

4.5 DRAFT - Image File Format Proposal for Digital Pictures

Introduction:

- Header preceeds image data in same file as image data
- Header is of variable length.
- Image file consists of :
 - a fixed format predefined section, containing information generically useful for all digital imaging applications, with reserved areas for future additions. (1K bytes)
 - a fixed format predefined section, for industry specific use, with reserved areas for future additions. (1K bytes)
 - a variable length, user defined area that could contain device dependent or application specific information and/or history of image processing steps (to be applied to the image, etc.
 - image data.
- All possible combinations of header field specifications are not supported by the High Resolution Electronic Intermediate System. However, to propose a minimal image file format that served the KODAK system alone, would not be generically useful for the motion picture industry, as a whole.
- Critical areas of information that the image file header needs to convey are :
 - How the image data is (to be) stored.
 - What the pixel values represent.
 - Image identification.
- Codes for Type field :

	Value indicating field is undefined :
-U8 unsigned 8 bit integer	FF hex
- U32 unsigned 32 bit integer	FFFFFFFF hex
- S32 signed 32 bit integer	80000000 hex
- R32 32 bit real number	7F800000 hex (+ infinity)
- ASCII	NULL
- Assumption : relation of code value to data metric is linear. Therefore, given the minimum and maximum code values for a given (color) channel, and the associated metric quantity represented, any value in between can be found via linear interpolation. For example, if min code value is 0 representing 0.2 log exposure, and max code value is 1168 representing 3.4 log exposure, then a code value of 584 represents 1.8 log exposure.

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Section 1 - Generic (Fixed Format) :

File Information:Head-2

<u>Field#</u>	<u>Offset</u>	<u>Length</u>	<u>Type</u>	<u>Content</u>
1.1	0	4	U32	Magic number (802A5FD7 hex) - indicates start of image file and byte ordering.
1.2	4	4	U32	Offset to image data in bytes
1.3	8	4	U32	Generic (fixed format) section header length in bytes
1.4	12	4	U32	Industry Specific (fixed format) section header length in bytes
1.5	16	4	U32	Length in bytes of variable length section
1.6	20	4	U32	Total image file size in bytes (includes header, image data, and padding, if any)
1.7	24	8	ASCII	Version number of header format
1.8	32	100	ASCII	Image filename
1.9	132	12	ASCII	Creation date - eg. "yyyy:mm:dd"
1.10	144	12	ASCII	Creation time - eg. "hh:mm:ssxxx" (xxx - time zone, eg. EST)
1.11	156	36	TBD	Reserved for future use

Image Information:

<u>Field#</u>	<u>Offset</u>	<u>Length</u>	<u>Type</u>	<u>Content</u>
1.12	192	1	U8	Image orientation <u>Line scan direction</u> <u>Page scan direction</u> 0 = left to righttop to bottom 1 = left to rightbottom to top 2 = right to lefttop to bottom 3 = right to leftbottom to top 4 = top to bottomleft to right 5 = top to bottomright to left 6 = bottom to topleft to right 7 = bottom to topright to left
1.13	193	1	U8	Number of channels (1-8)
1.13.1	194	2	U8*2	UNUSED (2 byte space for word allignment)
1.14.1	196	1	U8	* Channel 1 designator - Byte 0 (See Table 1)
1.14.2	197	1	U8	* Channel 1 designator - Byte 1 (See Table 1)
1.14.3	198	1	U8	* Bits per pixel - channel 1
1.14.4	199	1	U8	* UNUSED (1 byte space for word allignment)
1.14.5	200	4	U32	* Pixels per line - channel 1
1.14.6	204	4	U32	* Lines per image - channel 1
1.14.7	208	4	R32	* Minimum data value - channel 1
1.14.8	212	4	R32	* Minimum quantity represented - channel 1

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Section 1 - Generic (Fixed Format) :

Image Information (continued):

<u>Field#</u>	<u>Offset</u>	<u>Length</u>	<u>Type</u>		<u>Content</u>
1.14.9	216	4	R32	*	Maximum data value - channel 1
1.14.10	220	4	R32	*	Maximum quantity represented - channel 1
1.15	224	28	structure		Channel 2 specifier (Same as channel 1 *)
1.16	252	28	structure		Channel 3 specifier (Same as channel 1 *)
1.17	280	28	structure		Channel 4 specifier (Same as channel 1 *)
1.18	308	28	structure		Channel 5 specifier (Same as channel 1 *)
1.19	336	28	structure		Channel 6 specifier (Same as channel 1 *)
1.20	364	28	structure		Channel 7 specifier (Same as channel 1 *)
1.21	392	28	structure		Channel 8 specifier (Same as channel 1 *)
1.22	420	8	R32*2		White point (color temperature) - x,y pair
1.23	428	8	R32*2		Red primary chromaticity - x,y pair
1.24	436	8	R32*2		Green primary chromaticity - x,y pair
1.25	444	8	R32*2		Blue primary chromaticity - x,y pair
1.26	452	200	ASCII		Label text (other label info in user area - font, size, location)
1.27	652	28	TBD		Reserved for future use

Image Data Format Information :

<u>Field#</u>	<u>Offset</u>	<u>Length</u>	<u>Type</u>	<u>Content</u>
1.28	680	1	U8	Data interleave (if all channels are not the same spatial resolution, data interleave must be 2, channel interleave) 0 = pixel interleave (rgbrgrgb...) 1 = line interleave (rrr.ggg.bbb.rrr.ggg.bbb.) 2 = channel interleave (rrr..ggg..bbb..) 3 - 254 = user defined
1.29	681	1	U8	Packing (See note 1) 0 = use all bits (bitfields) - TIGHTEST - no byte, word or longword boundaries 1 = byte (8 bit) boundaries - left justified 2 = byte (8 bit) boundaries - right justified 3 = word (16 bit) boundaries - left justified 4 = word (16 bit) boundaries - right justified 5 = longword (32 bit) boundaries - left justified 6 = longword (32 bit) boundaries - right justified High order bit = 0 - pack at most one pixel per cell High order bit = 1 - pack as many fields as possible per cell

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Section 1 - Generic (Fixed Format) :

Image Data Format Information (continued) :

<u>Field#</u>	<u>Offset</u>	<u>Length</u>	<u>Type</u>	<u>Content</u>
1.30	682	1	U8	Data signed or unsigned 0 = unsigned 1 = signed
1.31	683	1	U8	Image sense 0 = positive image 1 = negative image
1.32	684	4	U32	End of line padding - number of bytes
1.33	688	4	U32	End of channel padding - number of bytes
1.34	692	20	TBD	Reserved for future use

Image Origination Information :

<u>Field#</u>	<u>Offset</u>	<u>Length</u>	<u>Type</u>	<u>Content</u>
1.35	712	4	S32	X offset (correlate digital data to source media)
1.36	716	4	S32	Y offset (correlate digital data to source media)
1.37	720	100	ASCII	Image filename
1.38	820	12	ASCII	Creation date - eg. "yyyy:mm:dd"
1.39	832	12	ASCII	Creation time - eg. "hh:mm:ssxxx" (xxx - time zone, eg. EST)
1.40	844	64	ASCII	Input device
1.41	908	32	ASCII	Input device model number
1.42	940	32	ASCII	Input device serial number
1.43	972	4	R32	X input device pitch (samples/mm.) (X determined by image orientation)
1.44	976	4	R32	Y input device pitch (samples/mm.) (Y determined by image orientation)
1.45	980	4	R32	Image gamma of capture device
1.46	984	40	TBD	Reserved for future use

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Section 2 - Motion Picture Industry Specific (Fixed Format) :

Film/Frame Information :

<u>Field#</u>	<u>Offset</u>	<u>Length</u>	<u>Type</u>	<u>Content</u>
2.1	1024	1	U8	Film mfg. ID code - 2 digit code from KEYCODE
2.2	1025	1	U8	Film type - 2 digit code from KEYCODE
2.3	1026	1	U8	Offset in perfs - 2 digit code from KEYCODE
2.4	1027	1	U8	UNUSED (1 byte space for word allignment)
2.5	1028	4	U32	Prefix - 6 digit code from KEYCODE
2.6	1032	4	U32	Count - 4 digit code from KEYCODE
2.7	1036	32	ASCII	Format - eg. "ACADEMY, "VISTAVISION", etc.
2.8	1068	4	U32	Frame position in sequence
2.9	1072	4	R32	Frame rate of original (frames per second)
2.10	1076	32	ASCII	Frame attribute - eg. "KEYFRAME"
2.11	1108	200	ASCII	Slate information
2.12	1308	740	TBD	Reserved for future use

Section 3 - User Defined (Variable Length) :

<u>Field#</u>	<u>Offset</u>	<u>Length</u>	<u>Type</u>	<u>Content</u>
3.0	2048	???	???	Reserved for customer use - compression, processing log, etc.

*** Note : For our application, this section is currently defined to contain the postage stamp image -
*** eg. 96x64x3 channels (18 KBytes for 8 bit mode) oriented correctly for display..

Section 4 - Digital Image Data

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Table 1

Channel Designator Codes :

Byte 0 -	0 =	Universal metric
	1-254 =	vendor specific (eg. 1= KODAK)
Byte 1 -	If byte 0 = 0	If 0 < byte 0 < 255
	Universal Metric	0-254 Vendor defined
	0=B&W	
	1 = red	(r,g,b printing density)
	2 = green	(r,g,b printing density)
	3 = blue	(r,g,b printing density)
	4 = red	(r,g,b CCIR XA/11)
	5 = green	(r,g,b CCIR XA/11)
	6 = blue	(r,g,b CCIR XA/11)
	7- 254	TBD - reserved

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Note 1 (on “packing” options 1-6) :

Define a **CELL** to be a BYTE (8 bits), WORD(16 bits) or LONGWORD(32 bits).

Define a **FIELD** to be one occurrence of a channel value. For example, with 3 channels (r,g,b), pixel interleaved, field 1 is r1, field 2 is g1, field 3 is b1, field 4 is r2, etc. With 3 channels (r,g,b), channel interleaved, field 1 is r1, field 2 is r2, field 3 is r3, etc.

The high order bit of the packing specifier either restricts packing to at most one pixel (n channels) per cell, or allows fields from adjacent pixels to spill over cell boundaries.

How to interpret PACKING specifier :

If number of channels = 1 OR data interleave = 1 or 2 (line or channel interleave)

Pack as many fields into the cell as possible, with appropriate justification, then align on the next cell boundary. The high order bit is a don't care in this case.

If number of channels is > 1 AND data interleave = 0 (pixel interleave)

If high order bit is clear

n = number of channels

Pack as many fields into the cell as possible up to n fields, with appropriate justification, then align on the next cell boundary.

If high order bit is set

Pack as many fields into the cell as possible, with appropriate justification, then align on the next cell boundary.

Examples :

Number of channels = 4	6 bits	6 bits	6 bits	6 bits	8 bits
All channels, 6 bits deep	field1	field2	field3	field4	empty
Data interleave = 0	ch1[1]	ch2[1]	ch3[1]	ch4[1]	xxxxxxxx
Packing = 5 (High order bit clear)					
Number of channels = 4	6 bits	6 bits	6 bits	6 bits	6 bits2 bits
All channels, 6 bits deep	field1	field2	field3	field4	field5empty
Data interleave = 0	ch1[1]	ch2[1]	ch3[1]	ch4[1]	ch1[2]xx
Packing = 5 (High order bit set)					