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CGM File Format Summary

Also Known As: Computer Graphics Metafile

Type	Metafile
Colors	Unlimited
Compression	RLE, CCITT Group3 and Group4
Maximum Image Size	Unlimited
Multiple Images Per File	Yes
Numerical Format	NA
Originator	ANSI, ISO
Platform	All
Supporting Applications	Too many to list
See Also	None

Usage

Standardized platform-independent format used for the interchange of bitmap and vector data.

Comments

CGM is a very feature-rich format which attempts to support the graphic needs of many general fields (graphic arts, technical illustration, cartography, visualization, electronic publishing, and so on). While the CGM format is rich in features (many graphical primitives and attributes), it is less complex than PostScript, produces much smaller (more compact) files, and allows the interchange of very sophisticated and artistic images. In fact, so many features are available to the software developer that a full implementation of CGM is considered by some to be quite difficult. Nevertheless, CGM use is spreading quickly.

[Sample images](#) are available for this format.

CGM (Computer Graphics Metafile) was developed by experts working on committees under the auspices of the International Standards Organization (ISO) and the American Standards National Institute (ANSI). It was specifically designed as a common format for the platform-independent interchange of bitmap and vector data, and for use in conjunction with a variety of input and output devices. Although CGM incorporates extensions designed to support bitmap (called raster in the CGM specification) data storage, files in CGM format are used primarily to store vector information. CGM files typically contain either bitmap or vector data, but rarely both.

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The newest revision of CGM is the CGM: 1992 standard, which defines three upwardly compatible levels of increasing capability and functionality. Version 1 is the original CGM: 1987 standard, a collection of simple metafile primitives. Version 2 metafiles may contain Closed Figures (a filled primitive comprised of other primitives). Version 3 is for advanced applications, and its metafiles may contain Beziers, NURBS, parabolic and hyperbolic arcs, and the Tile Array compressed tiled raster primitive.

CGM uses three types of syntactical encoding formats. All CGM files contain data encoded using one of these three methods:

- Character-based, used to produce the smallest possible file size for ease of storage and speed of data transmission
- Binary encoded, which facilitates exchange and quick access by software applications
- Clear-text encoded, designed for human readability and ease of modification using an ASCII text editor

CGM is intended for the storage of graphics data only. It is sometimes (erroneously) thought to be a data transfer standard for CAD/CAM data, like IGES, or a 3D graphic object model data storage standard. However, CGM is quite suited for the interchange of renderings from CAD/CAM systems, but not for the storage of the engineering model data itself.

CGM supports and is used by the Graphical Kernel System (GKS) standard, but is something completely different. GKS, which is in fact an API graphics library specification, is often mistaken for a graphics file format. CGM has found a role on most platforms as a method for the transfer of graphics data between applications. Programs that support CGM include most business graphics and visualization packages and many word processing and CAD applications.

Vector primitives supported by Version 1 CGM metafiles include lines, polylines, arcs, circles, rectangles, ellipses, polygons, and text. Each primitive may have one or more attributes, including fill style (hatch pattern), line or edge color, size, type, and orientation. CGM supports bitmaps in the form of *cell arrays* and *tile arrays*. The logical raster primitives of CGM are device-independent.

A minor point, but one worth noting, is that the three flavors of encoding supported by CGM may not all be readable by all software applications that import CGM files. Despite the existence of a solid body of rules and encoding schemes, CGM files are not universally interchangeable.

Many CGM file-writing applications support different subsets of standard features, often leaving some features out that may be required by other CGM readers. Also, because CGM allows vendor-specific extensions, many (such as custom fills) have been added, making full CGM support by an application difficult.

The CGM: 1987 standard included a "Minimum Recommended Capabilities" list to aid developers in implementing a CGM application capable of reading and writing CGM metafiles correctly. Unfortunately, some of the big manufacturers chose to ignore even these modest requirements. Therefore, because it is impossible to police everyone who implements CGM in an application, many incompatibilities do exist.

In an effort to improve compatibility, the CGM: 1992 standard removed the "Minimum Recommended Capabilities" list in anticipation of the publication of the CGM Amendment 1, which defines more stringent conformance requirements and a "Model Profile," which could be considered a minimal useful implementation level. Amendment 1 is entitled "Conformance, Rules for Profiles, and the Model Profile." Amendment 2, "Application Structuring," in the publication process as we go to press, provides the ability to "tag," reference, and index collections of elements with application significance. Modeled after SGML, the new features provide a way to "object structure" a metafile. (A 3D metafile project is also underway.)

File Organization and Details

All CGM files start with the same identifier, the BEGIN METAFILE statement, but its actual

appearance in the file depends on how the file is encoded. In clear-text encoding, the element is simply the ASCII string BEGMF. If the file is binary encoded, you must read in the first two bytes as a word; the most significant byte (MSB) is followed in the file by the least significant byte (LSB). Bits in this word provide the following information:

15-12: Element class

11-05: Element ID

04-00: Parameter list length

BEGIN METAFILE is a "Delimiter Element," making it class 0. The element ID within that class is 1. The parameter list length is variable, so it must be ANDed out when comparing. The bit pattern is then:

```
0 0 0 0 0 0 0 0 0 0 1 x x x x x
```

To check it, simply AND the word with 0XFFE0 and compare it with 0X0020. In reading the standard, we get the impression that it is actually legal to add padding characters (nulls) to the beginning of the file. We rather doubt that anyone would actually do this, but it may be appropriate to read in words until a non-zero word is read and compare this word. You can read in full words because all elements are constrained to start on a word boundary.

For Further Information

CGM is both an ANSI and an ISO standard and has been adopted by many countries, such as Australia, France, Germany, Japan, Korea, and the United Kingdom. The full ANSI designation of the current version of CGM is:

Information Processing Systems--Computer Graphics Metafile for the Storage and Transfer of Picture Description Information, ANSI/ISO 8632-1992 (commonly called CGM: 1992).

Note that CGM:1992 is the current standard. Be careful not to obtain the earlier ANSI X3.122-1986 if you need the latest standard. This earlier document, CGM:1986, defining the Version 1 metafile, was superseded by ISO/IEC 8632:1992. ANSI adopted CGM:1992 without modification and replaced ANSI X3.122-1986 with it. The CGM standard is contained in four ISO standards documents:

ISO 8632-1 Part 1: Functional Specification

ISO 8632-2 Part 2: Character Encoding

ISO 8632-3 Part 3: Binary Encoding

ISO 8632-4 Part 4: Clear Text Encoding

These may be purchased from any of the following organizations:

International Standards Organization (ISO)

1 rue de Varembe

Case Postal 56

CH-1211 Geneva 20 Switzerland

Voice: +41 22 749 01 11

FAX: +41 22 733 34 30

American National Standards Institute (ANSI)

Sales Department

1430 Broadway

New York, NY, 10018

Voice: 212-642-4900

Canadian Standards Association (CSA)

Sales Group

178 Rexdale Blvd.

Rexdale, Ontario, M9W 1R3

Voice: 416-747-4044

Other countries also make the CGM specification available through their standards organizations; these include DIN (Germany), BSI (United Kingdom), AFNOR (France), and JIS (Japan).

The National Institute of Standards and Technology (NIST) has set up a Web page for CGM at:

http://speckle.ncsl.nist.gov/~lsr/cgm_std.htm

NIST has also set up a CGM Testing Service for testing CGM metafiles, generators, and interpreters. The Testing Service examines binary-encoded CGM files for conformance to Version 1 CGM, as defined in the application profiles of FIPS 128-1 and the DoD CALS CGM AP military specification MIL-D-28003A. You can purchase the testing tool used by NIST so you can do internal testing on various PC and UNIX systems.

For more information about the CGM Testing Service, contact:

National Institute of Standards and Technology (NIST)
Computer Systems Laboratory
Information Systems Engineering Division
Gaithersburg, MD 20899
Voice: 301-975-3265

You can also obtain information about CGM from the following references:

Arnold, D.B. and P.R. Bono, *CGM and CGI: Metafile and Interface Standards for Computer Graphics*, Springer-Verlag, New York, NY, 1988.

Arnold, D.B. and P.R. Bono, *CGM et CGI: normes de metafichier et d'interfaces pour l'infographie*, French translation and updating of the above reference, Masson, 1992.

Henderson, L.R., and Gebhardt, "CGM: SGML for Graphics," *The Gilbane Report*, Fall 1994.

Henderson, L.R., and A.M. Mumford, *The CGM Handbook*, Academic Press, San Diego, CA, 1993.

Bono, P.R. , J.L. Encarnacao, L.M. Encarnacao, and W.R. Herzner, *PC Graphics With GKS*, Prentice-Hall, Englewood Cliffs, NJ, 1990.

There are also two amendments to this specification:

- Amendment 1. Conformance, Rules for Profiles, and Model Profile.
- Amendment 2. Application Structuring.

For additional information online, see:

<http://www.agocg.ac.uk:80/agocg/cgm.html>

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