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Bitmap

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It has been suggested that this article be merged with *Raster graphics*. (Discuss) *Proposed since March 2014.*

For other uses, see Bitmap (disambiguation).

In computing, a **bitmap** is a mapping from some domain (for example, a range of integers) to bits, that is, values which are zero or one. It is also called a bit array or bitmap index.

In computer graphics, when the domain is a rectangle (indexed by two coordinates) a bitmap gives a way to store a binary image, that is, an image in which each pixel is either black or white (or any two colors).

Bitmap image downsampled from an Inkscape vectorial image

The more general term **pixmap** refers to a map of pixels, where each one may store more than two colors, thus using more than one bit per pixel. Often *bitmap* is used for this as well. In some contexts, the term *bitmap* implies one bit per pixel, while *pixmap* is used for images with multiple bits per pixel.[1][2]

A bitmap is a type of memory organization or image file format used to store digital images. The term *bitmap* comes from the computer programming terminology, meaning just a *map of bits*, a spatially mapped array of bits. Now, along with *pixmap*, it commonly refers to the similar concept of a spatially mapped array of pixels. Raster images in general may be referred to as bitmaps or pixmaps, whether synthetic or photographic, in files or memory.

Many graphical user interfaces use bitmaps in their built-in graphics subsystems;[3] for example, the Microsoft Windows and OS/2 platforms' GDI subsystem, where the specific format used is the *Windows and OS/2 bitmap file format*, usually named with the file extension of `.BMP` (or `.DIB` for *device-independent bitmap*). Besides BMP, other file formats that store literal bitmaps include InterLeaved Bitmap (ILBM), Portable Bitmap (PBM), X Bitmap (XBM), and Wireless Application Protocol Bitmap (WBMP). Similarly, most other image file formats, such as JPEG, TIFF, PNG, and GIF, also store bitmap images (as opposed to vector graphics), but they are not usually referred to as *bitmaps*, since they use compressed formats internally.

Contents [hide]

Pixel storage [edit]

In typical uncompressed bitmaps, image pixels are generally stored with a color depth of 1, 4, 8, 16, 24, 32, 48, or 64 bits per pixel. Pixels of 8 bits and fewer can represent either grayscale or indexed color. An alpha channel (for transparency) may be stored in a separate bitmap, where it is similar to a grayscale bitmap, or in a fourth channel that, for example, converts 24-bit images to 32 bits per pixel.

The bits representing the bitmap pixels may be packed or unpacked (spaced out to byte or word boundaries), depending on the format or device requirements. Depending on the color depth, a pixel in the picture will occupy at least **n/8** bytes, where n is the bit depth.

For an uncompressed, packed within rows, bitmap, such as is stored in Microsoft DIB or BMP file format, or in uncompressed TIFF format, a lower bound on storage size for a n-bit-per-pixel (2^n colors) bitmap, in bytes, can be calculated as:

size = width • height • n/8, where height and width are given in pixels.

In the formula above, header size and color palette size, if any, are not included. Due to effects of row padding to align each row start to a storage unit boundary such as a word, additional bytes may be needed.

Device-independent bitmaps and BMP file format [edit]

Main article: BMP file format

Microsoft has defined a particular representation of color bitmaps of different color depths, as an aid to exchanging bitmaps between devices and applications with a variety of internal representations. They called these device-independent bitmaps or DIBs, and the file format for them is called DIB file format or BMP file format. According to Microsoft support:[4]

> A device-independent bitmap (DIB) is a format used to define device-independent bitmaps in various color resolutions. The main purpose of DIBs is to allow bitmaps to be moved from one device to another (hence, the device-independent part of the name). A DIB is an external format, in contrast to a device-dependent bitmap, which appears in the system as a bitmap object (created by an application...). A DIB is normally transported in metafiles (usually using the StretchDIBits() function), BMP files, and the Clipboard (CF_DIB data format).

Here, "device independent" refers to the format, or storage arrangement, and should not be confused with device-independent color.

Other bitmap file formats [edit]

Main article: Image file formats

The X Window System uses a similar XBM format for black-and-white images, and XPM (*pixelmap*) for color images. Numerous other uncompressed bitmap file formats are in use, though most not widely.[5] For most purposes standardized compressed bitmap files such as GIF, PNG, TIFF, and JPEG are used; lossless compression in particular provides the same information as a bitmap in a smaller file size.[6] TIFF and JPEG have various options. JPEG is usually lossy compression. TIFF is usually either uncompressed, or lossless Lempel-Ziv-Welch compressed like GIF. PNG uses deflate lossless compression, another Lempel-Ziv variant.

There are also a variety of "raw" image files, which store raw bitmaps with no other information; such raw files are just bitmaps in files, often with no header or size information (they are distinct from photographic raw image formats, which store raw unprocessed sensor data in a structured container such as TIFF format along with extensive image metadata).

See also [edit]

- Raster graphics
- Raster scan

Computer graphics portal

References [edit]

1. ^ James D. Foley (1995). *Computer Graphics: Principles and Practice*. Addison-Wesley Professional. p. 13. ISBN 0-201-84840-6. "The term bitmap, strictly speaking, applies only to 1-bit-per-pixel bilevel systems; for multiple-bit-per-pixel systems, we use the more general term pixmap (short for pixel map)."
2. ^ V.K. Pachghare (2005). *Comprehensive Computer Graphics: Including C++*. Laxmi Publications. p. 93. ISBN 81-7008-185-8.
3. ^ Julian Smart, Stefan Csomor, and Kevin Hock (2006). *Cross-Platform GUI Programming with Wxwidgets*. Prentice Hall. ISBN 0-13-147381-6.
4. ^ "DIBs and Their Uses". *Microsoft Help and Support*. 2005-02-11.
5. ^ "List of bitmap file types". *Search File-Extensions.org*.
6. ^ J. Thomas, A. Jones (2006). *Communicating Science Effectively: a practical handbook for integrating visual elements*. IWA Publishing. ISBN 1-84339-125-2.

v · t · e **Multimedia compression and container formats** [hide]

Video compression	**ISO/IEC**	MJPEG · Motion JPEG 2000 · MPEG-1 · MPEG-2 (Part 2) · MPEG-4 (Part 2/ASP · Part 10/AVC) · MPEG-H (Part 2/HEVC)
	ITU-T	H.120 · H.261 · H.262 · H.263 · H.264 · H.265
	Others	Apple Video · AVS · Bink · CineForm · Cinepak · Daala · Dirac · DV · DVI · FFV1 · Huffyuv · Indeo · Microsoft Video 1 · MSU Lossless · Lagarith · OMS Video · Pixlet · ProRes 422 · ProRes 4444 · QuickTime (Animation · Graphics) · RealVideo · RTVideo · SheerVideo · Smacker · Sorenson Video, Spark · Theora · VC-1 · VC-2 · VC-3 · VP3 · VP6 · VP7 · VP8 · VP9 · WMV · XEB · YULS
	ISO/IEC	MPEG-1 Layer III (MP3) · MPEG-1 Layer II (Multichannel) · MPEG-1 Layer I · AAC (HE-AAC · AAC-LD) · MPEG Surround · MPEG-4 ALS · MPEG-4 SLS · MPEG-4 DST · MPEG-4 HVXC · MPEG-4 CELP · MPEG-D USAC · MPEG-H 3D Audio

Audio compression	**ITU-T**	G.711 · G.718 · G.719 · G.722 · G.722.1 · G.722.2 · G.723 · G.723.1 · G.726 · G.728 · G.729 · G.729.1
	Others	ACELP · AC-3 · AMR · AMR-WB · AMR-WB+ · ALAC · Asao · ATRAC · CELT · Codec2 · DRA · DTS · EVRC · EVRC-B · FLAC · GSM-HR · GSM-FR · GSM-EFR · iLBC · iSAC · Monkey's Audio · TTA (True Audio) · MT9 · A-law · μ-law · Musepack · OptimFROG · Opus · OSQ · QCELP · RCELP · RealAudio · RTAudio · SD2 · SHN · SILK · Siren · SMV · Speex · SVOPC · TwinVQ · VMR-WB · Vorbis · VSELP · WavPack · WMA
Image compression	**IEC, ISO, ITU-T**	CCITT Group 4 · JPEG · JPEG 2000 · JPEG XR · Lossless JPEG · JBIG · JBIG2 · PNG · TIFF/EP · TIFF/IT · HEVC
	Others	APNG · BPG · DjVu · EXR · GIF · ICER · MNG · PGF · QTVR · TIFF · WBMP · WebP
Containers	**ISO/IEC**	MPEG-PS · MPEG-TS · ISO base media file format · MPEG-4 Part 14 (MP4) · Motion JPEG 2000 · MPEG-21 Part 9 · MPEG media transport
	ITU-T	H.222.0 · T.802
	Others	3GP and 3G2 · AMV · ASF · AIFF · AVI · AU · BPG · Bink (Smacker) · BMP · DivX Media Format · EVO · Flash Video · GXF · IFF · M2TS · Matroska (WebM) · MXF · Ogg · QuickTime File Format · RatDVD · RealMedia · RIFF (WAV) · MOD and TOD · VOB, IFO and BUP
See Compression methods for methods and Compression software for codecs		

Categories: Bit data structures | Graphics file formats