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Internet Fax T.30 Feature Mapping

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Abstract

This document describes how to map Group 3 fax capability identification bits, described in ITU T.30 [6], into the Internet fax feature schema described in "Content feature schema for Internet fax" [4].

This is a companion to the fax feature schema document [4], which itself defines a profile of the media feature registration mechanisms [1,2,3], for use in performing capability identification between extended Internet fax systems [5].

Table of Contents

1. Introduction

This document describes how to map Group 3 fax capability identification bits, described in ITU T.30 [6], into the Internet fax feature schema described in "Content feature schema for Internet fax" [4].

This is a companion to the fax feature schema document [4], which itself defines a profile of the media feature registration mechanisms [1,2,3], for use in performing capability identification between extended Internet fax systems [5].

1.1 Organization of this document

Section 2 introduces the mechanisms that combine feature tag constraints to describe complex recipient capabilities.

Section 3 surveys Group 3 fax (T.30) capability bits that relate to media handling capabilities.

Section 4 describes the dependencies between Group 3 fax (T.30) capability bits. These are presented in a decision table format [16] with descriptive text in place of the action bodies.

Section 5 describes a formal mechanism for converting Group 3 fax (T.30) capability masks to fax feature schema statements. The conversion process is driven by the decision tables introduced previously, using fax feature schema statements and combining rules in the action bodies.

Section 6 presents an example of a Group 3 fax (T.30) capability mask, and uses the formal mechanism described previously to convert that into a corresponding fax feature schema statement.

1.2 Terminology and document conventions

eifax system
: is used to describe any software, device or combination of these that conforms to the specification "Extended Facsimile Using Internet Mail" [5].

Feature
: is used as defined in [15]. (See also section 2 of this memo.)

Feature tag
: is used as defined in [15]. (See also section 2.)

Feature collection
: is used as defined in [2]. (See also section 2.)

Feature set
: is used as defined in [2]. (See also section 2.)

1.3 Discussion of this document

Discussion of this document should take place on the Internet fax mailing list hosted by the Internet Mail Consortium (IMC). Please send comments regarding this document to:

ietf-fax@imc.org

To subscribe to this list, send a message with the body 'subscribe' to "ietf-fax-request@imc.org".

To see what has gone on before you subscribed, please see the mailing list archive at:

http://www.imc.org/ietf-fax/

2. Combining feature tags

A fax document can be described by media features. Any single media feature value can be thought of as just one component of a feature collection that describes some instance of a document (e.g. a printed fax, a displayed image, etc.). Such a feature collection consists of a number of media feature tags (each per [1]) and associated feature values.

A feature set contains a number of feature collections. Thus, a feature set can describe a number of different fax document instances. These can correspond to different treatments of a single document (e.g. different resolutions used for printing a given fax), a number of different documents subjected to a common treatment (e.g. the range of different images that can be rendered on a given display), or some combination of these (see examples below).

Thus, a description of a feature set can describe the rendering requirements of a fax document or the capabilities of a receiving eifax system.

2.1 Relationship to Group 3 fax

A "feature tag" can be compared with a single bit in a T.30 DCS frame, describing a specific attribute of a specific fax document.

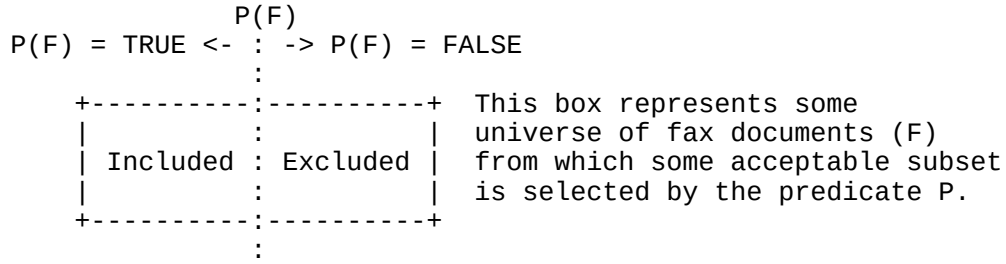
A "feature collection" corresponds to a complete T.30 DCS frame, describing a range of attributes of a specific fax document.

A "feature set" corresponds to a DIS or DTC frame, describing the range of document attributes that can be accepted by a given fax machine.

Within T.30 DIS/DTC frames, dependencies between the various capabilities are implicit in the definitions of the capabilities. E.g. multi-level coding (DIS/DTC bit 68) requires support for 200*200dpi resolution (DIS/DTC bit 15). In the feature set description framework used by eifax systems [1,2,3,4] such dependencies between different features are expressed explicitly. Later sections of this memo describe how the implicit dependencies of T.30 are expressed using the media feature set notation.

2.2 Feature set descriptions

The general approach to describing feature sets, described more fully in [2], is to use functions ("predicates") that, when applied to a feature collection value, yield a Boolean value that is TRUE if the feature collection describes an acceptable fax document instance, otherwise FALSE.



2.3 Examples

In the examples below the following notation is used:

(x ? y)	tests feature tag ’x’ for some relationship with value ’y’.
(| p1 p2 ... pn)	represents the logical-OR of predicates ’p1’, ’p2’ up to ’pn’.

```
(& p1 p2 ... pn )   represents the logical-AND of predicates
                    'p1', 'p2' up to 'pn'.
```

2.3.1 Data resource example

The following expression uses the syntax of [2] to describe a data resource that can be displayed either:
(a) as a 750x500 pixel image using 15 colours, or
(b) at 150dpi on an A4 page.

```
(| (& (pix-x=750) (pix-y=500) (color=15) )
   (& (dpi>=150) (papersize=A4) ) )
```

2.3.2 Recipient capabilities example

The following expression describes a receiving system that has:
(a) a screen capable of displaying 640*480 pixels and 16 million colours (24 bits per pixel), 800*600 pixels and 64 thousand colours (16 bits per pixel) or 1024*768 pixels and 256 colours (8 bits per pixel), or
(b) a printer capable of rendering 300dpi on A4 paper.

```
(| (& (| (& (pix-x<=640)  (pix-y<=480) (color<=16777216) )
         (& (pix-x<=800)  (pix-y<=600) (color<=65535) )
         (& (pix-x<=1024) (pix-y<=768) (color<=256) ) )
      (media=screen) )
   (& (dpi=300)
      (media=stationery) (papersize=A4) ) )
```

3. Survey of media-related T.30 capability bits

The following sections refer to T.30 DIS/DTC bits identified and described in Table 2/T.30 and accompanying notes [6]. Bit numbers that are not referenced below are considered to be not related to media features, hence not relevant to the Internet fax feature schema.

> NOTE: some of the DIS/DTC bits identified below are documented in revisions of the T.30 specification that may be not yet publicly available from the ITU.

3.1 DIS/DTC bit 15 (resolution)

All Group 3 fax systems are required to support a basic resolution of 200*100dpi (dots per inch) or 8*3.85dpmm (dots per millimetre).

Setting this bit indicates additional support for 200*200dpi or 8*7.7dpmm.

For multi-level images, 200*200dpi is the basic resolution, and this bit must be set. The other basic resolution options apply to bi-level images only.

See also: bits 44,45.

3.2 DIS/DTC bit 16 (MR coding)

All Group 3 fax systems are required to support Modified Huffman (MH) 1-dimensional coding for bi-level images. (A bi-level image is one with just two pixel states such as black and white, as opposed to a grey-scale or colour image.)

Setting this bit indicates additional support for Modified Read (MR) 2-dimensional coding for bi-level images.

Both MH and MR coding are described in ITU T.4 [7].

See also: bits 31,78,79.

3.3 DIS/DTC bits 17,18 (width)

All Group 3 fax systems are required to support 215mm paper width. These bits can be set to indicate additional support for 255mm and 303mm paper widths.

See also: bits 76,77.

3.4 DIS/DTC bits 19,20 (length)

All Group 3 fax systems are required to support 297mm paper length. These bits can be set to indicate additional support for 364mm and unlimited paper lengths.

See also: bits 76,77.

3.5 DIS/DTC bit 31 (MMR coding)

Setting this bit indicates support for Modified Modified Read (MMR) 2-dimensional coding for bi-level images, in addition to the required support for MH coding.

MMR coding is described in ITU T.6 [8].

See also: bits 16,78,79.

3.6 DIS/DTC bit 36 (JBIG multi-level coding)

If multi-level images are to be handled, support for JPEG coding is required (i.e. bit 68 must be set). Setting bit 36 indicates additional support for JBIG lossless coding of multi-level images.

JBIG coding for multi-level images is described in ITU T.43 [10] and T.4 Annex G [7].

See also: bits 68,69.

3.7 DIS/DTC bit 37 (plane interleave)

Setting this bit indicates support for plane interleave for JBIG-coded multi-level images in addition to stripe interleave, which is standard for JBIG multi-level images.

JBIG coding for multi-level images is described in ITU T.43 [10] and T.4 Annex G [7].

See also: bit 36.

3.8 DIS/DTC bits 41,42,43 (resolution)

Setting these bits indicates support for resolutions in addition to 200*100dpi and 200*200dpi, or 8*3.85dpmm and 8*7.7dpmm. (Or in addition to the basic 200*200dpi resolution when using a multi-level image mode.)

Bit 41 indicates support for 8*15.4dpmm bi-level images (independently of the settings of bits 44 and 45).

Bit 42 indicates support for 300*300dpi bi-level images (independently of the settings of bits 44 and 45). Also applies to multi-level images or MRC mask if bit 97 is set.

Bit 43 indicates support for 400*400dpi and/or 16*15.4dpmm bi-level images, depending upon the settings of bits 44 and 45. Also applies to multi-level images or MRC mask if bit 97 is set.

See also: bits 15,44,45,97.

3.9 DIS/DTC bits 44,45 (preferred units)

These bits are used to indicate the preferred resolution units for received images. Because the exact resolution and x/y pixel density measures in dpi or dpmm are slightly different, some image size and aspect ratio distortion may occur if the sender and receiver use different units.

Even when sender and recipient have different preferred units, image transfer must be accomplished. For most fax uses, the dpi and dpmm measurements are sufficiently close to each other that the difference is not noticed.

The preferred units setting affects the detailed interpretation of the following resolutions:

	dpi	dpmm	(dpi equivalent)
Base	200*100	8*3.85	204*98
Bit 15	200*200	8*7.7	204*196
Bit 43	400*400	16*15.4	408*391

But terminals are required to accept the inch- and metric-based measures given above as equivalent, distorting the image if necessary to accommodate the differences.

See also: bits 15, 43

3.10 DIS/DTC bit 68 (JPEG)

This bit indicates support for JPEG coding of multi-level images.

JPEG coding for multi-level images is described in ITU T.81 [12] and T.4 Annex E [7].

See also: bits 15,69,73

3.11 DIS/DTC bit 69 (colour)

This bit indicates support for colour images, in addition to just grey-scale.

Both grey-scale and colour require multi-level coding. The difference is that grey is single component while colour is multi-component.

See also: bits 36,68,73.

3.12 DIS/DTC bit 71 (bits/sample)

Standard support for multi-level images uses 8 bits per sample. Setting this bit indicates additional support for 12 bits per sample.

For a grey-scale multi-level image, there is just one sample per pixel, giving 256 or 4096 possible pixel values. For a full colour multi-level image there are three samples per pixel, giving 256^3 (16777216) or 4096^3 (6871946736) possible values.

When related to a mapped colour image, bit 71 also affects the maximum number of entries in the mapping table: when it is reset, up to 4096 different pixel values can be used; when set, up to 65536 different values can be used.

See also: bit 68.

3.13 DIS/DTC bit 73 (no subsampling)

Standard support for JPEG-coded multi-level images uses 4:1:1 chrominance subsampling. That is, for each 4 luminance samples in the image data there is a single chrominance sample.

Setting this bit indicates that JPEG-coded colour images without subsampling can also be supported. This is not applicable to JBIG coding (bit 36).

See also: bits 68,69.

3.14 DIS/DTC bit 74 (custom illuminant)

Standard support for multi-level images requires use of D50 illuminant. Setting this bit indicates that a custom illuminant also can be supported for multi-level images (both grey-scale and colour). Details of the custom illuminant are contained in the image data.

Use of a custom illuminant with multi-level images is described in ITU T.4 Annex E [7].

See also: bits 36,68.

3.15 DIS/DTC bit 75 (custom gamut)

Standard support for a default colour gamut is required for multi-level images. Setting this bit indicates that a custom gamut also can be supported for multi-level images (both grey-scale and colour). Details of the custom gamut are contained in the image data.

The default gamut (L*=[0,100], a*=[-85, 85], b* = [-75, 125]), and use of a custom gamut with multi-level images is described in ITU T.42 [9] and T.4 Annex E [7].

See also: bits 36,68.

3.16 DIS/DTC bits 76,77 (paper size)

All Group 3 faxes are required to support A4 paper size. These bits can be set to indicate additional support for North American letter and legal paper sizes.

See also: bits 17,18,19,20.

3.17 DIS/DTC bit 78 (JBIG bi-level coding)

Setting bit 78 indicates support for JBIG coding of bi-level images (using T.85 encoding rules), in addition to the required support for MH coding.

JBIG coding of bi-level images is described in ITU T.85 [14].

See also: bits 16,31,79.

3.18 DIS/DTC bit 79 (JBIG stripe size)

Setting bit 79 (along with bit 78) indicates support for the 'LO' option with JBIG coded bi-level images. Basic bi-level JBIG coding uses 128 lines per stripe; the 'LO' option allows other stripe sizes to be used.

The stripe size is used for all stripes except the last, which may have fewer lines than the indicated value.

JBIG coding of bi-level images is described in ITU T.85 [14].

See also: bits 16,31,78.

3.19 DIS/DTC bit 92,93,94 (MRC maximum functional mode)

If these bits are all zero, then Mixed Raster Content (MRC) coding is not supported. Otherwise, they represent a number in the range 1-7 that indicates an MRC maximum functional mode.

MRC coding of images is described in ITU T.44 [11] and T.4 Annex H [17].

See also: bits 68,95.

3.20 DIS/DTC bit 95 (MRC stripe size)

Standard support for MRC uses a maximum stripe size of 256 lines. When this bit is set, the maximum stripe size is a full page.

This bit is meaningful only if bits 92-94 indicate an MRC coding capability. MRC coding of images is described in ITU T.44 [11] and T.4 Annex H [17].

See also: bits 92,93,94.

3.21 DIS/DTC bit 97 (resolution)

Setting this bit indicates that the additional resolutions indicated by bits 42 and 43 may be used for multi-level images and any MRC mask layer.

When this bit is set, bit 42 implies 300dpi and bit 43 implies 400dpi for multi-level or MRC mask layer images (irrespective of the preferred units indicated by bits 44 and 45).

See also: bits 42,43,68.

3.22 DIS/DTC bit 98 (resolution)

Setting this bit indicates that the additional resolution 100*100dpi may be used for multi-level images.

> NOTE: 100dpi is not used for bi-level images, including the MRC mask layer.

See also: bit 36,68,92-94.

4. Summary of T.30 capability dependencies

This section contains a number of decision tables that indicate the allowable combinations of T.30 DIS/DTC mask bits.

Within the decision table bodies, the following symbols are use to indicate values of T.30 DIS/DTC bits:

```
0  = bit set to '0'
1  = bit set to '1'
x  = don't care bit value: may be '0' or '1'
*0 = bit must be '0' ('1' is invalid in given combination)
*1 = bit must be '1' ('0' is invalid in given combination)
#  = bits in row combined to form a numeric value
```

4.1 Image coding

MH coding is required as a minimum for Group 3 fax operation.

4.1.1 Bi-level coding

<------- T.30 bits --------->										
15	16	31	36	37	68	69	73	78	79	Description
x	0	0						0	0	Compression = [MH]
x	1	0						0	0	Compression = [MH,MR]
x	0	1						0	0	Compression = [MH,MMR]
x	1	1						0	0	Compression = [MH,MR,MMR]
x	0	0						1	0	Compression = [MH,T.85]
x	1	0						1	0	Compression = [MH,MR,T.85]
x	0	1						1	0	Compression = [MH,MMR,T.85]
x	1	1						1	0	Compression = [MH,MR,MMR,T.85]
x	0	0						*1	1	Compression = [MH,T.85,T.85LO]
x	1	0						*1	1	Compression = [MH,MR,T.85,T.85LO]
x	0	1						*1	1	Compression = [MH,MMR,T.85,T.85LO]
x	1	1						*1	1	Compression = [MH,MR,MMR,T.85,T.85LO]
										MH = 1-D per T.4
										MR = 2-D per T.4
										MMR = 2-D per T.6
										T.85 = Basic JBIG per T.85
										T.85LO = Optional LO with T.85/JBIG
										(Basic JBIG is 128 lines/stripe; LO
										allows other stripe sizes to be used)

4.1.2 Multi-level coding

Note: When 37, 69, 73, 79 and 95 are set to "1", the feature represented by "0" is also available. Example: If plane interleave is available then stripe interleave is also available.

```
<------- T.30 bits --------->
15|16|31|36|37|68|69|73|78|79||Description
--+--+--+--+--+--+--+--+--+--++-------------------------------------
 x|  |  |*0| x| 0| x| x|  |  ||No grey or colour (no T.43 or JPEG)
*1|  |  | 0| x| 1| 0| x|  |  ||JPEG, grey scale only
*1|  |  | 0| x| 1| 1| 0|  |  ||JPEG, full colour, subsampling
*1|  |  | 0| x| 1| 1| 1|  |  ||JPEG, full colour, no subsampling
*1|  |  | 1| 0|*1| 0| x|  |  ||T.43, JPEG, grey only, stripe i/l
*1|  |  | 1| 1|*1| 0| x|  |  ||T.43, JPEG, grey only, plane i/l
*1|  |  | 1| 0|*1| 1| 0|  |  ||T.43, JPEG, colour, stripe i/l, s/s
*1|  |  | 1| 0|*1| 1| 1|  |  ||T.43, JPEG, colour, stripe i/l, no s/s
*1|  |  | 1| 1|*1| 1| 0|  |  ||T.43, JPEG, colour, plane i/l, s/s
*1|  |  | 1| 1|*1| 1| 1|  |  ||T.43, JPEG, colour, plane i/l, no s/s
  |  |  |  |  |  |  |  |  |  ||'s/s'    is 4:1:1 L*:a*:b* subsampling
  |  |  |  |  |  |  |  |  |  ||'No s/s' is 1:1:1 L*:a*:b* subsampling
  |  |  |  |  |  |  |  |  |  ||'stripe i/l' is stripe interleave
  |  |  |  |  |  |  |  |  |  ||'plane i/l'  is full-plane interleave
--+--+--+--+--+--+--+--+--+--++-------------------------------------
```

4.1.3 MRC format

Multi-level coders, as indicated above, are used for foreground and background images within an MRC-format document. Bi-level codes are used for the mask layer.

```
<---- T.30 bits ------>
15|92|93|94|95|  |  |  ||Description
--+--+--+--+--+--+--+--++-------------------------------------
 x| 0| 0| 0| x|  |  |  ||MRC not accepted
*1| #| #| #| 0|  |  |  ||MRC level, max strip 256 lines
*1| #| #| #| 1|  |  |  ||MRC level, max strip full page
  |  |  |  |  |  |  |  ||### is MRC performance level (1-7, per T.44)
--+--+--+--+--+--+--+--++-------------------------------------
```

4.2 Resolution and units

Support for bi-level coding at least one of 200*100dpi or 8*3.85dpmm is required in all cases for Group 3 fax conformance. For multi-level coders (colour/grey) and MRC mask layers the base resolution is 200*200dpi (i.e. bit 15 must be set).

When multi-level coders (JPEG or T.43) or MRC are used, only inch-based square resolutions are available. However, the base non-square resolution (i.e. 200x100dpi or 8x3.85dpmm) must still be available as a capability for use with the mandatory bi-level coder (MH). Hence, any references to metric and non-square resolutions in the table below apply only to bi-level coders.

When describing MRC capabilities, the complete set of usable resolutions is listed. However, there are some restrictions on their use: (a) 100dpi resolution can be used only with multi-level images, and (b) any multi-level image resolution is required to be an integral sub-multiple of the applicable mask resolution.

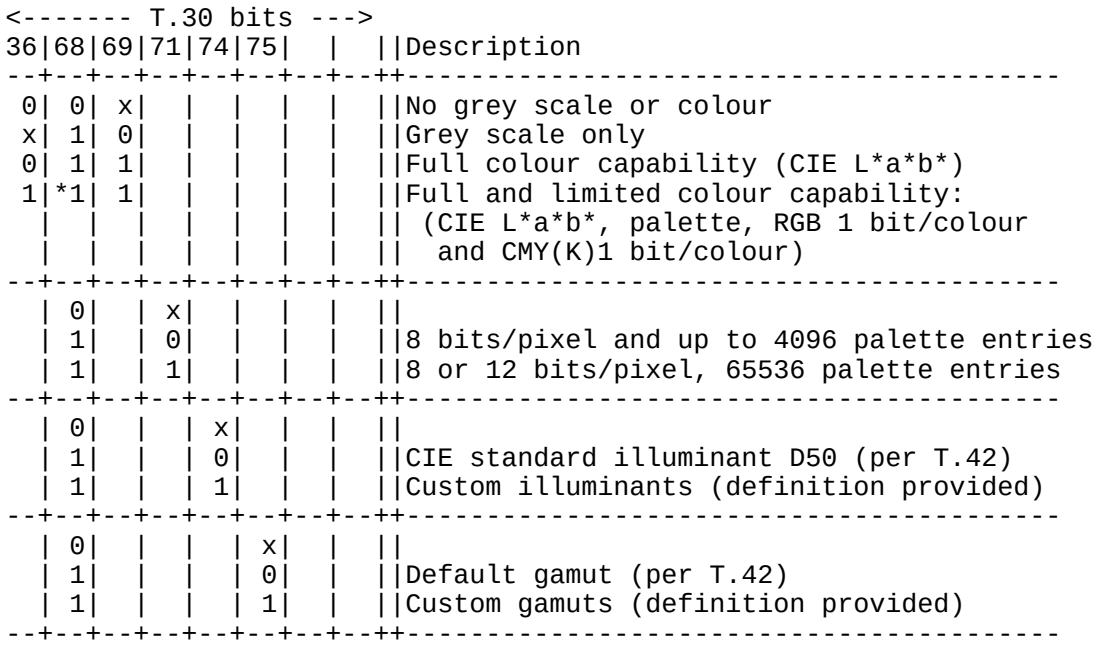
In the following table:
dpi = dots per inch
dpmm = dots per millimetre

Preferred resolutions are indicated here, even though inch- or mm-based units must be accepted, according to the T.30 protocol [6].

```
<------- T.30 bits ------>
15|41|42|43|44|45|68|97|98||Description
--+--+--+--+--+--+--+--+--++---------------------------------------
 0|  |  | 0| x| x|  |  |  ||Resolution = base only
  |  |  |  |  |  |  |  |  ||
 1|  |  | 0| 0| 0|  |  |  ||Invalid
 1|  |  | 0| 0| 1|  |  |  ||Resolution = 8*3.85dpmm or 8*7.7dpmm
 1|  |  | 0| 1| 0|  |  |  ||Resolution = 200*100dpi or 200*200dpi
 1|  |  | 0| 1| 1|  |  |  ||Resolution = 8*3.85dpmm or 8*7.7dpmm
  |  |  |  |  |  |  |  |  ||        or   200*100dpi or 200*200dpi
  |  |  |  |  |  |  |  |  ||
 0|  |  | 1| 0| 0|  |  |  ||Invalid
 0|  |  | 1| 0| 1|  |  |  ||Resolution = 8*3.85dpmm or 16*15.4dpmm
 0|  |  | 1| 1| 0|  |  |  ||Resolution = 200*100dpi or 400*400dpi
 0|  |  | 1| 1| 1|  |  |  ||Resolution = 8*3.85dpmm or 16*15.4dpmm
  |  |  |  |  |  |  |  |  ||        or   200*100dpi or 400*400dpi
  |  |  |  |  |  |  |  |  ||
 1|  |  | 1| 0| 0|  |  |  ||Invalid
 1|  |  | 1| 0| 1|  |  |  ||Resolution = 8*3.85dpmm or 8*7.7dpmm
  |  |  |  |  |  |  |  |  ||        or   16*15.4dpmm
 1|  |  | 1| 1| 0|  |  |  ||Resolution = 200*100dpi or 200*200dpi
  |  |  |  |  |  |  |  |  ||        or   400*400dpi
 1|  |  | 1| 1| 1|  |  |  ||Resolution = 8*7.7dpmm  or 8*7.7dpmm
  |  |  |  |  |  |  |  |  ||        or   16*15.4dpmm
  |  |  |  |  |  |  |  |  ||        or   200*100dpi or 200*200dpi
  |  |  |  |  |  |  |  |  ||        or   400*400dpi
--+--+--+--+--+--+--+--+--++---------------------------------------
  | 0|  |  |  |  |  |  |  ||Resolutions as above
  | 1|  |  |  |  |  |  |  ||Also supports 8*15.4dpmm (bi-level only)
  |  |  |  |  |  |  |  |  ||Independent of bits 44,45
--+--+--+--+--+--+--+--+--++---------------------------------------
  |  | 0|  |  |  |  |  |  ||Resolutions as above
  |  | 1|  |  |  |  |  |  ||Also supports 300*300dpi
  |  |  |  |  |  |  |  |  ||Independent of bits 44,45
--+--+--+--+--+--+--+--+--++---------------------------------------
  |  |  |  |  |  | x| 0|  ||Resolutions as above
  |  |  |  |  |  |*1| 1|  ||Also 300*300dpi or 400*400dpi (see below)
  |  |  |  |  |  |  |  |  ||(Applies colour, grey-scale or MRC mask)
  |  |  |  |  |  |  |  |  ||(Valid only when bit 42 or 43 is set.)
  |  |  |  |  |  |  |  |  ||(42 => 300dpi, 43=>400dpi)
--+--+--+--+--+--+--+--+--++---------------------------------------
  |  |  |  |  |  | x|  | 0||Resolutions as above
  |  |  |  |  |  |*1|  | 1||Also 100*100dpi
  |  |  |  |  |  |  |  |  ||(Applies colour or grey-scale only)
  |  |  |  |  |  |  |  |  ||(Independent of bits 44,45)
--+--+--+--+--+--+--+--+--++---------------------------------------
```

4.3 Colour capabilities

Bit 68 (JPEG) is required for any colour/grey scale mode, and bit 36 indicates additional T.43 capability.



```
<------- T.30 bits --->
36|68|69|71|74|75|  |  ||Description
--+--+--+--+--+--+--+--++----------------------------------------
 0| 0| x|  |  |  |  |  ||No grey scale or colour
 x| 1| 0|  |  |  |  |  ||Grey scale only
 0| 1| 1|  |  |  |  |  ||Full colour capability (CIE L*a*b*)
 1|*1| 1|  |  |  |  |  ||Full and limited colour capability:
  |  |  |  |  |  |  |  ||  (CIE L*a*b*, palette, RGB 1 bit/colour
  |  |  |  |  |  |  |  ||   and CMY(K)1 bit/colour)
--+--+--+--+--+--+--+--++----------------------------------------
  | 0|  | x|  |  |  |  ||
  | 1|  | 0|  |  |  |  ||8 bits/pixel and up to 4096 palette entries
  | 1|  | 1|  |  |  |  ||8 or 12 bits/pixel, 65536 palette entries
--+--+--+--+--+--+--+--++----------------------------------------
  | 0|  |  | x|  |  |  ||
  | 1|  |  | 0|  |  |  ||CIE standard illuminant D50 (per T.42)
  | 1|  |  | 1|  |  |  ||Custom illuminants (definition provided)
--+--+--+--+--+--+--+--++----------------------------------------
  | 0|  |  |  | x|  |  ||
  | 1|  |  |  | 0|  |  ||Default gamut (per T.42)
  | 1|  |  |  | 1|  |  ||Custom gamuts (definition provided)
--+--+--+--+--+--+--+--++----------------------------------------
```

4.4 Document size

A4 width (215mm) is required as a minimum for Group 3 fax conformance. A Group 3 fax machine must always be able to receive an A4 image.

<---- T.30 bits ------>								
17	18	19	20	76	77			Description
0	0							Width = 215mm
1	0							Width = 215mm or 255mm
0	1							Width = 215mm, 255mm or 303mm
1	1							Invalid - interpret as (17=0,18=1)
								(measurements described as scan line length)
								(corresp. inch measurements: T.4 sect 2.2)
		0	0					Length = 297mm (A4)
		1	0					Length = 297mm (A4) or 364mm (B4)
		0	1					Length = unlimited
		1	1					Invalid
				0	0			Papersize = A4
				1	0			Papersize = A4 or NA-Letter
				0	1			Papersize = A4 or NA-Legal
				1	1			Papersize = A4 or NA-Letter or NA-Legal
								(These in addition to paper sizes implied
								by bits 17-20 above)

5. Mapping T.30 capabilities to fax feature schema

This section follows the structure of the previous section, except that the decision tables are restated with feature set expression mappings in the action stub. The feature set expressions use media feature tags presented in "Content feature schema for Internet fax" [4].

To construct a feature set expression corresponding to a collection of DIS frame bits:

- Compare the DIS bits with each decision table in the following sections (5.1 to 5.4). Some decision tables consist of a number of sub-tables separated by horizontal lines.

- The DIS bits will match exactly one row from each table or sub-table: collect the corresponding feature set expression from the action stub (the right hand column of the table).

- In the case of the table in section 5.2, which consists of several sub-tables, combine the feature set expressions from each sub-table with a logical-OR: (| s1 s2 ... sn), where 's1', 's2' etc. are the feature set expressions selected from each sub-table. In this way, a single feature set expression is obtained for the table.

- In the case of the tables in sections 5.3 and 5.4, combine the sub-table expressions with a logical-AND: (& s1 s2 ... sn).

- Combine the feature set expressions for each table as follows:

  (& (| T511 T512) T513 T52 T53 T54)

  where:

  - T511 is the feature set expression obtained from the table in section 5.1.1

  - T512 is obtained from the table in section 5.1.2

  - T513 is obtained from the table in section 5.1.3

  - T52 is obtained from the table in section 5.2

  - T53 is obtained from the table in section 5.3

  - T54 is obtained from the table in section 5.4

The resulting expression is the feature set expression corresponding to the DIS bits given. Remember that there may be other capabilities not expressed by the DIS bits that should be incorporated into the final feature expression (e.g. TIFF image file structure).

To do the reverse transformation, match the feature set to each row of each decision table using the matching algorithm in RFC 2533 [2], and OR together the DIS bit masks for each row whose feature set expression is completely contained by (i.e. is a subset of) that given (where the bit value in a table is 'x', use '0').

A feature set A is completely contained by B if the feature set match of A and B (obtained by applying the feature set matching algorithm in [2]) is equal to A.

5.1 Image coding

5.1.1 Bi-level coding

<-------- T.30 bits --------->

15	16	31	36	37	68	69	73	78	79	Feature set expression
x	0	0						0	0	(& (color=binary)
										(image-coding=[MH]))
x	1	0						0	0	(& (color=binary)
										(image-coding=[MH,MR])
x	0	1						0	0	(& (color=binary)
										(image-coding=[MH,MMR])
x	1	1						0	0	(& (color=binary)
										(image-coding=[MH,MR,MMR])
x	0	0						1	0	(& (color=binary)
										(image-coding=[MH,JBIG])
										(image-coding-constraint=JBIG-T85)
										(JBIG-stripe-size=128))
x	1	0						1	0	(& (color=binary)
										(image-coding=[MH,MR,JBIG])
										(image-coding-constraint=JBIG-T85)
										(JBIG-stripe-size=128))
x	0	1						1	0	(& (color=binary)
										(image-coding=[MH,MMR,JBIG])
										(image-coding-constraint=JBIG-T85)
										(JBIG-stripe-size=128))
x	1	1						1	0	(& (color=binary)
										(image-coding=[MH,MR,MMR,JBIG])
										(image-coding-constraint=JBIG-T85)
										(JBIG-stripe-size=128))
x	0	0						*1	1	(& (color=binary)
										(image-coding=[MH,JBIG])
										(image-coding-constraint=JBIG-T85)
										(JBIG-stripe-size>=0))
x	1	0						*1	1	(& (color=binary)
										(image-coding=[MH,MR,JBIG])
										(image-coding-constraint=JBIG-T85)
										(JBIG-stripe-size>=0))
x	0	1						*1	1	(& (color=binary)
										(image-coding=[MH,MMR,JBIG])
										(image-coding-constraint=JBIG-T85)
										(JBIG-stripe-size>=0))
x	1	1						*1	1	(& (color=binary)
										(image-coding=[MH,MR,MMR,JBIG])
										(image-coding-constraint=JBIG-T85)
										(JBIG-stripe-size>=0))

5.1.2 Multi-level coding

```
<------- T.30 bits --------->
15|16|31|36|37|68|69|73|78|79||Feature set expression
--+--+--+--+--+--+--+--+--+--++---------------------------------------
 x|  |  |*0| x| 0| x| x|  |  ||
*1|  |  | 0| x| 1| 0| x|  |  ||(& (color=grey)
  |  |  |  |  |  |  |  |  |  ||   (image-coding=JPEG)
  |  |  |  |  |  |  |  |  |  ||   (image-coding-constraint=JPEG-T4E) )
*1|  |  | 0| x| 1| 1| 0|  |  ||(& (color=[grey,full])
  |  |  |  |  |  |  |  |  |  ||   (image-coding=JPEG)
  |  |  |  |  |  |  |  |  |  ||   (image-coding-constraint=JPEG-T4E)
  |  |  |  |  |  |  |  |  |  ||   (& (color=full)
  |  |  |  |  |  |  |  |  |  ||      (color-subsampling="4:1:1") ) )
*1|  |  | 0| x| 1| 1| 1|  |  ||(& (color=[grey,full])
  |  |  |  |  |  |  |  |  |  ||   (image-coding=JPEG)
  |  |  |  |  |  |  |  |  |  ||   (image-coding-constraint=JPEG-T4E)
  |  |  |  |  |  |  |  |  |  ||   (& (color=full)
  |  |  |  |  |  |  |  |  |  ||      (color-subsampling=
  |  |  |  |  |  |  |  |  |  ||       ["1:1:1","4:1:1"]) ) )
*1|  |  | 1| 0|*1| 0| x|  |  ||(& (color=grey)
  |  |  |  |  |  |  |  |  |  ||   (image-coding=[JPEG,JBIG])
  |  |  |  |  |  |  |  |  |  ||   (image-coding-constraint=
  |  |  |  |  |  |  |  |  |  ||    [JPEG-T4E,JBIG-T43])
  |  |  |  |  |  |  |  |  |  ||   (image-interleave=stripe) )
*1|  |  | 1| 1|*1| 0| x|  |  ||(& (color=grey)
  |  |  |  |  |  |  |  |  |  ||   (image-coding=[JPEG,JBIG])
  |  |  |  |  |  |  |  |  |  ||   (image-coding-constraint=
  |  |  |  |  |  |  |  |  |  ||    [JPEG-T4E,JBIG-T43])
  |  |  |  |  |  |  |  |  |  ||   (image-interleave=[stripe,plane]) )
*1|  |  | 1| 0|*1| 1| 0|  |  ||(& (color=[limited,mapped,grey,full])
  |  |  |  |  |  |  |  |  |  ||   (image-coding=[JPEG,JBIG])
  |  |  |  |  |  |  |  |  |  ||   (image-coding-constraint=
  |  |  |  |  |  |  |  |  |  ||    [JPEG-T4E,JBIG-T43])
  |  |  |  |  |  |  |  |  |  ||   (& (color=full)
  |  |  |  |  |  |  |  |  |  ||      (color-subsampling="4:1:1"]) )
  |  |  |  |  |  |  |  |  |  ||   (image-interleave=stripe) )
*1|  |  | 1| 0|*1| 1| 1|  |  ||(& (color=[limited,mapped,grey,full])
  |  |  |  |  |  |  |  |  |  ||   (image-coding=[JPEG,JBIG])
  |  |  |  |  |  |  |  |  |  ||   (image-coding-constraint=
  |  |  |  |  |  |  |  |  |  ||    [JPEG-T4E,JBIG-T43])
  |  |  |  |  |  |  |  |  |  ||   (& (color=full)
  |  |  |  |  |  |  |  |  |  ||      (color-subsampling=
  |  |  |  |  |  |  |  |  |  ||       ["1:1:1","4:1:1"]) )
  |  |  |  |  |  |  |  |  |  ||   (image-interleave=stripe) )
```

```
*1|  |  | 1| 1|*1| 1| 0|  |  ||(& (color=[limited,mapped,grey,full])
  |  |  |  |  |  |  |  |  |  ||   (image-coding=[JPEG,JBIG])
  |  |  |  |  |  |  |  |  |  ||   (image-coding-constraint=
  |  |  |  |  |  |  |  |  |  ||    [JPEG-T4E,JBIG-T43])
  |  |  |  |  |  |  |  |  |  ||   (& (color=full)
  |  |  |  |  |  |  |  |  |  ||      (color-subsampling="4:1:1"]) )
  |  |  |  |  |  |  |  |  |  ||   (image-interleave=[stripe,plane]) )
*1|  |  | 1| 1|*1| 1| 1|  |  ||(& (color=[limited,mapped,grey,full])
  |  |  |  |  |  |  |  |  |  ||   (image-coding=[JPEG,JBIG])
  |  |  |  |  |  |  |  |  |  ||   (image-coding-constraint=
  |  |  |  |  |  |  |  |  |  ||    [JPEG-T4E,JBIG-T43])
  |  |  |  |  |  |  |  |  |  ||   (& (color=full)
  |  |  |  |  |  |  |  |  |  ||      (image-coding=JPEG)
  |  |  |  |  |  |  |  |  |  ||      (color-subsampling=
  |  |  |  |  |  |  |  |  |  ||       ["1:1:1","4:1:1"]) )
  |  |  |  |  |  |  |  |  |  ||   (image-interleave=[stripe,plane]) )
--+--+--+--+--+--+--+--+--+--++---------------------------------------
15|16|31|36|37|68|69|73|78|79||
--+--+--+--+--+--+--+--+--+--++---------------------------------------
```

5.1.3 MRC format

```
<---- T.30 bits ------>
15|92|93|94|95|  |  |  ||Feature set expression
--+--+--+--+--+--+--+--++-------------------------------------
 x| 0| 0| 0| x|  |  |  ||(MRC-mode=0)
*1| #| #| #| 0|  |  |  ||(& (MRC-mode<=###)
  |  |  |  |  |  |  |  ||   (MRC-max-stripe-size=[0..256]) )
*1| #| #| #| 1|  |  |  ||(& (MRC-mode<=###)
  |  |  |  |  |  |  |  ||   (MRC-max-stripe-size>=0) )
--+--+--+--+--+--+--+--++-------------------------------------
```

5.2 Resolution and units

```
<------- T.30 bits ------>
15|41|42|43|44|45|68|97|98||Feature set expression
--+--+--+--+--+--+--+--+--++----------------------------------------
 0|  |  | 0|  |  |  |  |  ||(& (color=binary)
  |  |  |  |  |  |  |  |  ||   (| (& (dpi=200) (dpi-xyratio=200/100) )
  |  |  |  |  |  |  |  |  ||      (& (dpi=204)
  |  |  |  |  |  |  |  |  ||         (dpi-xyratio=204/98) ) ) )
  |  |  |  |  |  |  |  |  ||
 1|  |  | 0|  |  |  |  |  ||(| (& (color=binary)
  |  |  |  |  |  |  |  |  ||      (| (& (dpi=204)
  |  |  |  |  |  |  |  |  ||            (dpi-xyratio=204/98) )
  |  |  |  |  |  |  |  |  ||         (& (dpi=204)
  |  |  |  |  |  |  |  |  ||            (dpi-xyratio=204/196) )
  |  |  |  |  |  |  |  |  ||         (& (dpi=200)
  |  |  |  |  |  |  |  |  ||            (dpi-xyratio=200/100) ) ) )
  |  |  |  |  |  |  |  |  ||   (& (dpi=200) (dpi-xyratio=1) ) )
 0|  |  | 1|  |  |  |  |  ||(| (& (color=binary)
  |  |  |  |  |  |  |  |  ||      (| (& (dpi=204)
  |  |  |  |  |  |  |  |  ||            (dpi-xyratio=204/98) )
  |  |  |  |  |  |  |  |  ||         (& (dpi=408)
  |  |  |  |  |  |  |  |  ||            (dpi-xyratio=408/391) )
  |  |  |  |  |  |  |  |  ||         (& (dpi=200)
  |  |  |  |  |  |  |  |  ||            (dpi-xyratio=200/100) ) ) )
  |  |  |  |  |  |  |  |  ||   (& (dpi=400) (dpi-xyratio=1) ) )
 1|  |  | 1|  |  |  |  |  ||(| (& (color=binary)
  |  |  |  |  |  |  |  |  ||      (| (& (dpi=204)
  |  |  |  |  |  |  |  |  ||            (dpi-xyratio=204/98) )
  |  |  |  |  |  |  |  |  ||         (& (dpi=204)
  |  |  |  |  |  |  |  |  ||            (dpi-xyratio=204/196) )
  |  |  |  |  |  |  |  |  ||         (& (dpi=408)
  |  |  |  |  |  |  |  |  ||            (dpi-xyratio=408/391) )
  |  |  |  |  |  |  |  |  ||         (& (dpi=200)
  |  |  |  |  |  |  |  |  ||            (dpi-xyratio=200/100) ) ) )
  |  |  |  |  |  |  |  |  ||   (& (dpi=200) (dpi-xyratio=1) )
  |  |  |  |  |  |  |  |  ||   (& (dpi=400) (dpi-xyratio=1) ) )
--+--+--+--+--+--+--+--+--++----------------------------------------
  | 0|  |  |  |  |  |  |  ||
  | 1|  |  |  |  |  |  |  ||(& (color=binary)
  |  |  |  |  |  |  |  |  ||   (dpi=204)
  |  |  |  |  |  |  |  |  ||   (dpi-xyratio=204/391) )
--+--+--+--+--+--+--+--+--++----------------------------------------
  |  | 0|  |  |  |  |  |  ||
  |  | 1|  |  |  |  |  |  ||(& (dpi=300) (dpi-xyratio=1) )
```

```
--+--+--+--+--+--+--+--+--++-----------------------------------------
  |  | x| x|  |  | x| 0|  ||
  |  | x| 1|  |  |*1| 1|  ||(& (dpi=400) (dpi-xyratio=1) )
  |  |*1| 0|  |  |*1| 1|  ||
--+--+--+--+--+--+--+--+--++-----------------------------------------
  |  |  |  |  |  | x|  | 0||
  |  |  |  |  |  |*1|  | 1||(| (color=binary)
  |  |  |  |  |  |  |  |  ||   (& (color=[limited,mapped,grey,full])
  |  |  |  |  |  |  |  |  ||      (dpi=100) (dpi-xyratio=1) ) )
--+--+--+--+--+--+--+--+--++-----------------------------------------
15|41|42|43|44|45|68|97|98||
--+--+--+--+--+--+--+--+--++-----------------------------------------
```

Note: all numbers in media feature expressions are integer or rational values; hence the rational number format (n/m) used here.

Also note: the preferred unit bits (44,45) are not tested here, as a Group 3 fax machine must accept and process either form of units for binary images. All resolutions are expressed in dpi; here are the metric unit equivalents:

```
204  ~= (1728/215)*25.4  ~=  8.04dpmm expressed in dpi
408  ~= (3456/215)*25.4  ~= 16.08dpmm expressed in dpi
 98  ~=  3.85*25.4       ~=  3.85dpmm expressed in dpi
196  ~=  7.70*25.4       ~=  7.70dpmm expressed in dpi
391  ~= 15.40*25.4       ~= 15.40dpmm expressed in dpi
```

5.3 Colour capabilities

```
<------- T.30 bits --->
36|68|69|71|74|75|  |  ||Feature set expression
--+--+--+--+--+--+--+--++-----------------------------------------
 0| 0| x|  |  |  |  |  ||
 x| 1| 0|  |  |  |  |  ||(| (color=binary)
  |  |  |  |  |  |  |  ||   (& (color=grey)
  |  |  |  |  |  |  |  ||      (color-space=CIELAB) ) )
 0| 1| 1|  |  |  |  |  ||(| (color=binary)
  |  |  |  |  |  |  |  ||   (& (color=[grey,full])
  |  |  |  |  |  |  |  ||      (color-space=CIELAB) ) )
 1|*1| 1|  |  |  |  |  ||(| (color=binary)
  |  |  |  |  |  |  |  ||   (& (color=limited)
  |  |  |  |  |  |  |  ||      (color-space=[Device-RGB,Device-CMY])
  |  |  |  |  |  |  |  ||      (color-levels<=8) )
  |  |  |  |  |  |  |  ||   (& (color=limited)
  |  |  |  |  |  |  |  ||      (color-space=Device-CMYK)
  |  |  |  |  |  |  |  ||      (color-levels<=16) )
  |  |  |  |  |  |  |  ||   (& (color=[mapped,grey,full])
  |  |  |  |  |  |  |  ||      (color-space=CIELAB) ) )
```

```
--+--+--+--+--+--+--+--++----------------------------------------
  | 0|  | x|  |  |  |  ||
  | 1|  | 0|  |  |  |  ||(| (color=[binary,limited])
  |  |  |  |  |  |  |  ||   (& (color=mapped)
  |  |  |  |  |  |  |  ||      (color-levels<=4096) )
  |  |  |  |  |  |  |  ||   (& (color=grey)
  |  |  |  |  |  |  |  ||      (color-levels<=256) )
  |  |  |  |  |  |  |  ||   (& (color=full)
  |  |  |  |  |  |  |  ||      (color-levels<=16777216) ) )
  | 1|  | 1|  |  |  |  ||(| (color=[binary,limited])
  |  |  |  |  |  |  |  ||   (& (color=mapped)
  |  |  |  |  |  |  |  ||      (color-levels<=65536) )
  |  |  |  |  |  |  |  ||   (& (color=grey)
  |  |  |  |  |  |  |  ||      (color-levels<=4096) )
  |  |  |  |  |  |  |  ||   (& (color=full)
  |  |  |  |  |  |  |  ||      (color-levels<=68719476736) ) )
--+--+--+--+--+--+--+--++----------------------------------------
  | 0|  |  | x|  |  |  ||
  | 1|  |  | 0|  |  |  ||(| (color=[binary,limited])
  |  |  |  |  |  |  |  ||   (& (color=[mapped,grey,full])
  |  |  |  |  |  |  |  ||      (color-illuminant=D50) ) )
  | 1|  |  | 1|  |  |  ||   -- Any color illuminant: D50 or custom
  |  |  |  |  |  |  |  ||   -- See note below
--+--+--+--+--+--+--+--++----------------------------------------
  | 0|  |  |  | x|  |  ||
  | 1|  |  |  | 0|  |  ||(| (color=[binary,limited])
  |  |  |  |  |  |  |  ||   (& (color=grey)
  |  |  |  |  |  |  |  ||      (CIELAB-L-min>=0)
  |  |  |  |  |  |  |  ||      (CIELAB-L-max<=100) )
  |  |  |  |  |  |  |  ||   (& (color=[mapped,full])
  |  |  |  |  |  |  |  ||      (CIELAB-L-min>=0)
  |  |  |  |  |  |  |  ||      (CIELAB-L-max<=100)
  |  |  |  |  |  |  |  ||      (CIELAB-a-min>=-85)
  |  |  |  |  |  |  |  ||      (CIELAB-a-max<=85)
  |  |  |  |  |  |  |  ||      (CIELAB-b-min>=-75)
  |  |  |  |  |  |  |  ||      (CIELAB-b-max<=125) ) )
  | 1|  |  |  | 1|  |  ||   -- Any color gamut: default or custom
--+--+--+--+--+--+--+--++----------------------------------------
36|68|69|71|74|75|  |  ||Feature set expression
--+--+--+--+--+--+--+--++----------------------------------------
```

NOTE: the above table assumes the registration of a feature tag for color illuminant, values of which are tokens that are the same as those described by ITU T.4 [7], Annex E, section E.6.7.

5.4 Document size

A4 width (215mm) is required as a minimum for Group 3 fax conformance. A Group 3 fax machine must always be able to receive an A4 image.

```
<---- T.30 bits ------>
17|18|19|20|76|77|  |  ||Feature set expression
--+--+--+--+--+--+--+--++---------------------------------------
 0| 0|  |  |  |  |  |  ||(Size-x <= 2150/254)
 1| 0|  |  |  |  |  |  ||(Size-x <= 2550/254)
 x| 1|  |  |  |  |  |  ||(Size-x <= 3030/254)
--+--+--+--+--+--+--+--++---------------------------------------
  |  | 0| 0|  |  |  |  ||(Size-y <= 2970/254)
  |  | 1| 0|  |  |  |  ||(Size-y <= 3640/254)
  |  | 0| 1|  |  |  |  ||  -- unlimited
  |  | 1| 1|  |  |  |  ||  -- invalid
--+--+--+--+--+--+--+--++---------------------------------------
  |  |  |  | 0| 0|  |  ||(Paper-size=A4)
  |  |  |  | 1| 0|  |  ||(Paper-size=[A4,Letter])
  |  |  |  | 0| 1|  |  ||(Paper-size=[A4,Legal])
  |  |  |  | 1| 1|  |  ||(Paper-size=[A4,Letter,Legal])
--+--+--+--+--+--+--+--++---------------------------------------
```

6. Examples

NOTE: Although motivated by the requirements of eifax [5], this document is concerned with describing capabilities of Group 3 fax systems [6]. As such, the algorithms do not of themselves create equivalent Internet fax capability statements but, rather, they construct capability expressions that might be incorporated into those for eifax systems.

This point is illustrated at the end of the first example below where subsection 6.1.1 has been added, which combines T.30 capabilities with an appropriate TIFF file format capability to yield an expression that might be used to describe an Internet fax system.

6.1 Common black-and-white fax machine

DIS/DTC Bit No.	DIS/DTC bit description	Value
15	R8 x 7.7 lines/mm and/or 200 x 200 pels/25.4 mm	1
16	Two dimensional coding capability	1
17,18	Recording width capabilities: Scan line length 215 mm + 1%	0,0
19,20	Recording length capability: unlimited	01
31	T.6 (MMR) coding capability	1
36	T.43 (JBIG) coding capability	0
37	Plane interleave	0
41	Resolution: 8x15.4 dpmm	0
42	Resolution: 300x300 dpi	1
43	Resolution: 16x15.4 dpmm and/or 400x400 dpi	0
68	JPEG coding: not supported	0
69	Full color mode: not supported	0
71	12 bits/pel component: not supported	0
73	No subsampling (1:1:1): not supported	0
74	Custom illuminant: not supported	0
75	Custom gamut range: not supported	0
76	North American Letter paper size (8.5"x11") capability	1
77	North American Legal paper size (8.5"x14") capability: not supported	0
78	Single-progression sequential coding (T.85, bi-level JBIG) basic capability: not supported	0
79	Single-progression sequential coding (T.85, bi-level JBIG) optional L0 capability for other than 128 lines/stripe: not supported	0
92,93,94	T.44 (Mixed Raster Content) mode: not supported	0,0,0
95	Page length maximum stripe size for MRC coding: not supported.	0
97	Multi-level resolution 300x300dpi or 400x400dpi: not supported	0
98	Multi-level resolution 100x100dpi: not supported	0

Following the procedure in section 5, matching these DIS bits against the decision tables in sections 5.1 to 5.4, we get:

```
5.1.1  [Bits 16,31,78,79 = 1,1,0,0]
         (& (color=binary) (image-coding=[MH,MR,MMR]) )

5.1.2  [Bits 15,36,37,68,69,73 = 1,0,0,0,0,0]
         -- no capabilities

5.1.3  [Bits 15,92,93,94,95 = 1,0,0,0,0]
         (MRC-mode=0)

5.2    [Bits 15,43 = 1,0]
         (| (& (color=binary)
               (| (& (dpi=204)
                     (dpi-xyratio=204/98) )
                  (& (dpi=204)
                     (dpi-xyratio=204/196) )
                  (& (dpi=200)
                     (dpi-xyratio=200/100) ) ) )
            (& (dpi=200) (dpi-xyratio=1) ) )
       [Bit 41 = 0]
         -- no capabilities
       [Bit 42 = 1]
         (& (dpi=300) (dpi-xyratio=1) )
       [Bits 42,43,68,97 = 0,0,0,0]
         -- no capabilities
       [Bits 68,98 = 0,0]
         -- no capabilities

5.3    [Bits 36,68,69 = 0,0,0]
         -- no capabilities
       [Bits 68,71 = 0,0]
         -- no capabilities
       [Bits 68,74 = 0,0]
         -- no capabilities
       [Bits 68,75 = 0,0]
         -- no capabilities

5.4    [Bits 17,18 = 0,0]
         (size-x<=2150/254)
       [Bits 19,20 = 0,1]
         -- no capability constraint
       [Bits 76,77 = 1,0]
         (Paper-size=[A4,Letter])
```

Combining these as indicated in section 5, we get the following. (The initial expression is constructed verbatim per the rules in the first part of section 5, even though it contains some redundancy.)

```
(& (| (& (color=binary) (image-coding=[MH,MR,MMR]) ) )
   (MRC-mode=0)
   (| (| (& (color=binary)
            (| (& (dpi=204) (dpi-xyratio=204/98)  )
               (& (dpi=204) (dpi-xyratio=204/196) )
               (& (dpi=200) (dpi-xyratio=200/100) ) ) )
         (& (dpi=200) (dpi-xyratio=1) ) )
      (& (dpi=300) (dpi-xyratio=1) ) )
   (& (size-x<=2150/254)
      (Paper-size=[A4,Letter]) ) )
```

This in turn is simplified as follows. Note that the expression '(& (| (& A B)) C ...)' simplifies to just '(& A B C ...)'.

```
(& (color=binary)
   (image-coding=[MH,MR,MMR])
   (MRC-mode=0)
   (| (& (dpi=204) (dpi-xyratio=204/98)  )
      (& (dpi=204) (dpi-xyratio=204/196) )
      (& (dpi=200) (dpi-xyratio=200/100) )
      (& (dpi=200) (dpi-xyratio=1) )
      (& (dpi=300) (dpi-xyratio=1) ) )
   (size-x<=2150/254)
   (Paper-size=[A4,Letter]) )
```

6.1.1 Corresponding Internet fax capabilities

In the case of an Internet fax device, additional capabilities not described by the T.30 DIS frame should be included; e.g. the supported TIFF file structure:

```
(& (color=binary)
   (image-file-structure=[TIFF-Limited,TIFF-Minimal])
   (image-coding=[MH,MR,MMR])
   (MRC-mode=0)
   (| (& (dpi=204) (dpi-xyratio=204/98)  )
      (& (dpi=204) (dpi-xyratio=205/196) )
      (& (dpi=200) (dpi-xyratio=200/100) )
      (& (dpi=200) (dpi-xyratio=1) )
      (& (dpi=300) (dpi-xyratio=1) ) )
   (size-x<=2150/254)
   (Paper-size=[A4,Letter]) )
```

6.2 Full-featured color fax machine

DIS/DTC Bit No.	DIS/DTC bit description	Value
15	R8 x 7.7 lines/mm and/or 200 x 200 pels/25.4 mm	1
16	Two dimensional coding capability	1
17,18	Recording width capabilities: Scan line length 215 mm + 1%	0,0
19,20	Recording length capability: unlimited	01
31	T.6 (MMR) coding capability	1
36	T.43 (JBIG) coding capability	0
37	Plane interleave	0
41	Resolution: 8x15.4 dpmm	1
42	Resolution: 300x300 dpi	0
43	Resolution: 16x15.4 dpmm and/or 400x400 dpi	1
68	JPEG coding: supported	1
69	Full color mode: supported	1
71	12 bits/pel component: not supported	0
73	No subsampling (1:1:1): supported	1
74	Custom illuminant: not supported	0
75	Custom gamut range: not supported	0
76	North American Letter paper size (8.5"x11") capability	1
77	North American Legal paper size (8.5"x14") capability: not supported	0
78	Single-progression sequential coding (T.85, bi-level JBIG) basic capability: not supported	0
79	Single-progression sequential coding (T.85, bi-level JBIG) optional L0 capability for other than 128 lines/stripe: not supported	0
92,93,94	T.44 (Mixed Raster Content) mode: mode 1 supported	0,0,1
95	Page length maximum stripe size for MRC coding.	1
97	Multi-level resolution 300x300dpi or 400x400dpi: supported	1
98	Multi-level resolution 100x100dpi: supported	1

Matching these DIS bits against the decision tables in sections 5.1 to 5.4, we get:

```
5.1.1  [Bits 16,31,78,79 = 1,1,0,0]
         (& (color=binary) (image-coding=[MH,MR,MMR]) )

5.1.2  [Bits 15,36,37,68,69,73 = 1,0,0,1,1,1]
         (& (color=[grey,full])
            (image-coding=JPEG)
            (image-coding-constraint=JPEG-T4E)
            (& (color=full)
               (image-coding=JPEG)
               (color-subsampling=["1:1:1","4:1:1"]) ) )

5.1.3  [Bits 15,92,93,94,95 = 1,0,0,1,1]
         (& (MRC-mode<=1) (MRC-max-stripe-size>=0) )

5.2    [Bits 15,43 = 1,1]
         (| (& (color=binary)
               (| (& (dpi=204)
                     (dpi-xyratio=204/98) )
                  (& (dpi=204)
                     (dpi-xyratio=204/196) )
                  (& (dpi=408)
                     (dpi-xyratio=408/391) )
                  (& (dpi=200)
                     (dpi-xyratio=200/100) ) ) )
            (& (dpi=200) (dpi-xyratio=1) )
            (& (dpi=400) (dpi-xyratio=1) ) )
       [Bit 41 = 1]
         (& (color=binary)
            (dpi=204) (dpi-xyratio=204/391) )
       [Bit 42 = 0]
         -- no capabilities
       [Bits 42,43,68,97 = 0,1,1,1]
         (& (dpi=400) (dpi-xyratio=1) )
       [Bits 68,98 = 1,1]
         (| (color=binary)
            (& (color=[limited,mapped,grey,full])
               (dpi=100) (dpi-xyratio=1) ) )

5.3    [Bits 36,68,69 = 0,1,1]
         (| (color=binary)
            (& (color=[grey,full])
               (color-space=CIELAB) ) )
       [Bits 68,71 = 1,0]
         (| (color=[binary,limited])
            (& (color=mapped)
```

```
                  (color-levels<=4096) )
               (& (color=grey)
                  (color-levels<=256) )
               (& (color=full)
                  (color-levels<=16777216) ) )
         [Bits 68,74 = 1,0]
           (| (color=[binary,limited])
              (& (color=[mapped,grey,full])
                 (color-illuminant=D50) ) )
         [Bits 68,75 = 1,0]
           (| (color=[binary,limited])
              (& (color=grey)
                 (CIELAB-L-min>=0)
                 (CIELAB-L-max<=100) )
              (& (color=[mapped,full])
                 (CIELAB-L-min>=0)
                 (CIELAB-L-max<=100)
                 (CIELAB-a-min>=-85)
                 (CIELAB-a-max<=85)
                 (CIELAB-b-min>=-75)
                 (CIELAB-b-max<=125) ) )
```

5.4

```
         [Bits 17,18 = 0,0]
           (size-x<=2150/254)
         [Bits 19,20 = 0,1]
           -- no capability constraint
         [Bits 76,77 = 1,0]
           (Paper-size=[A4,Letter])
```

Combining these as indicated in section 5, we get the following:

```
(& (| (& (color=binary)
         (image-coding=[MH,MR,MMR]) )
      (& (color=[grey,full])
         (image-coding=JPEG)
         (image-coding-constraint=JPEG-T4E)
         (& (color=full)
            (image-coding=JPEG)
            (color-subsampling=["1:1:1","4:1:1"]) ) )
   (& (MRC-mode<=1) (MRC-max-stripe-size>=0) )
   (| (| (& (color=binary)
            (| (& (dpi=204) (dpi-xyratio=204/98) )
               (& (dpi=204) (dpi-xyratio=204/196) )
               (& (dpi=408) (dpi-xyratio=408/391) )
               (& (dpi=200) (dpi-xyratio=200/100) ) ) )
         (& (dpi=200) (dpi-xyratio=1) )
         (& (dpi=400) (dpi-xyratio=1) ) )
      (& (color=binary)
```

```
               (dpi=204) (dpi-xyratio=204/391) )
            (& (dpi=400) (dpi-xyratio=1) )
            (| (color=binary)
               (& (color=[limited,mapped,grey,full])
                  (dpi=100) (dpi-xyratio=1) ) ) )
         (& (| (color=binary)
               (& (color=[grey,full]) (color-space=CIELAB) ) )
            (| (color=[binary,limited])
               (& (color=mapped) (color-levels<=4096) )
               (& (color=grey) (color-levels<=256) )
               (& (color=full) (color-levels<=16777216) ) )
            (| (color=[binary,limited])
               (& (color=[mapped,grey,full]) (color-illuminant=D50) ) )
            (| (color=[binary,limited])
               (& (color=grey)
                  (CIELAB-L-min>=0)
                  (CIELAB-L-max<=100) )
               (& (color=[mapped,full])
                  (CIELAB-L-min>=0)
                  (CIELAB-L-max<=100)
                  (CIELAB-a-min>=-85)
                  (CIELAB-a-max<=85)
                  (CIELAB-b-min>=-75)
                  (CIELAB-b-max<=125) ) ) )
         (& (size-x<=2150/254)
            (Paper-size=[A4,Letter]) ) )
```

This in turn simplifies to:

```
   (| (& (color=binary)
         (image-coding=[MH,MR,MMR])
         (MRC-mode<=1) (MRC-max-stripe-size>=0)
         (| (& (dpi=204) (dpi-xyratio=204/98) )
            (& (dpi=204) (dpi-xyratio=204/196) )
            (& (dpi=204) (dpi-xyratio=204/391) )
            (& (dpi=408) (dpi-xyratio=408/391) )
            (& (dpi=200) (dpi-xyratio=200/100) )
            (& (dpi=200) (dpi-xyratio=1) )
            (& (dpi=400) (dpi-xyratio=1) ) )
         (size-x<=2150/254)
         (Paper-size=[A4,Letter]) )
      (& (color=grey)
         (image-coding=JPEG)
         (image-coding-constraint=JPEG-T4E)
         (MRC-mode<=1) (MRC-max-stripe-size>=0)
         (dpi=[100,200,400]) (dpi-xyratio=1)
         (color-space=CIELAB)
         (color-levels<=256)
```

```
            (color-illuminant=D50)
            (CIELAB-L-min>=0)
            (CIELAB-L-max<=100)
            (size-x<=2150/254)
            (Paper-size=[A4,Letter]) )
         (& (color=full)
            (image-coding=JPEG)
            (image-coding-constraint=JPEG-T4E)
            (color-subsampling=["1:1:1","4:1:1"])
            (MRC-mode<=1) (MRC-max-stripe-size>=0)
            (dpi=[100,200,400]) (dpi-xyratio=1)
            (color-space=CIELAB)
            (color-levels<=16777216)
            (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)
            (size-x<=2150/254)
            (Paper-size=[A4,Letter]) ) )
```

7. Security Considerations

Security considerations are discussed in the fax feature schema description [4]. This memo is not believed to introduce any additional security concerns.

8. Acknowledgements

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9. References

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[6] "Procedures for document facsimile transmission in the general switched telephone network" ITU-T Recommendation T.30 (1996), including Amendment 1 (1997), Amendment 2 (1997), Amendment 3 (1998) and Amendment 4 (1999) International Telecommunications Union

[7] "Standardization of Group 3 facsimile terminals for document transmission" ITU-T Recommendation T.4 (1996), including Amendment 1 (1997), Amendment 2 (1997) and Amendment 3 (1999) International Telecommunications Union (Covers basic fax coding formats: MH, MR; Annex E deals with some color image related matters, including codes for optional custom illuminants. Annex G deals with some aspects of JBIG encoding of multi-level images.)

[8] "Facsimile coding schemes and coding control functions for Group 4 facsimile apparatus" ITU Recommendation T.6 International Telecommunications Union (Commonly referred to as the MMR standard; covers extended 2-D fax coding format)

[9] "Continuous-tone colour representation method for facsimile" ITU-T Recommendation T.42 (1996) International Telecommunications Union (Covers custom illuminant, gamut)

[10] "Colour and gray-scale image representation using lossless coding scheme for facsimile" ITU-T Recommendation T.43 (1997) International Telecommunications Union (Covers JBIG for colour/grey images)

[11] "Mixed Raster Content (MRC)" ITU-T Recommendation T.44 (1999) International Telecommunications Union

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