to complement those found in [tiff-fx-ext1] and provide the necessary level of conformance for UIF Documents. It is to be removed once the definition of TIFF-FX Extensions 20 through 26 have been formalized in a separate document.

B.1 TIFF-FX Extension 20: Relaxed Image Widths and Resolutions

The allowances shown below supersede the TIFF-FX requirements specified in [RFC2301] concerning the ImageWidth, XResolution, and YResolution TIFF fields:

- If this TIFF-FX Extension is supported, then the ImageWidth, XResolution, and YResolution TIFF fields are not constrained to the set of resolutions specified in [RFC2301]; however, the. Receiver MUST support the image width & length that are determined by the media size and resolutions supported.

B.2 TIFF-FX Extensions 21 – Required Resolution

The requirement shown below supersedes the TIFF-FX requirements in [RFC2301] concerning the XResolution, YResolution, and ResolutionUnit TIFF fields:

- If this TIFF-FX Extension is supported, then Receivers MUST support XResolution=YResolution=200 and ResolutionUnit=2 (inches)

B.3 TIFF-FX Extensions 22 – Required Resolution

The requirement shown below supersedes the TIFF-FX requirements in [RFC2301] concerning the XResolution, YResolution, and ResolutionUnit TIFF fields:

- If this TIFF-FX Extension is supported, then Receivers MUST support XResolution=YResolution=300 and ResolutionUnit=2 (inches)

B.4 TIFF-FX Extensions 23 – Required Resolution

The requirement shown below supersedes the TIFF-FX requirements in [RFC2301] concerning the XResolution, YResolution, and ResolutionUnit TIFF fields:

- If this TIFF-FX Extension is supported, then Receivers MUST support XResolution=YResolution=400 and ResolutionUnit=2 (inches)

B.5 TIFF-FX Extensions 24 – Required Resolution

The requirement shown below supersedes the TIFF-FX requirements in [RFC2301] concerning the XResolution, YResolution, and ResolutionUnit TIFF fields:

- If this TIFF-FX Extension is supported, then Receivers MUST support XResolution=YResolution=600 and ResolutionUnit=2 (inches)

B.6 TIFF-FX Extensions 25 – Required Field

The requirement shown below supersedes the conformance found in [tiff-fx-ext1] concerning the JPEGTables field (see [TTN2] for a description of the JPEGTables field):

- If this TIFF-FX Extension is supported, then Receivers MUST support the use the JPEGTables Extension Field

B.7 TIFF-FX Extension 26 – Required Compression

The requirement shown below supersedes TIFF-FX requirements in [RFC2301] concerning the required Compression TIFF field:

- If this TIFF-FX Extension is supported, Receivers MUST support Resolution=4 (2-dimensional MMR encoding as defined in [T.6]) and T6Options=0.