Devices

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Contents

Chapter 1

Devices

1.1 A / FORM Specs from Original EA Doc / ILBM IFF Interleaved Bitmap

```
Date: January 17, 1986~(CRNG data updated Oct, 1988 by Jerry Morrison)
  (Appendix E added and CAMG updated Oct, 1988
         by Commodore-Amiga, Inc.)

From: Jerry Morrison, Electronic Arts

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```


1.2 ILBM IFF Interleaved Bitmap / Introduction

```
EA IFF 85 is Electronic Arts' standard for interchange format files.
"ILBM" is a format for a 2 dimensional raster graphics image, specifically
an InterLeaved bitplane BitMap image with color map.  An ILBM is an IFF
"data section" or "FORM type", which can be an IFF file or a part of one.
ILBM allows simple, highly portable raster graphic storage.

An ILBM is an archival representation designed for three uses.  First, a
stand- alone image that specifies exactly how to display itself
(resolution, size, color map, etc.).  Second, an image intended to be
merged into a bigger picture which has its own depth, color map, and so
on.  And third, an empty image with a color map selection or "palette" for
a paint program.  ILBM is also intended as a building block for composite
IFF FORMs like "animation sequences" and "structured graphics".  Some uses
of ILBM will be to preserve as much information as possible across
disparate environments.  Other uses will be to store data for a single
```

program or highly cooperative programs while maintaining subtle details. So we're trying to accomplish a lot with this one format.

This memo is the IFF supplement for FORM ILBM. Section 2 defines the purpose and format of property chunks bitmap header "BMHD", color map "CMAP", hotspot "GRAB", destination merge data "DEST", sprite information "SPRT", and Commodore Amiga viewport mode "CAMG". Section 3 defines the standard data chunk "BODY". These are the "standard" chunks. Section 4 defines the non- standard data chunks. Additional specialized chunks like texture pattern can be added later. The ILBM syntax is summarized in Appendix A as a regular expression and in Appendix B as a box diagram. Appendix C explains the optional run encoding scheme. Appendix D names the committee responsible for this FORM ILBM standard.

Details of the raster layout are given in part 3, Standard Data Chunk. Some elements are based on the Commodore Amiga hardware but generalized for use on other computers. An alternative to ILBM would be appropriate for computers with true color data in each pixel, though the wealth of available ILBM images makes import and export important.

Reference

1.3 ILBM IFF Interleaved Bitmap / Reference

"EA IFF 85" Standard for Interchange Format Files describes the underlying conventions for all IFF files.

1.4 ILBM IFF Interleaved Bitmap / Standard Properties

ILBM has several defined property chunks that act on the main data chunks. The required property "BMHD" and any optional properties must appear before any "BODY" chunk. (Since an ILBM has only one BODY chunk, any following properties would be superfluous.) Any of these properties may be shared over a LIST of several ILBMs by putting them in a PROP ILBM (See the EA IFF 85 document).

BMHD
CMAP
GRAB
DEST
SPRT
CAMG

1.5 Standard Properties / BMHD

The required property "BMHD" holds a BitMapHeader as defined in the following documentation. It describes the dimensions of the image, the encoding used, and other data necessary to understand the BODY to follow.

```
typedef UBYTE Masking;     /* Choice of masking technique. */

#define mskNone                 0
#define mskHasMask              1
#define mskHasTransparentColor 2
#define mskLasso                3

typedef UBYTE Compression;    /* Choice of compression algorithm
   applied to the rows of all source and mask planes.  "cmpByteRun1"
   is the byte run encoding described in Appendix C.  Do not compress
   across rows! */
#define cmpNone        0
#define cmpByteRun1    1

typedef struct {
  UWORD       w, h;             /* raster width & height in pixels      */
  WORD        x, y;             /* pixel position for this image        */
  UBYTE       nPlanes;          /* # source bitplanes                   */
  Masking     masking;
  Compression compression;
  UBYTE       pad1;             /* unused; ignore on read, write as 0   */
  UWORD       transparentColor; /* transparent "color number" (sort of) */
  UBYTE       xAspect, yAspect; /* pixel aspect, a ratio width : height */
  WORD        pageWidth, pageHeight; /* source "page" size in pixels    */
    } BitMapHeader;
```

Fields are filed in the order shown. The UBYTE fields are byte-packed (the C compiler must not add pad bytes to the structure).

The fields w and h indicate the size of the image rectangle in pixels. Each row of the image is stored in an integral number of 16 bit words. The number of words per row is words=((w+15)/16) or Ceiling(w/16). The fields x and y indicate the desired position of this image within the destination picture. Some reader programs may ignore x and y. A safe default for writing an ILBM is (x, y) = (0, 0).

The number of source bitplanes in the BODY chunk is stored in nPlanes. An ILBM with a CMAP but no BODY and nPlanes = 0 is the recommended way to store a color map.

Note: Color numbers are color map index values formed by pixels in the destination bitmap, which may be deeper than nPlanes if a DEST chunk calls for merging the image into a deeper image.

The field masking indicates what kind of masking is to be used for this image. The value mskNone designates an opaque rectangular image. The value mskHasMask means that a mask plane is interleaved with the bitplanes in the BODY chunk (see below). The value mskHasTransparentColor indicates that pixels in the source planes matching transparentColor are to be

considered "transparent". (Actually, transparentColor isn't a "color number" since it's matched with numbers formed by the source bitmap rather than the possibly deeper destination bitmap. Note that having a transparent color implies ignoring one of the color registers. The value mskLasso indicates the reader may construct a mask by lassoing the image as in MacPaint(tm). To do this, put a 1 pixel border of transparentColor around the image rectangle. Then do a seed fill from this border. Filled pixels are to be transparent.

Issue: Include in an appendix an algorithm for converting a transparent color to a mask plane, and maybe a lasso algorithm.

A code indicating the kind of data compression used is stored in compression. Beware that using data compression makes your data unreadable by programs that don't implement the matching decompression algorithm. So we'll employ as few compression encodings as possible. The run encoding byteRun1 is documented in Appendix C.

The field pad1 is a pad byte reserved for future use. It must be set to 0 for consistency.

The transparentColor specifies which bit pattern means "transparent". This only applies if masking is mskHasTransparentColor or mskLasso. Otherwise, transparentColor should be 0 (see above).

The pixel aspect ratio is stored as a ratio in the two fields xAspect and yAspect. This may be used by programs to compensate for different aspects or to help interpret the fields w, h, x, y, pageWidth, and pageHeight, which are in units of pixels. The fraction xAspect/yAspect represents a pixel's width/height. It's recommended that your programs store proper fractions in the BitMapHeader, but aspect ratios can always be correctly compared with the test:

```
xAspect * yDesiredAspect = yAspect * xDesiredAspect
```

Typical values for aspect ratio are width : height = 10 : 11 for an Amiga 320 x 200 display and 1 : 1 for a Macintosh(tm) display.

The size in pixels of the source "page" (any raster device) is stored in pageWidth and pageHeight, e.g., (320, 200) for a low resolution Amiga display. This information might be used to scale an image or to automatically set the display format to suit the image. Note that the image can be larger than the page.

1.6 Standard Properties / CMAP

The optional (but encouraged) property "CMAP" stores color map data as triplets of red, green, and blue intensity values. The n color map entries ("color registers") are stored in the order 0 through n-1, totaling 3n bytes. Thus n is the ckSize/3. Normally, n would equal 2^(nPlanes).

A CMAP chunk contains a ColorMap array as defined below. Note that these typedefs assume a C compiler that implements packed arrays of 3-byte elements.

```
    typedef struct {
        UBYTE red, green, blue;           /* color intensities 0..255 */
        } ColorRegister;                  /* size = 3 bytes           */

    typedef ColorRegister ColorMap[n];    /* size = 3n bytes          */
```

The color components red, green, and blue represent fractional intensity values in the range 0 through 255 256ths. White is (255, 255, 255) and black is (0, 0, 0). If your machine has less color resolution, use the high order bits. Shift each field right on reading (or left on writing) and assign it to (from) a field in a local packed format like Color4, below. This achieves automatic conversion of images across environments with different color resolutions. On reading an ILBM, use defaults if the color map is absent or has fewer color registers than you need. Ignore any extra color registers. (See Appendix E for a better way to write colors)

The example type Color4 represents the format of a color register in working memory of an Amiga computer, which has 4 bit video DACs. (The ":4" tells smarter C compilers to pack the field into 4 bits.)

```
    typedef struct {
        unsigned pad1 :4, red :4, green :4, blue :4;
        } Color4;                /*   Amiga RAM format.  Not filed.  */
```

Remember that every chunk must be padded to an even length, so a color map with an odd number of entries would be followed by a 0 byte, not included in the ckSize.

1.7 Standard Properties / GRAB

The optional property "GRAB" locates a "handle" or "hotspot" of the image relative to its upper left corner, e.g., when used as a mouse cursor or a "paint brush". A GRAB chunk contains a Point2D.

```
    typedef struct {
        WORD x, y;          /* relative coordinates (pixels) */
        } Point2D;
```

1.8 Standard Properties / DEST

The optional property "DEST" is a way to say how to scatter zero or more source bitplanes into a deeper destination image. Some readers may ignore DEST.

The contents of a DEST chunk is DestMerge structure:

```
typedef struct {
  UBYTE depth;      /* # bitplanes in the original source              */
  UBYTE pad1;       /* unused; for consistency put 0 here              */
```

```
  UWORD planePick;  /* how to scatter source bitplanes into destination */
  UWORD planeOnOff; /* default bitplane data for planePick              */
  UWORD planeMask;  /* selects which bitplanes to store into            */
  } DestMerge;
```

The low order depth number of bits in planePick, planeOnOff, and planeMask correspond one-to-one with destination bitplanes. Bit 0 with bitplane 0, etc. (Any higher order bits should be ignored.) "1" bits in planePick mean "put the next source bitplane into this bitplane", so the number of "1" bits should equal nPlanes. "0" bits mean "put the corresponding bit from planeOnOff into this bitplane". Bits in planeMask gate writing to the destination bitplane: "1" bits mean "write to this bitplane" while "0" bits mean "leave this bitplane alone". The normal case (with no DEST property) is equivalent to planePick = planeMask = 2^(nPlanes) - 1.

Remember that color numbers are formed by pixels in the destination bitmap (depth planes deep) not in the source bitmap (nPlanes planes deep).

1.9 Standard Properties / SPRT

The presence of an "SPRT" chunk indicates that this image is intended as a sprite. It's up to the reader program to actually make it a sprite, if even possible, and to use or overrule the sprite precedence data inside the SPRT chunk:

```
    typedef UWORD SpritePrecedence;/* relative precedence,0 is the high */
```

Precedence 0 is the highest, denoting a sprite that is foremost.

Creating a sprite may imply other setup. E.g., a 2 plane Amiga sprite would have transparentColor = 0. Color registers 1, 2, and 3 in the CMAP would be stored into the correct hardware color registers for the hardware sprite number used, while CMAP color register 0 would be ignored.

1.10 Standard Properties / CAMG

A "CAMG" chunk is specifically for Commodore Amiga ILBM's. All Amiga-based reader and writer software should deal with CAMG. The Amiga supports many different video display modes including interlace, Extra Halfbrite, hold and modify (HAM), plus a variety of new modes under the 2.0 operating system. A CAMG chunk contains a single long word (length=4) which specifies the Amiga display mode of the picture.

Prior to 2.0, it was possible to express all available Amiga ViewModes in 16 bits of flags (Viewport->Modes or NewScreen->ViewModes). Old-style writers and readers place a 16-bit Amiga ViewModes value in the low word of the CAMG, and zeros in the high word. The following Viewmode flags should always be removed from old-style 16-bit ViewModes values when writing or reading them:

```
EXTENDED_MODE | SPRITES | VP_HIDE |
```

```
          GENLOCK_AUDIO | GENLOCK_VIDEO (=0x7102, mask=0x8EFD)
```

New ILBM readers and writers, should treat the full CAMG longword as a 32-bit ModeID to support new and future display modes.

New ILBM writers, when running under the 2.0 Amiga operating system, should directly store the full 32-bit return value of the graphics function GetVPModeID(vp) in the CAMG longword. When running under 1.3, store a 16-bit Viewmodes value masked as described above.

ILBM readers should only mask bits out of a CAMG if the CAMG has a zero upper word (see exception below). New ILBM readers, when running under 2.0, should then treat the 32-bit CAMG value as a ModeID, and should use the graphics ModeNotAvailable() function to determine if the mode is available. If the mode is not available, fall back to another suitable display mode. When running under 1.3, the low word of the CAMG may generally be used to open a compatible display.

Note that one popular graphics package stores junk in the upper word of the CAMG of brushes, and incorrect values (generally zero) in the low word. You can screen for such junk values by testing for non-zero in the upper word of a ModeID in conjunction with the 0x00001000 bit NOT set in the low word.

The following code fragment demonstrates ILBM reader filtering of inappropriate bits in 16-bit CAMG values.

```
#include <graphics/view.h>
#include <graphics/displayinfo.h>

/* Knock bad bits out of old-style CAMG modes before checking availability.
 * (some ILBM CAMG's have these bits set in old 1.3 modes, and should not)
 * If not an extended monitor ID, or if marked as extended but missing
 * upper 16 bits, screen out inappropriate bits now.
 */
if((!(modeid & MONITOR_ID_MASK)) ||
    ((modeid & EXTENDED_MODE)&&(!(modeid & 0xFFFF0000))))
   modeid &=
      (~(EXTENDED_MODE|SPRITES|GENLOCK_AUDIO|GENLOCK_VIDEO|VP_HIDE));

/* Check for bogus CAMG like some brushes have, with junk in
 * upper word and extended bit NOT set not set in lower word.
 */
if((modeid & 0xFFFF0000)&&(!(modeid & EXTENDED_MODE)))
    {
    /* Bad CAMG, so ignore CAMG and determine a mode based on
     * based on pagesize or aspect
     */
     modeid = NULL;
     if(wide >= 640) modeid |= HIRES;
     if(high >= 400) modeid |= LACE;
     }

/* Now, ModeNotAvailable() may be used to determine if mode is available.
 *
 * If the mode is not available, you may prompt the user for a mode
 * choice, or search the 2.0 display database for an appropriate
```

```
 * replacement mode, or you may be able to get a relatively compatible
 * old display mode by masking out all bits except
 * HIRES | LACE | HAM | EXTRA_HALFBRITE
 */

   if((modeid & 0xFFFF0000)&&(!(modeid & 0x00001000)))
  {
  /* Then probably invalid ModeID */
  }
```

1.11 ILBM IFF Interleaved Bitmap / Standard BODY Data Chunk

```
Raster Layout
BODY
```

1.12 Standard BODY Data Chunk / Raster Layout

Raster scan proceeds left-to-right (increasing X) across scan lines, then top-to-bottom (increasing Y) down columns of scan lines. The coordinate system is in units of pixels, where (0,0) is the upper left corner.

The raster is typically organized as bitplanes in memory. The corresponding bits from each plane, taken together, make up an index into the color map which gives a color value for that pixel. The first bitplane, plane 0, is the low order bit of these color indexes.

A scan line is made of one "row" from each bitplane. A row is one plane's bits for one scan line, but padded out to a word (2 byte) boundary (not necessarily the first word boundary). Within each row, successive bytes are displayed in order and the most significant bit of each byte is displayed first.

A "mask" is an optional "plane" of data the same size (w, h) as a bitplane. It tells how to "cut out" part of the image when painting it onto another image. "One" bits in the mask mean "copy the corresponding pixel to the destination". "Zero" mask bits mean "leave this destination pixel alone". In other words, "zero" bits designate transparent pixels.

The rows of the different bitplanes and mask are interleaved in the file (see below). This localizes all the information pertinent to each scan line. It makes it much easier to transform the data while reading it to adjust the image size or depth. It also makes it possible to scroll a big image by swapping rows directly from the file without the need for random-access to all the bitplanes.

1.13 Standard BODY Data Chunk / BODY

The source raster is stored in a "BODY" chunk. This one chunk holds all bitplanes and the optional mask, interleaved by row.

The BitMapHeader, in a BMHD property chunk, specifies the raster's dimensions w, h, and nPlanes. It also holds the masking field which indicates if there is a mask plane and the compression field which indicates the compression algorithm used. This information is needed to interpret the BODY chunk, so the BMHD chunk must appear first. While reading an ILBM's BODY, a program may convert the image to another size by filling (with transparentColor) or clipping.

The BODY's content is a concatenation of scan lines. Each scan line is a concatenation of one row of data from each plane in order 0 through nPlanes-1 followed by one row from the mask (if masking = hasMask). If the BitMapHeader field compression is cmpNone, all h rows are exactly (w+15)/16 words wide. Otherwise, every row is compressed according to the specified algorithm and the stored widths depend on the data compression.

Reader programs that require fewer bitplanes than appear in a particular ILBM file can combine planes or drop the high-order (later) planes. Similarly, they may add bitplanes and/or discard the mask plane.

Do not compress across rows, and don't forget to compress the mask just like the bitplanes. Remember to pad any BODY chunk that contains an odd number of bytes and skip the pad when reading.

1.14 ILBM IFF Interleaved Bitmap / Nonstandard Data Chunks

The following data chunks were defined after various programs began using FORM ILBM so they are "nonstandard" chunks. See the registry document for the latest information on additional non-standard chunks.

CRNG
CCRT

1.15 Nonstandard Data Chunks / CRNG

A "CRNG" chunk contains "color register range" information. It's used by Electronic Arts' Deluxe Paint program to identify a contiguous range of color registers for a "shade range" and color cycling. There can be zero or more CRNG chunks in an ILBM, but all should appear before the BODY chunk. Deluxe Paint normally writes 4 CRNG chunks in an ILBM when the user asks it to "Save Picture".

```
typedef struct {
    WORD  pad1;      /* reserved for future use; store 0 here    */
    WORD  rate;      /* color cycle rate                         */
    WORD  flags;     /* see below                                */
    UBYTE low, high; /* lower and upper color registers selected */
    } CRange;
```

The bits of the flags word are interpreted as follows: if the low bit is set then the cycle is "active", and if this bit is clear it is not active. Normally, color cycling is done so that colors move to the next higher position in the cycle, with the color in the high slot moving around to

the low slot. If the second bit of the flags word is set, the cycle moves in the opposite direction. As usual, the other bits of the flags word are reserved for future expansion. Here are the masks to test these bits:

```
#define RNG_ACTIVE  1
#define RNG_REVERSE 2
```

The fields low and high indicate the range of color registers (color numbers) selected by this CRange.

The field active indicates whether color cycling is on or off. Zero means off.

The field rate determines the speed at which the colors will step when color cycling is on. The units are such that a rate of 60 steps per second is represented as 2^14 = 16384. Slower rates can be obtained by linear scaling: for 30 steps/second, rate = 8192; for 1 step/second, rate = 16384/60 * 273.

1.16 Nonstandard Data Chunks / CCRT

Commodore's Graphicraft program uses a similar chunk "CCRT" (for Color Cycling Range and Timing). This chunk contains a CycleInfo structure.

```
typedef struct {
    WORD  direction;    /* 0 = don't cycle.  1 = cycle forwards      */
                        /* (1, 2, 3). -1 = cycle backwards (3, 2, 1) */
    UBYTE start, end;   /* lower and upper color registers selected  */
    LONG  seconds;      /* # seconds between changing colors plus... */
    LONG  microseconds; /* # microseconds between changing colors    */
    WORD  pad;          /* reserved for future use; store 0 here     */
    } CycleInfo;
```

This is very similar to a CRNG chunk. A program would probably only use one of these two methods of expressing color cycle data, new programs should use CRNG. You could write out both if you want to communicate this information to both Deluxe Paint and Graphicraft.

1.17 ILBM IFF Interleaved Bitmap / Appendix A. ILBM Regular Expression

Here's a regular expression summary of the FORM ILBM syntax. This could be an IFF file or a part of one.

```
ILBM ::= "FORM" #{    "ILBM" BMHD [CMAP] [GRAB] [DEST] [SPRT] [CAMG]
                        CRNG* CCRT* [BODY]    }

BMHD ::= "BMHD" #{    BitMapHeader    }
CMAP ::= "CMAP" #{    (red green blue)*    } [0]
GRAB ::= "GRAB" #{    Point2D    }
DEST ::= "DEST" #{    DestMerge    }
SPRT ::= "SPRT" #{    SpritePrecedence    }
CAMG ::= "CAMG" #{    LONG    }
```

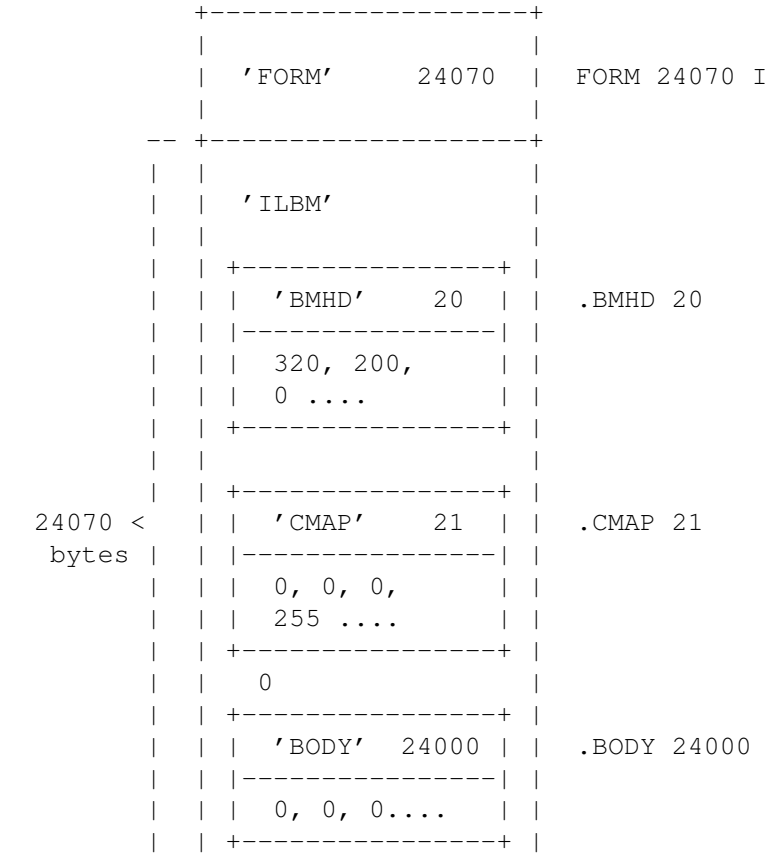
```
    CRNG ::= "CRNG" #{    CRange    }
    CCRT ::= "CCRT" #{    CycleInfo    }
    BODY ::= "BODY" #{    UBYTE*    } [0]
```

The token "#" represents a ckSize LONG count of the following {braced} data bytes. E.g., a BMHD's "#" should equal sizeof(BitMapHeader). Literal strings are shown in "quotes", [square bracket items] are optional, and "*" means 0 or more repetitions. A sometimes-needed pad byte is shown as "[0]".

The property chunks BMHD, CMAP, GRAB, DEST, SPRT, CAMG and any CRNG and CCRT data chunks may actually be in any order but all must appear before the BODY chunk since ILBM readers usually stop as soon as they read the BODY. If any of the 6 property chunks are missing, default values are inherited from any shared properties (if the ILBM appears inside an IFF LIST with PROPs) or from the reader program's defaults. If any property appears more than once, the last occurrence before the BODY is the one that counts since that's the one that modifies the BODY.

1.18 ILBM IFF Interleaved Bitmap / Appendix B. ILBM Box Diagram

Here's a box diagram for a simple example: an uncompressed image 320 x 200 pixels x 3 bitplanes. The text to the right of the diagram shows the outline that would be printed by the Sift utility program for this particular file.



```
        |  |                    |
        -- +--------------------+
```

The "0" after the CMAP chunk is a pad byte.

1.19 ILBM IFF Interleaved Bitmap / Appendix C. IFF Hints

Hints on ILBM files from Jerry Morrison, Oct 1988. How to avoid some pitfalls when reading ILBM files:

* Don't ignore the BitMapHeader.masking field. A bitmap with a mask (such as a partially-transparent DPaint brush or a DPaint picture with a stencil) will read as garbage if you don't de-interleave the mask.

* Don't assume all images are compressed. Narrow images aren't usually run-compressed since that would actually make them longer.

* Don't assume a particular image size. You may encounter overscan pictures and PAL pictures.

There's a better way to read a BODY than the example IFF code. The GetBODY routine should call a GetScanline routine once per scan line, which calls a GetRow routine for each bitplane in the file. This in turn calls a GetUnpackedBytes routine, which calls a GetBytes routine as needed and unpacks the result. (If the picture is uncompressed, GetRow calls GetBytes directly.) Since theunpacker knows how many packed bytes to read, this avoids juggling buffers for a memory-to-memory UnPackBytes routine.

Caution: If you make many AmigaDOS calls to read or write a few bytes at a time, performance will be mud! AmigaDOS has a high overhead per call, even with RAM disk. So use buffered read/write routines.

Different hardware display devices have different color resolutions:

Device	R:G:B bits	maxColor
Mac SE	1	1
IBM EGA	2:2:2	3
Atari ST	3:3:3	7
Amiga	4:4:4	15
CD-I	5:5:5	31
IBM VGA	6:6:6	63
Mac II	8:8:8	255

An ILBM CMAP defines 8 bits of Red, Green and Blue (i.e., 8:8:8 bits of R:G:B). When displaying on hardware which has less color resolution, just take the high order bits. For example, to convert ILBM's 8-bit Red to the Amiga's 4-bit Red, right shift the data by 4 bits (R4 := R8 >> 4).

To convert hardware colors to ILBM colors, the ILBM specification says just set the high bits (R8 := R4 << 4). But you can transmit higher contrast to foreign display devices by scaling the data [0..maxColor] to the full range [0..255]. In other words, R8 := (Rn x 255) $\div$ maxColor. (Example #1: EGA color 1:2:3 scales to 85:170:255. Example #2: Amiga 15:7:0 scales to 255:119:0). This makes a big difference where maxColor

is less than 15. In the extreme case, Mac SE white (1) should be converted to ILBM white (255), not to ILBM gray (128).

 CGA and EGA subtleties
 24-bit ILBMs

1.20 Appendix C. IFF Hints / CGA and EGA subtleties

IBM EGA colors in 350 scan line mode are 2:2:2 bits of R:G:B, stored in memory as xxR'G'B'RBG. That's 3 low-order bits followed by 3 high-order bits.

IBM CGA colors are 4 bits stored in a byte as xxxxIRGB. (EGA colors in 200 scan line modes are the same as CGA colors, but stored in memory as xxxIxRGB.) That's 3 high-order bits (one for each of R, G, and B) plus one low-order " Intensity" bit for all 3 components R, G, and B. Exception: IBM monitors show IRGB = 0110 as brown, which is really the EGA color R:G:B = 2:1:0, not dark yellow 2:2:0.

1.21 ILBM IFF Interleaved Bitmap / 24-bit ILBMs

When storing deep images as ILBMs (such as images with 8 bits each of R,G, and B), the bits for each pixel represent an absolute RGB value for that pixel rather than an index into a limited color map. The order for saving the bits is critical since a deep ILBM would not contain the usual CMAP of RGB values (such a CMAP would be too large and redundant).

To interpret these "deep" ILBMs, it is necessary to have a standard order in which the bits of the R, G, and B values will be stored. A number of different orderings have already been used in deep ILBMs, so it was necessary to us chose one of these orderings as a standard.

The following bit ordering has been chosen as the default bit ordering for deep ILBMs.

Default standard deep ILBM bit ordering:
saved first --> saved last
R0 R1 R2 R3 R4 R5 R6 R7 G0 G1 G2 G3 G4 G5 G6 G7 B0 B1 B2 B3 B4 B5 B6 B7

One other existing deep bit ordering that you may encounter is the 21-bit NewTek format.

NewTek deep ILBM bit ordering:
saved first --> saved last
R7 G7 B7 R6 G6 B6 R5 G5 B5 R4 G4 B4 R3 G3 B3 R2 G2 B2 R1 G1 B1 R0 G0 B0

Note that you may encounter CLUT chunks in deep ILBM's. See the Third Party Specs appendix for more information on CLUT chunks.

1.22 ILBM IFF Interleaved Bitmap / Appendix D. ByteRun1 Run Encoding

The run encoding scheme byteRun1 is best described by pseudo code for the decoder Unpacker (called UnPackBits in the Macintosh(tm) toolbox):

```
  UnPacker:
    LOOP until produced the desired number of bytes
        Read the next source byte into n
        SELECT n FROM
            [0..127]   => copy the next n+1 bytes literally
            [-1..-127] => replicate the next byte -n+1 times
            -128       => no operation
            ENDCASE;
        ENDLOOP;
```

In the inverse routine Packer, it's best to encode a 2 byte repeat run as a replicate run except when preceded and followed by a literal run, in which case it's best to merge the three into one literal run. Always encode 3 byte repeats as replicate runs.

Remember that each row of each scan line of a raster is separately packed.

1.23 ILBM IFF Interleaved Bitmap / Appendix E. Standards Committee

The following people contributed to the design of this FORM ILBM standard:

Bob "Kodiak" Burns, Commodore-Amiga
R. J. Mical, Commodore-Amiga
Jerry Morrison, Electronic Arts
Greg Riker, Electronic Arts
Steve Shaw, Electronic Arts
Dan Silva, Electronic Arts
Barry Walsh, Commodore-Amiga