

PNG

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COLLABORATORS

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Contents

1	PNG	1
1.1	PNG DataType	1
1.2	Installation	2
1.3	The PNG Format	2
1.4	PNG Letter	3
1.5	From GIF to PNG	5
1.6	PNG Specification	17
1.7	GIF to PNG ARexx Script	17
1.8	GIF to PNG ARexx Script - Comments	19
1.9	DataTypes	21
1.10	C Source Code	21
1.11	Personal Paint	28
1.12	Orders	30
1.13	Distributors	31
1.14	Legal Notes	32
1.15	Cloanto	34

Chapter 1

PNG

1.1 PNG DataType

PNG and the PNG DataType v. 1.0, by Cloanto ¹

When we heard news that several, very popular, graphics formats were menaced by software patents, at Cloanto we took a strong position in favor of a new, improved format: PNG (Portable Network Graphics).

We are presenting here a PNG DataType for the Amiga, some background information on PNG, sample source code to use DataTypes and an ARExx script to automatically find GIFs and convert them to PNG. As the creators of Personal Paint, we've also included some information on that program.

The DataType supports all types of PNG-encoded images. Grayscale images are converted to palette-based images. True color (up to 48-bit) images are dithered using a fast Floyd-Steinberg method. (More professional color quantization options are available in Personal Paint.)

This DataType also reads the Author, Copyright and Comment fields (DTA_ObjAuthor, DTA_ObjCopyright and DTA_ObjAnnotation DataType attributes). The included source code shows how to read this information.

The Legal Notes contain a distribution license and other information.

Your feedback is very appreciated.

For more information:

Installation

PNG

DataTypes

Personal Paint

Cloanto

Legal Notes

^1\$ The material presented here and the name Cloanto are ↔
respectively

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1.2 Installation

Installation

The PNG DataType can be installed with a double-click on the included Installer icon. This automatic installation procedure uses the Amiga Installer program, which must be stored in the SYS:Utilities directory of your system. Manual installation is described in the following lines.

The PNG DataType can be installed by copying PNG to DEVS:DataTypes, and png.datatype to SYS:Classes/DataTypes. If the files are copied using Shell commands, the PNG icon file ("PNG.info") must also be copied manually (to DEVS:DataTypes).

Users of Amiga systems with a 68020 or higher CPU can install a special version of the DataType, written to take advantage of new features of these more powerful CPUs. This file is named "png.datatype.020", and must be renamed to "png.datatype" once installed SYS:Classes/DataTypes. (This is also taken care of by the automatic installation script.)

For more information:

PNG

DataTypes

1.3 The PNG Format

The PNG Format

The PNG (Portable Network Graphics) file format was designed as a replacement and extension to GIF and LZW-based TIFF, after Unisys Corporation began demanding royalties on GIF/LZW code.

PNG is gaining general recognition as the best lossless format for storing digital images. (JPEG remains recommended for storing real world images where minimum storage occupation is a priority and loss of information is acceptable.) PNG has the potential to replace both GIF and TIFF, and as a unifying force it should attract more attention beyond that.

For more information:

PNG Letter

Article

PNG Specification

GIF to PNG ARexx script

1.4 PNG Letter

Graphics Community Endorses a New File Format

May 1, 1995. A coalition of major software developers, publishers and technical writers announced today its endorsement for the new PNG graphics format. PNG (Portable Network Graphics, pronounced "ping") is a flexible and open format for storing bitmapped graphics images. This effort began in late 1994, when CompuServe and Unisys stunned the online world by announcing that royalties would be required on the formerly freely used GIF file format.

Several companies claim a patent on the LZW compression algorithm, which is an integral part of the GIF file format. Unisys is now requiring developers, publishers, and vendors to pay royalties on any software that either creates or displays GIF files. In response to this announcement, developers hastened to replace the GIF file format with an improved royalty-free format. A coalition of experienced independent graphics developers from the Internet and CompuServe formed a working group and proceeded to design the new format. The result is the PNG format.

PNG is a major advance over the venerable GIF format. By adopting PNG, you would not only be helping the computer graphics community free itself from the Unisys patent, but you would be enjoying the advantages of a powerful new graphics file format. Converting your GIF collections to PNG offers the following benefits:

- * PNG retains GIF's strength as a simple and portable graphics format.
 - * PNG's compression method has been thoroughly researched and judged free from patent problems.
 - * PNG allows support for true color and alpha channel storage. Its extensible structure leaves room for future requirements.
 - * PNG's feature set allows conversion of all GIF files.
 - * On average, PNG files are smaller than GIF files.
 - * PNG offers a new, more visually appealing, method for progressive display than the scanline interlacing used by GIF.
 - * PNG is designed to support full file integrity checking as well as simple, quick detection of common transmission errors.
-

* Implementations of PNG are royalty-free.

The advantages of making PNG an industry-standard file format are clear. We are now presented with a rare opportunity to move forward in the area of royalty-free graphics display and archiving software. Please help with the adoption of PNG by supporting it as your preferred graphics file format. For more information, source code, file specifications, developer tools, and freeware file converters, you can contact the comp.graphics Internet newsgroups or the Graphics Support Forum on CompuServe (GO GRAPHSUP). For files, check the ftp.uu.net:/graphics/png directory, or email png-info@uunet.uu.net.

Thank you for supporting this project.

Signed by:

Michael Abrash, author, Zen of Graphics Programming
Michael Console Battilana, Cloanto (Personal Paint/Write, etc.)
Bradley Bell & Elizabeth Piegari, TriSoft (Depth Dwellers)
Andrei Belogortseff, ChaoSoft (FM StepUp, FM Toolbar, FM Guard, etc.)
C. Steven Blackwood, Cytherean Adventures (Cargo Bay)
Robert K. Blaine, ECONO-SOFT
John Bradley, author of XV
John Bridges, author of GRASP, PC Paint and PICEM
Rick Byrnes, The Software Development Group (NoteWorthy, MoneyWise, Eventz, and various shareware products.)
Tony Caine, ARCaine Technology
George Campbell, OsoSoft (Winclip, etc.)
Mike Ceranski, President, Dvorak Development
Lee Crocker (Piclab, PGIF, GTools)
Karen Crowther, Redwood Games (Math Rescue, Word Rescue, Pickle Wars)
E. Nicholas Cupery, Farba Research (Farba Utilities (tm))
Thomas Boutell, author of the gd library and the World Wide Web FAQ
Gary Elfring, Elfring Soft Fonts (Clip Art)
Steve Estvanik, Cascoly Software (Winzle, Windows in Time, MVP Bridge)
Jim Faliveno, Monumental Computer Applications, Inc. (TagVue-CaddView)
Dan Farmer, POV-Team (POV-Ray)
Oliver Fromme, TBH-Softworx (QPEG, PicDex)
John Gallant, First Magnitude (3-Ball Juggler, Beat the Bomb, Math Sampler)
Lawrence Gozum, author (VIDVUE)
Phil Grenetz, Ivden Technologies
Diana Gruber, Ted Gruber Software, Inc. (Fastgraph)
David Hofmann (Computer Graphics Artist, Germany)
Michael D. Jones, Insight Software Solutions (Finance/Hobbies/Word Games)
Lutz Kretzschmar, coauthor of Ray Tracing Worlds (Moray)
Tom Lane, organizer, Independent JPEG Group (IJG JPEG software)
Steve Lee (Atlantic Coast plc)
Ralph Mariano @ STReport International Online Magazine
David K. Mason, author of Morphing on Your PC, coauthor of Making Movies on Your PC (DTA, DFV, DMorf)
Randy Maclean, Formgen Corp.
Brad McLane, Caladonia Systems Inc. (Code.Print, ToolThings)
Al Meadows/Fineware Systems (Author of Space Hound, Peeper, etc.)
Scott Miller, Apogee Software, Sultans of Shareware
Jeff Napier, Another Company (Computer Magic)
Peter Nielsen, Raja Thiagarajan, Julie England (PMView & PMSnap for OS/2)

David Noakes, Fugue Software
Dick Oliver, author of PC graphics books and software including
Tricks of the Graphics Gurus, PC Graphics Unleashed, and FractalVision
Dan Richardson, illustrator, author of Create Stereograms on Your PC
John Richardson, Rogue Marketing (Amazing Secrets Series, Gambling
Secrets, JobDisk)
Steve Rimmer, Alchemy Mindworks Inc. (Graphic Workshop, etc.)
Greg Roelofs, Info-ZIP (Zip, UnZip and related utilities)
Guy Eric Schalnatt, Group 42 (PNGLIB, GraphX Viewer)
Paul Schmidt, Photodex Corporation, GDS (The Graphics Display System)
Monty Shelton, CrystalWorks (EZCosmos, SIRDS for NIRDS, Language Wiz)
Steve Sneed, Ozarks West Software, Inc. (OzCIS, OzWin, OZBEXT/OZGIF)
David Snyder, MVP Software (MVP Paint)
Chuck Steenburgh, Tay-Jee Software (Palantir for DOS & Windows, S.O.S.)
Peter Tiemann (author of TrueBase)
Glen Tippetts, NeoSoft Corporation (NeoPaint, NeoBook, etc.)
Rod Underhill, Computer Fine Artist (CIS Comic Forum's Underhill Gallery)
John Wagner (Improces)
Bruce F. Webster, Pages Software Inc (WebPages by Pages)
Tim Wegner, author of Image Lab and Fractal Creations (Fractint)
Rosemary West, R. K. West Consulting (By The Numbers, LoveDOS, etc.)
Thomas R. White, Recreational Engineering Associates (MultiMedia Swiss
Army Knife)
Charles L. Wiedemann, REXXcom Systems (XL2001, E-Z-Book, etc.)
Terry Wilkinson, CIO, AffNet Publishing
Ben Williams, Black Belt Systems Inc. (WinImages, Imagemaster, etc.)
Jeff Woods, deltaComm Development, Inc. (Telix for Windows)

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1.5 From GIF to PNG

The GIF Controversy: A Software Developer's Perspective

January 27, 1995 - Text revision 2 - March 31, 1995
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Parts are excerpted from the PNG specification

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Abstract

Introduction

Software Patents

10 Years of LZW

December 29, 1994 - The Days After

Reference

Bibliography

Abstract

During the past eight years, GIF (Graphics Interchange Format) peacefully became the most popular file format for archiving and exchanging computer images. At the end of December 1994, CompuServe Inc. and Unisys Corporation announced to the public that developers would have to pay a license fee in order to continue to use technology patented by Unisys in certain categories of software supporting the GIF format. These first statements caused immediate reactions and some confusion. As a longer term consequence, it appears likely that GIF will be replaced and extended by the new PNG (Portable Network Graphics) format.

Introduction

This is a very interesting case, which could teach more than one lesson on the theory and practice of software and the laws. There are many entities involved. Fingers have been pointed at lawmakers, Unisys, CompuServe and developers. In theory, it may have been possible for any or all of these parts to prevent the matter from creating so much anxiety in the first place. Yet we are all here, debating on this issue. This article intends to provide a collection of information from the history of the controversy to the most recent events, as they were perceived by a software developer.

CompuServe released GIF as a free and open specification in 1987. GIF soon became a world standard, and also played an important role in the Internet community. It was well supported by CompuServe's Information Service, but many developers wrote (or acquired under license) software supporting GIF without even needing to know that a company named CompuServe existed. GIF was relatively simple, and very well documented in books, articles and text files.

GIF images are compressed to reduce the file size. The technique used to compress the image data is called LZW (after Lempel-Ziv-Welch) and was first described by Terry A. Welch in the June 1984 issue of IEEE's Computer magazine. Unisys holds a patent on the procedure described in the article, but the article describing the algorithm had no mention of this. The LZW procedure was simple and very well described, and it soon became a very popular technique for data compression (just as GIF would become a standard in its own field). It appears that neither CompuServe, nor the CompuServe Associate who designed GIF, nor the computer world in general

were aware of the patent. GIF is not alone in the use of LZW. The TIFF file specification also includes LZW-compression among its compression methods, and so do dozens of very popular file archiving programs (such as Compress).

While having the right to pursue legal action or seek damages against infringing LZW developers and publishers, Unisys has so far been very accomodating and fair. It is likely that the success of LZW and its thousands of implementations, especially among small developers, caught Unisys unprepared. Otherwise, it would be difficult to understand how Unisys could first allow a very large number of small and big developers to use LZW for years, and then, after the establishment of various standards based on LZW, change its attitude.

The original CompuServe/Unisys licensing agreement text which had upset so many developers was immediately followed by clarifications from both CompuServe and Unisys. Given that the online community tends to be suspicious about anything that is big, has a legal department or owns software patents, Unisys had to face a particularly delicate challenge. But it probably wasn't easier for CompuServe, who had to explain the patent issue to its own developers, some of whom felt "betrayed". The outside world would learn about this issue from the press in the following days.

Even Time Magazine reported about this matter, although like most of the newspapers it concentrated on GIF more than on TIFF, LZW, Unisys or software patents. In the meantime, a group of leaders of the online graphics community began working on a patent-free future of GIF. These efforts would later converge into the PNG specification. The full texts of official statements from CompuServe and Unisys are also included at the end of this article (see
Reference
).

Among the first reactions, some bulletin board systems had all GIF files deleted from their hard disks (or converted into JPEG format). Common remarks included:

"PROTEST OF NEW COMPUSERVE-UNISYS GIF USAGE TAX !!"

"They [CompuServe] seem to think that GIF is the greatest thing since free online magazines."

"The announcement by CompuServe and Unisys that users of the GIF image format must register by January 10 and pay a royalty or face lawsuits for their past usage, is the online communications community's equivalent of the sneak attack at Pearl Harbor."

These reactions may require some clarification.

Unisys, and not CompuServe, has been "trying to impose" a royalty. The problem is not specific to GIF, but includes TIFF and archiving software.

GIF files are not covered by the patent. There is no risk in distributing GIF files or in using the GIF name. According to a CompuServe spokesperson,

"Recent discussions of GIF taxes and fees are totally without merit. For people who view GIF images, who keep GIF images on servers, or who are creating GIF images for distribution, the recent licensing discussions have no effect on their activities."

Only the software employing the LZW algorithm for writing GIF files is "at risk". The Unisys patent includes claims which specifically cover the decompression of LZW-compressed material, so it may also affect simple GIF readers. Several patent attorneys consulted on this matter have concluded that decompression-only programs do not infringe upon the Unisys patent. Unisys however does not appear to share this opinion.

A format such as JPEG cannot be used as a substitute for GIF. Unlike GIF (and PNG), JPEG was designed as a "lossy" format. This means that it slightly changes an image as it is compressed. This is unacceptable for many applications. Also, while JPEG excels in compressing real world true color images, it offers no support for palette-based images.

The CompuServe licensing agreement was intended as a voluntary service to the few dozen developers creating software for use primarily in conjunction with the CompuServe Information Service (CIS). This includes applications such as CompuServe "navigators", but does not apply to general purpose GIF readers/writers (which are not intended for use primarily in conjunction with CIS).

On January 27, 1995, Unisys announced new licensing policies regarding "The Welch Patent". These include a .45% royalty on the total unit selling price of GIF/LZW products (minimum \$0.10, maximum \$10.00 per unit) and a .65% royalty on GIF/TIFF/LZW products (minimum \$0.20, maximum \$25.00). For further information and a copy of the written agreement it is possible to call Unisys at +1 215 986-4411, or send E-mail to <lzw_info@unisys.com>.

Any organization using LZW should look at whether they have an infringement on Unisys' patent. CompuServe is not involved in any of these discussions - they are between Unisys and outside developers.

Software Patents

Normally, procedures such as LZW are published in magazines so that they can be shared by the community of software developers. LZW itself is a refinement of other algorithms published in the years before (Ziv-Lempel and others). Software is usually protected by copyright law, but in recent years (since 1981 in the USA) in several countries it has become possible to patent software. Initially, only software used to control hardware could be patented. This interpretation was soon extended to include all types of software (except for "pure mathematical algorithms"). While software patents have become an opportunity for many, they remain a controversial danger for others. Any programmer or publisher might be trapped at any time by a patent infringement claim that could not be foreseen or avoided.

Publication of an algorithm in a magazine does not automatically exclude a patent application. In many countries, including the USA, it is possible to apply for a patent and still publish the paper without mention of the application. In the USA (but not in many other countries), the patent application may even be filed within 12 months of the publication. Under

such regulations, the only algorithms that might be used freely and without risk would be those published prior to 1981 (e.g. Donald Knuth's "The Art of Computer Programming").

Today, even designing a graphics file format can become a programmer's nightmare. One very active member of the Internet community (and author of the GZIP compressor) has collected information on more than 350 patents on lossless data compression and 100 on lossy image compression. Lempel, Ziv, Cohn and Eastman patented their original LZ78 algorithm (US patent 4,464,650). The LZW algorithm which is now attracting so much attention is patented by both IBM (4,814,746) and Unisys (4,558,302), while British Telecom (BT) holds a similar patent. The IBM patent application was filed three weeks before that of Unisys, but the US patent office apparently failed to recognize that they covered the same algorithm. (The IBM patent is more general, but its claim 7 is said to be exactly LZW.)

10 Years of LZW

While the original article on LZW was published in 1984, the LZW patent issue first surfaced in the press in 1989, when the BTLZ algorithm (a procedure similar to LZW developed and patented by British Telecom) was to be approved for data compression into the V.42bis modem standard. Unisys said on at least one occasion that it first began to learn of the widespread use of LZW in connection with the development of this standard. The first licensing arrangements put into place included those with modem manufacturers (\$ 20,000 for each one-time license) and with Adobe PostScript developers (\$ 10,000).

An article on "LZW Data Compression" was published in the October 1989 issue of Dr. Dobb's Journal (see the

Bibliography
section for more

details). A reader replied in the December issue explaining that the algorithm was patented. The author of the article added that he was unaware of any patent on the algorithm. More readers wrote, and in the March 1990 issue the editor-in-chief dedicated his Editorial to this topic, which in his words "sparked a forest of fires". The same issue also contained an official statement by Unisys Corporation, which confirmed that LZW was patented, mentioned the modem industry, and indicated how developers could contact Unisys.

In the October 2, 1989 issue of PC Week a columnist wrote:

"Alas, there's no consolation for developers of archiving programs that rely on the LZW data-compression algorithm. While cruising the bulletin boards last week, Spencer learned that Unisys has a patent on the algorithm, upon which a slew of data-compression programs are based. Watch out."

In about the same period, an article in InfoWorld mentioned the fact that modem manufacturers were facing the possibility of having to pay royalties to Unisys and to other patent holders for the right to use LZW.

Page 132 ("LZWEncode Filter") of the PostScript Language Reference Manual, Second Edition, published in December 1990, contains the address of the Welch Licensing Department at Unisys Corporation.

In the March 1991 issue of Byte, Steve Apiki ("Lossless Data Compression") explained that LZW is used in GIF, and that "The [LZW] algorithm itself is patented by Sperry [now Unisys]."

At this point, at least the readers of some publications were potentially aware of the LZW patent. But still, there were few links to GIF. Unisys apparently didn't know about GIF, nor did most GIF developers know that GIF contained LZW technology. And those who may have known, not necessarily knew about the patent.

This issue was also discussed among a small group of the better informed members of the CompuServe PICS Forum (now GRAPH SUP). The general feeling at that time was that "Unisys only intends to get royalties from hardware vendors," and there was some consensus on the idea that Unisys "wouldn't do anything about pure software implementations".

Until the end of 1994, discussions on CompuServe's Information Service showed no clear mention of the requirement to get a license from Unisys for using LZW in GIF applications. During 1988 at least one developer stopped working on GIF tools because of considerations regarding the LZW patent, and reportedly "made CompuServe aware of it". This apparently was limited to private verbal conversations, and information on this behalf could be found neither in the press nor in CIS.

Among the developers who contacted Unisys between the end of 1990 and the beginning of 1991, there was at least one GIF developer. He recently described his experience:

"Finding the right person was the most difficult part of licensing LZW, but hopefully it's easier today (perhaps only 5 phone calls would be needed!)... When talking to Unisys back then, my recollection is that we had to basically tell the people at Unisys, 'Believe me, you DO own a patent on LZW; who do we talk to about LICENSING?' When we finally reached the licensing/legal department, THEY knew they had a patent, and spelled out the terms. I recall the person we were dealing with saying something like, 'They [Unisys] laugh when I make all these \$1 deals, but we have to charge something to protect the patent.'"

In those days, the standard license fee for PC-based software products was \$1 per copy sold (or a 1% royalty), after a \$100 advance payment. Apparently, Unisys still didn't know that GIF was based on LZW. In January 1995, Unisys stated: "Two years ago, Unisys learned that the LZW method was incorporated in the GIF specification and immediately began negotiations with CompuServe in January of 1993. We reached agreement with CompuServe on licensing the technology in June 1994..."

Two years before the Unisys statement, at the end of 1992, Cloanto, an Italian software house, contacted Unisys because it was interested in a license for the possible use of LZW in its PostScript Level 2 drivers. That correspondence also mentioned GIF and TIFF as using LZW, and anticipated some of the controversies which would follow 25 months later. Unisys replied: "... You raise a number of interesting issues which require consideration..."

While disclosing the full contents of this correspondence would probably

not serve anyone's interest, the text of two letters sent to Unisys in 1992 is included at the end of this article, because the author feels that this 1992 perspective could complement the article with a few interesting ideas. The letters have not been edited, so some details (such as the reference to ZIP) may be incomplete with respect to current knowledge.

Unisys offered Cloanto a \$.25 per unit royalty (1% of the net income) as an alternative to the PostScript one-time license, but did not answer the question raised by Cloanto: "If we implemented a software GIF or TIFF image file loader and saver (both formats are based on the LZW algorithm), would we need a license from Unisys Corp., as far as U.S. Patent 4,558,302 is concerned?". According to public statements, Unisys did however contact CompuServe the following month.

December 29, 1994 - The Days After

Between 1993 and 1994, the majority of developers still didn't know that GIF employed a patented algorithm, although both Unisys and CompuServe were aware of this (as the developers would learn in December 1994). Different opinions have been expressed on this. Some developers feel that reaching an agreement behind the scenes was the least destructive thing that could be done. Other (at times passionate) opinions picked up on electronic media are similar to these three:

"Consider this. CompuServe admits to knowing about patent problems with the GIF file format as early as January of 1993. ... We added GIF support to Fastgraph months after CompuServe admits knowledge of the patent problem... We relied on the information that was supplied to us by CompuServe. If CompuServe had told us the truth when they knew it, we never would have added GIF support..."

"If I chose to put GIF encode/decode functions in my software development toolkits, my main threat of legal liability would not come from Unisys, but rather from one of my customers being sued by Unisys, who would turn around and sue me for selling them some code that contained patented algorithms."

"I still don't have a clue what my situation is if I want to sell source and object code that imports and exports GIF images. I am not in the end-user app business, but my customers are, and they certainly will have to have an LZW license, but what about me? I've talked with Unisys by voice and E-mail, and the voice discussion was entirely unsatisfactory as I posted when it happened - basically the Unisys guy said anyone who sells code for \$100-\$300 a pop was a total _____ for selling it that cheap. The E-mail discussions I've had said 'OK - we hear you - we'll get back to you.' Never happened."

Unisys replied in part with reassuring clarifications to the general public, explaining that if the software was developed prior to 1995, or if it is public domain or freeware, the developer need not to worry:

"... Unisys does not intend to pursue previous inadvertent infringement by versions of GIF-based software products marketed prior to 1995... Unisys does not require licensing, or fees to be paid, for non-commercial, non-profit GIF-based applications,

including those for use on the online services... Commercial developers... are expected to secure a licensing agreement with Unisys for software products introduced beginning in 1995, or enhancements of products that were introduced prior to 1995."

However, these statements were followed by far more restrictive interpretations. It soon became clear that Unisys could be demanding royalties for everything "manufactured" after 1994. One developer contacted Unisys and reported:

"I called the Unisys lawyer you referred me to and he confirmed this position. Even a book or CD containing *pre 1995* freeware is subject to royalties if the disk is put together in 1995... Royalties must be collected *again* for each update release."

While the new Unisys licensing policies (announced on January 27, 1995) enabled many software publishers to again ship their products after a month-long pause, other developers preferred to wait, hoping for a patent-free evolution of GIF. Comments included:

"What if I sign up and then they announce a new GIF specification which does not use LZW?"

"Labeling and user notification requirements in the agreement are ridiculous. I understand their desire to 'spread the word' about their patent, but they're telling me that I have to provide far more info on their ownership of the patent than they require in the docs/packaging of modem manufacturers and other users of LZW. Fair is fair. A blurb in the online help and docs should be sufficient; a 'non-defeatable' splash screen at startup is going too far."

"Unisys is attempting to control how we (and other shareware authors) do business, and to make us billboards for their LZW patent... By making me tell my users how many security backups they can make, etc., they're telling me how to run my business and how to interface with my customers."

"Imagine the nightmare of having to pay royalties to 10 patent holders, each of whom tells you how to run your business..."

"Unisys has given us a chance to work together to change the system - rather than waiting to be sued one by one for this patent or that. We can win the fight against software patents, if we speak loud and clear against them."

Some of the most active developers decided to collaborate on the design of a patent-free evolution of GIF (and TIFF's LZW compression mode). A variety of different procedures and data structures (such as Shannon-Fano and AVL trees) have been used to compress data in ways similar, if not equivalent, to LZW. But this diversity apparently does not escape the patent. As one expert said, "If the output data is GIF, the compressor infringes the Unisys patent regardless of the algorithm."

On January 16, 1995, CompuServe declared its intention to coordinate the development of GIF24, a freely usable successor to GIF capable of 24-bit lossless compression. Several developers invested a lot of time and

energies to solve the Unisys patent problem, and rapidly worked out different modifications to the GIF specification. One of the better known efforts was the project for a "GEF" graphics-exchange format. GEF and GIF24 converged into PNG (official abbreviation of "Portable Network Graphics", unofficially "Png is Not Gif").

The open architecture of PNG preserves the simplicity that made GIF so popular, and adds features such as true color. Test results indicate that PNG is capable of (losslessly) compressing true color images better than any other widely used image format. It is also more effective than GIF in storing palette-based images. (More information on PNG is included in the Reference and Bibliography sections.)

At the end, it appears that if so many efforts converge into a new, improved standard, we still have to give part of the credit to the LZW patent...

The author of this text can be contacted at <mcb@cloanto.it>. Any comments, or experience you would like to share, would be very appreciated.

Reference

If the excerpts from the PNG specification are not included here in order to keep the file size reasonable ("lossy compression"), please check for another file accompanying this text (suggested file name: "giflzw2.txt"), or send E-mail to <gltext2@cloanto.it> before June 30, 1995. The latest hypertext version of the full document is available on the World Wide Web: <URL:http://sunsite.unc.edu/boutell/png.html>

Excerpts from the PNG (Portable Network Graphics) Specification,
Ninth Draft - Revision date: 7 March, 1995

[The text is not included here - Newer versions are available]

If the official texts from CompuServe and Unisys are not included here in order to keep the file size reasonable, please check for another file accompanying this text (suggested file name: "giflzw2.txt"), or send E-mail to <gltext2@cloanto.it> before June 30, 1995.

AGREEMENT FOR USE OF GRAPHICS INTERCHANGE FORMAT (SM)

[The text of the Graphics Interchange Format (GIF) Developer Agreement, released by CompuServe on December 29, 1994 is not included here. It became obsolete when Unisys announced its new licensing policies regarding "The Welch Patent" on January 27, 1995.]

%: 174559 S19/GIF/LZW Discussion [GRAPHSUP]
04-Jan-95 17:07:50
Sb: #GIF/LZW Clarification
Fm: Larry Wood 76703,704
To: All

[The text is not included here]

#: 181065 S3/Hot News and Rumor
07-Jan-95 19:12:19
Sb: #Unisys GIF Clarification
Fm: Steve Ahlstrom/SYSOP 76703,2006
To: All

[The text is not included here]

From: rmarks@ecdcsvr.tredydev.unisys.com (Richard Marks)
Date: Fri, 6 Jan 1995 22:09:14 GMT

Unisys LZW Patent FREQUENTLY ASKED QUESTIONS January 6, 1995

[The text is not included here]

If the texts of the two letters are not included here in order to keep the file size reasonable, please check for another file accompanying this text (suggested file name: "giflzw2.txt"), or send E-mail to <gltext2@cloanto.it> before June 30, 1995.

From Cloanto/Unisys - November 6, 1992

[The text is not included here]

From Cloanto/Unisys - November 12, 1992

[The text is not included here]

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PNG (Portable Network Graphics)
Information and support material available from:
Internet comp.graphics Newsgroups
Internet comp.sys.graphics Newsgroup
CompuServe Graphics Support Forum (GO GRAPHSUP)
Via FTP from <ftp://godzilli.cs.sunysb.edu/pub/ngf>
The PNG specification is also available on the World Wide Web:
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Special thanks to Dave, David, Diana, Frank, Jason, Jean-loup, Jon, Kevin, Larry, Pierce, Richard, Tim, Tom and many others for their precious help.

1.6 PNG Specification

PNG (Portable Network Graphics) Specification

Information and support material is available from:

Internet comp.graphics Newsgroups
Internet comp.sys.graphics Newsgroup
CompuServe Graphics Support Forum (GO GRAPHSUP)
Via FTP from <ftp://godzilli.cs.sunysb.edu/pub/ngf>

The PNG specification is also available on the World Wide Web:

<URL:http://sunsite.unc.edu/boutell/png.html>

1.7 GIF to PNG ARexx Script

```
/* GifToPng.pprx - PPaint ARexx Script - Copyright © 1995 Cloanto ←  
   Italia srl  
  
$VER: GifToPng.pprx 1.0  
  
   More Comments  
*/  
  
MYPOR = 'PPAINT'  
  
IF ~SHOW('P', MYPOR) THEN DO  
  IF EXISTS('PPaint:PPaint') THEN DO  
    ADDRESS COMMAND 'Run >NIL: PPaint:PPaint'  
    DO 30 WHILE ~SHOW('P', MYPOR)  
      ADDRESS COMMAND 'Wait >NIL: 1 SEC'  
    END  
  END  
ELSE DO
```

```

        SAY "Personal Paint could not be loaded."
        EXIT 10
    END
END

IF ~SHOW('P', MYPORT) THEN DO
    SAY 'Personal Paint Rexx port could not be opened.'
    EXIT 10
END

ADDRESS VALUE MYPORT
OPTIONS RESULTS
OPTIONS FAILAT 10000

Version 'REXX'
IF RESULT < 2 THEN DO
    errmess = 'This script requires a newer_version of Personal Paint.'
    SAY errmess
    RequestNotify 'PROMPT="'errmess'"'
    EXIT 10
END

LockGUI
FreeBrush
IF RC = 0 THEN RequestPath "GifToPng target directory"
IF RC = 0 THEN DO
    tmpfname = 'T:pprx_temp.'PRAGMA('ID')
    ADDRESS COMMAND 'List >'tmpfname' 'RESULT' NOHEAD PAT=~(?.info) LFORMAT="*"s%s ←
        *"" ALL FILES'
    IF OPEN('listfile', tmpfname, R) THEN DO
        Get SETTING ICONS
        iconmode = RESULT
        errcode = 0
        Set '"ICONS=3"'
        DO FOREVER
            curfname = READLN('listfile')
            IF EOF('listfile') THEN BREAK
            GetFileFormat curfname
            IF RC = 0 THEN DO
                IF UPPER(RESULT) = 'GIF' THEN DO
                    SAY 'Processing 'curfname
                    LoadBrush curfname FORCE
                    IF RC = 0 THEN DO
                        IF UPPER(RIGHT(curfname, 5)) = '.GIF"' THEN DO
                            len = LENGTH(curfname)
                            newfname = OVERLAY(D2C(C2D(SUBSTR(curfname, len-3, 1)) + 9), ←
                                curfname, len-3)
                            newfname = OVERLAY(D2C(C2D(SUBSTR(curfname, len-2, 1)) + 5), ←
                                newfname, len-2)
                            newfname = OVERLAY(D2C(C2D(SUBSTR(curfname, len-1, 1)) + 1), ←
                                newfname, len-1)
                            IF EXISTS(SUBSTR(newfname, 2, len-2)) = 0 THEN DO
                                ADDRESS COMMAND 'Rename >NIL: 'curfname' 'newfname
                                curiconfname = INSERT('.info', curfname, len-1)
                                newiconfname = INSERT('.info', newfname, len-1)
                                curfname = newfname
                                IF EXISTS(SUBSTR(curiconfname, 2, len+3)) THEN DO

```

```

        IF EXISTS(SUBSTR(newiconfname,2,len+3)) THEN
            ADDRESS COMMAND 'Delete >NIL: 'curiconfname
        ELSE
            ADDRESS COMMAND 'Rename >NIL: 'curiconfname' 'newiconfname
        END
    END
END
SaveBrush 'FORCE FILE 'curfname' FORMAT PNG OPTIONS "PROGDSP=0" "COMPR ←
    =6" "AUTO=1"
IF RC > 0 THEN DO
    errcode = RC
    IF RC = 5 THEN
        errmess = 'User abort during save.'
    ELSE
        errmess = 'Error 'RC' during save.'
    END
    FreeBrush FORCE
END
ELSE DO
    errcode = RC
    IF RC = 5 THEN
        errmess = 'User abort during load.'
    ELSE
        errmess = 'Error 'RC' during load.'
    END
END
END
END
IF errcode > 0 THEN BREAK
END
IF errcode > 0 THEN DO
    SAY errmess
    RequestNotify 'PROMPT="'errmess'"'
END
Set '"ICONS='iconmode'"
CALL CLOSE('listfile')
END
ADDRESS COMMAND 'Delete >NIL: 'tmpfname
END
UnlockGUI

```

1.8 GIF to PNG ARexx Script - Comments

GIF to PNG ARexx Script - Comments

This script asks the user to specify a directory, scans the directory and its subdirectories and converts all GIF files it finds into PNG.

Non-GIF files are not affected. Icon images are preserved. Icon format information is updated (Tool Types: FILETYPE=PNG). GIF Author, Copyright and Comment fields are translated to PNG equivalents. File name suffixes are changed (i.e. the files are renamed) as follows:

```

.gif    -> .png
.GIF    -> .PNG

```

.Gif -> .Png, ecc.

others -> unchanged

Personal Paint identifies the file type by its contents (not by the file name suffix). If the script runs during Workbench use, the Workbench Update menu item must be selected to visually update the contents of any windows containing files being renamed by this script.

This script requires Personal Paint version 6.3 (PPaint Rexx version 2) or higher, `personal_png_io.library` (enclosed with PPaint), and `personal_gif_io.library` (available via free electronic distribution).

Possible changes that could be applied to this file:

Convert all images to PNG (not just GIFs). To do this, change the line selecting GIFs to `IF UPPER(RESULT) ~= 'PNG' THEN DO`. However, be careful if you have IFF animations, as they can be loaded as ILBM images unless they are filtered out (IFF animations begin with an ILBM image).

Activate PNG Adam 7 progressive display in files being written. This degrades compression but the resulting images appear more nicely when displayed by progressive viewers. Set `PROGDSP=1`.

Convert any file to uncompressed IFF-ILBM. This may be good for files to be stored on an Amiga CD-ROM, where loading speed could be more important than compression. Remove the instructions selecting only GIFs and replace the PNG FORMAT option with `FORMAT ILBM OPTIONS "COMPR=0" "SCRFMT=0"`.

PNG was designed as a replacement and extension to GIF and LZW-based TIFF, after Unisys Corporation began demanding royalties on GIF/LZW code. As the PNG specification was released in May 1995, it gained general recognition as the best lossless standard for storing digital images.

Cloanto, the first software house to publish a paint program supporting the PNG file format, is also making available a PNG developer's kit for the Amiga. This includes instructions for using `personal_png_io.library`, and is a commercial product. A PNG

DataType

is available at no cost for free

electronic distribution.

An

Article

on the GIF/LZW issue can be requested by sending E-mail to

`<gltext1@cloanto.it>`

For more information, or suggestions, please address E-mail to

`<info@cloanto.it>`

1.9 DataTypes

Amiga DataTypes

Amiga DataTypes provide an object oriented approach for determining and handling data types. A simple DataType consists of one short format descriptor file (stored in DEVS:DataTypes) and a library containing code to process that datatype (stored in SYS:Classes/DataTypes).

A format descriptor file simply describes how to recognize a file. For example, it could list the initial bytes (if all files of that format have a standard header). This is how the PNG format descriptor works. The system of format descriptions can be used by applications to identify various file formats (for example, to assign appropriate Workbench icons to files that don't come with an icon). Beyond that, the DataType I/O libraries allow applications to handle different formats without re-implementing the same format again and again.

In theory, DataTypes should be documented in the original Amiga documentation. In the 3.1 Amiga Developer Update disk set, documentation can be found in Docs/datatypes.doc, Tutorial/DataTypes and Examples2/DataTypes.

In practice, the original release of the documentation was not very complete, and it has allowed very few developers to implement support for DataTypes in their applications. At Cloanto we felt the same problem, and for this reason we would now like to share some of our own source code with other developers.

The

C source code
of a DataType-based image viewer is included here.

1.10 C Source Code

```
/*
ViewDT

Simple DataType-based Picture Viewer

Syntax:
ViewDT FILES/A

Examples:
ViewDT pictures:space/#?.pic
ViewDT portrait.png

Status:
Public Domain

If you require more information please send E-mail to <info@cloanto.it>
*/
```

```

#include <exec/types.h>
#include <exec/memory.h>
#include <graphics/gfx.h>
#include <graphics/displayinfo.h>
#include <intuition/intuitionbase.h>
#include <intuition/gadgetclass.h>
#include <datatypes/datatypes.h>
#include <datatypes/datatypesclass.h>
#include <datatypes/pictureclass.h>
#include <proto/exec.h>
#include <proto/dos.h>
#include <proto/graphics.h>
#include <proto/intuition.h>
#include <proto/datatypes.h>
#include <string.h>
#include <stdio.h>

struct Picture
{
    struct BitMapHeader bmhd; /* format and infos */
    struct BitMap *bmap; /* bitmap */
    ULONG *palette; /* color table in LoadRGB32() format */
    LONG palette_size; /* mem usage */
    LONG palette_entries; /* number of colors */
    ULONG display_ID; /* video mode */
    UBYTE *author; /* author info */
    UBYTE *copyright; /* copyright info */
    UBYTE *annotation; /* other info */
    LONG author_size; /* mem usage */
    LONG copyright_size; /* mem usage */
    LONG annotation_size; /* mem usage */
};

void FreePicture(struct Picture *pic);
LONG GetDataTypesPicture(UBYTE *file_name, struct Picture *pic, ULONG);
BOOL IsDataTypes(UBYTE *file_name, UBYTE *name_buff, LONG nbuff_size);
BOOL ViewPicture(struct Picture *pic);

struct IntuitionBase *IntuitionBase;
struct GfxBase *GfxBase;
struct Library *DataTypesBase;

/*
    IsDataTypes

    Parameters
        file_name: name of the file to inspect
        name_buff: (optional) buffer to store the file format name
        nbuff_size: size of name_buff

    Return value
        TRUE if DataTypes recognized the file as a valid picture file
        FALSE otherwise
*/
BOOL IsDataTypes(UBYTE *file_name, UBYTE *name_buff, LONG nbuff_size)

```



```
        DTA_GroupID, GID_PICTURE,
        PDTA_Remap, FALSE,
        TAG_DONE)) /* get the picture object */
{
    if (GetDTAttrs(obj,
        PDTA_ModeID, &pic->display_ID,
        PDTA_BitMapHeader, &bmh,
        TAG_DONE) == 2) /* get the bitmap_header and mode_id */
    {
        pic->bmhd = *bmh;

        /*
         * query the object about its author, copyright and annotation
         */
        if (GetDTAttrs(obj, DTA_ObjAuthor, &str, TAG_DONE) == 1)
        {
            if (str)
            {
                pic->author_size = strlen(str) + 1;
                if (pic->author = AllocMem(pic->author_size, 0))
                    strcpy(pic->author, str);
            }
        }
        if (GetDTAttrs(obj, DTA_ObjCopyright, &str, TAG_DONE) == 1)
        {
            if (str)
            {
                pic->copyright_size = strlen(str) + 1;
                if (pic->copyright = AllocMem(pic->copyright_size, 0))
                    strcpy(pic->copyright, str);
            }
        }
        if (GetDTAttrs(obj, DTA_ObjAnnotation, &str, TAG_DONE) == 1)
        {
            if (str)
            {
                pic->annotation_size = strlen(str) + 1;
                if (pic->annotation = AllocMem(pic->annotation_size, 0))
                    strcpy(pic->annotation, str);
            }
        }

        layout.MethodID = DTM_PROCLAYOUT; /* render the object */
        layout.gpl_GInfo = NULL;
        layout.gpl_Initial = TRUE;

        if (DoDTMethodA(obj, NULL, NULL, (Msg)&layout))
        {
            if (GetDTAttrs(obj,
                PDTA_BitMap, &bmap,
                PDTA_CRegs, &creg,
                PDTA_NumColors, &ncol,
                TAG_DONE) == 3) /* get the bitmap and its colors */
            {
                crsize = (ncol * 3) * 4;
                pic->palette_entries = ncol;
            }
        }
    }
}
```

```

    pic->palette_size = crsize + (2 * 4); /* LoadRGB32() table ←
        requirements */

    if (pic->palette = AllocMem(pic->palette_size, 0))
    {
        ctab = pic->palette;
        *ctab++ = (ncol << 16) | 0; /* number of colors and first ←
            color to load
        memcpy(ctab, creg, crsize);
        *(ctab + (crsize / 4)) = 0; /* terminator
    }
    else err = ERROR_NO_FREE_STORE;

    if (pic->bmap = AllocBitMap(pic->bmhd.bmh_Width, pic->bmhd. ←
        bmh_Height, pic->bmhd.bmh_Depth, bmap_flags, NULL))
    {
        BltBitMap(bmap, 0,0, pic->bmap, 0,0, pic->bmhd.bmh_Width, pic-> ←
            bmhd.bmh_Height, 0xC0, 0xFF, NULL);
        WaitBlit();
    }
    else err = ERROR_NO_FREE_STORE;
}
else err = IoErr();
}
else err = IoErr();
}
else err = ERROR_REQUIRED_ARG_MISSING;

    DisposeDObject(obj); /* free the object */
}
else err = IoErr();

if (err)
    FreePicture(pic);

return(err);
}

/*
FreePicture

Parameters
    pic: Picture structure with resources to free

Return value
    none
*/
void FreePicture(struct Picture *pic)
{
    if (pic->bmap)
    {
        WaitBlit();
        FreeBitMap(pic->bmap);
    }
    if (pic->palette)
        FreeMem(pic->palette, pic->palette_size);
}

```

```

    if (pic->author)
        FreeMem(pic->author, pic->author_size);

    if (pic->copyright)
        FreeMem(pic->copyright, pic->copyright_size);

    if (pic->annotation)
        FreeMem(pic->annotation, pic->annotation_size);

    memset(pic, 0, sizeof(struct Picture)); /* clear it all */
}

/*
ViewPicture

Parameters
    pic: picture infos and data

Return value
    TRUE if the user cancelled the view sequence (<Esc> key)
    FALSE otherwise
*/
BOOL ViewPicture(struct Picture *pic)
{
    struct Screen *scr;
    struct Window *win;
    struct IntuiMessage *imsg;
    BOOL done, quit;

    done = quit = FALSE;
    if (scr = OpenScreenTags(NULL,
        SA_Width, pic->bmhd.bmh_Width,
        SA_Height, pic->bmhd.bmh_Height,
        SA_Depth, pic->bmhd.bmh_Depth,
        SA_Quiet, TRUE,
        SA_ShowTitle, FALSE, /* no title bar */
        SA_Behind, TRUE,
        SA_Type, CUSTOMSCREEN,
        SA_DisplayID, pic->display_ID,
        SA_Overscan, OSCAN_TEXT,
        SA_AutoScroll, TRUE,
        SA_Colors32, pic->palette,
        SA_BackFill, LAYERS_NOBACKFILL, /* no screen-clearing when the ↔
            window is closed (is faster) */
        TAG_END))
    {
        if (win = OpenWindowTags(NULL,
            WA_Width, scr->Width,
            WA_Height, scr->Height,
            WA_IDCMP, MOUSEBUTTONS | VANILLAKEY,
            WA_CustomScreen, scr,
            WA_Backdrop, TRUE,
            WA_Borderless, TRUE,
            WA_Activate, TRUE,
            WA_RMBTrap, TRUE,
            WA_SimpleRefresh, TRUE,

```

```

        WA_BackFill, LAYERS_NOBACKFILL, /* no screen-clearing when the ↵
        window is opened (is faster) */
        TAG_END))
    {
        BltBitMap(pic->bmap, 0,0, scr->RastPort.BitMap, 0,0, pic->bmhd.bmh_Width, ↵
        pic->bmhd.bmh_Height, 0xC0, 0xFF, NULL);
        WaitBlit();
        ScreenToFront(scr); /* show the screen only when the picture has been ↵
        copied to it */

        while (!done)
        {
            Wait(1 << win->UserPort->mp_SigBit);

            while (imsg = (struct IntuiMessage *)GetMsg(win->UserPort))
            {
                switch (imsg->Class)
                {
                    case VANILLAKEY:
                        switch (imsg->Code)
                        {
                            case 27: done = quit = TRUE; break; /* <Esc> = cancel ↵
                            */
                            case 13:
                            case 32: done = TRUE; break; /* <Enter> / <Space> = ↵
                            continue */
                        }
                        break;
                    case MOUSEBUTTONS:
                        switch (imsg->Code)
                        {
                            case SELECTUP: /* MButton = continue */
                            case MIDDLEUP:
                            case MENUUP: done = TRUE; break;
                        }
                        break;
                }
                ReplyMsg((struct Message *)imsg);
            }
            }
        CloseWindow(win);
    }
    CloseScreen(scr);
}
return(quit);
}

void main(int argc, char *argv[])
{
    #define AP_BUFFSIZE 240
    #define PT_SIZE 80
    struct Picture pic;
    struct AnchorPath *ap;
    UBYTE pic_type[PT_SIZE];
    LONG err;
    BOOL quit;

```

```

if (argc > 1)
{
    if (IntuitionBase = (struct IntuitionBase *)OpenLibrary("intuition.library", ↵
        39))
    {
        if (GfxBase = (struct GfxBase *)OpenLibrary("graphics.library", 39))
        {
            if (DataTypesBase = OpenLibrary("datatypes.library", 39))
            {
                if (ap = AllocMem(sizeof(struct AnchorPath) + AP_BUFSIZE, ↵
                    MEMF_CLEAR))
                {
                    ap->ap_Strlen = AP_BUFSIZE;
                    for (err = MatchFirst(argv[1], ap); err == 0; err = MatchNext(ap ↵
                        ))
                    {
                        if (IsDataTypes(ap->ap_Buf, pic_type, PT_SIZE))
                        {
                            if (GetDataTypesPicture(ap->ap_Buf, &pic, 0) == 0)
                            {
                                printf("%s (%s, %dx%d, %d colors)\n",
                                    ap->ap_Info.fib_FileName,
                                    pic_type,
                                    pic.bmhd.bmh_Width,
                                    pic.bmhd.bmh_Height,
                                    pic.palette_entries);
                                if (pic.author)
                                    printf("    author: %s\n", pic.author);
                                if (pic.copyright)
                                    printf("    copyright: %s\n", pic.copyright);
                                if (pic.annotation)
                                    printf("    annotation: %s\n", pic.annotation);

                                quit = ViewPicture(&pic);
                                FreePicture(&pic);
                                if (quit)
                                    break;
                            }
                        }
                    }
                    MatchEnd(ap);
                    FreeMem(ap, sizeof(struct AnchorPath) + AP_BUFSIZE);
                }
                CloseLibrary(DataTypesBase);
            }
            CloseLibrary((struct Library *)GfxBase);
        }
        CloseLibrary((struct Library *)IntuitionBase);
    }
}

```

1.11 Personal Paint

Personal Paint 6.3

Personal Paint is a powerful and intuitive paint, image processing, animation and 24-bit printing package. Employ stunning effects like transparencies, emboss, water-colors and stereograms (as in "Magic Eye"), while virtual memory frees precious Chip RAM by using other storage resources! Plus: support of RTG graphics cards, different file formats (IFF, PNG, PCX, encrypted, C source code, DataTypes etc.), nine brushes, two independent working environments, multi-level Undo/Redo, animation storyboard, Bézier curves, autoscroll painting, professional color reduction, superior text editor, color fonts, PostScript output, screen grabber, ARexx...

Features of Personal Paint 6.3 Include:

- First paint program worldwide to support the new PNG (Portable Network Graphics) file format. Includes an ARexx script to convert GIFs to PNG.
 - Animation (featuring a storyboard, superior compression, multiple palettes, frame-by-frame timing, ANIM-5/7/8 and hybrid formats, etc.)
 - Sophisticated "behind the scenes" memory management, including virtual memory (swaps inactive image data to Fast RAM and disk storage) and multiple levels of undo and redo
 - New, faster image processing effects, including transparencies, alpha channel and single image stereograms (both SIRDS and custom pattern stereograms, as in "Magic Eye")
 - Support of Retargetable Graphics (display cards like the Picasso, Retina, Piccolo, Rainbow, EGS, Talon, Cybergraphics etc.)
 - Animation on RTG display cards (with or without double-buffering)
 - Direct, high quality 24-bit printing (Color and Black & White) and interface to third-party software such as Studio Print Server
 - Professional and fast modes for converting 24-bit pictures (IFF, PNG, PCX, PBM etc.) to 256 colors or less
 - HAM, HAM8 and Picasso 24-bit viewer active during color reduction
 - External input/output modules (loaders and savers) for easy extensions and upgrades. Modules for IFF, PNG, PCX, PBM, Amiga DataTypes and several others are included. GIF module is available from public domain sources.
 - Support and editing of IFF, PNG and GIF project annotations (Author, Copyright and Comment fields, plus Amiga filenotes)
 - Autoscroll painting
 - Workbench Application Icon (Drag and Drop)
 - Basic set of ARexx commands for presentations, format conversions and printing
-

- ASL-compatible file requester
- More power through machine language code: the software is in part up to 500% faster
- "New Look" user interface
- A collection of utilities, including color fonts, new DeskJet printer drivers (up to four inks) and JPEG Data Type

Requirements:

- 1 Mbyte RAM, 1 disk drive required; 1 Mbyte of Chip RAM recommended
- Amiga Kickstart from 1.2, Amiga Workbench from 1.3
- Actively exploits 2.x and 3.x operating systems, FPU, CPU Cache RAM and RTG boards
- JPEG Data Type requires at least 68020 CPU

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North America:

DKB
29318 Lorie Lane
USA - Wixom, MI 48393

Tel +1 810 348-3755 (tech.)
Tel +1 810 348-3821 (sales)
Fax +1 810 348-3531

Great Britain:

Ramiga International Ltd.
Stablau 'Rin
GB - Pentrefoelas, Clwyd LL24 0HT

Tel +44 1690 770304
Fax +44 1690 770266
Bbs +44 1690 770696

Meridian Software Distribution Ltd.

East House
East Road Industrial Estate
GB - London SW19 1AH

Tel +44 181 5433500
Fax +44 181 5432255

German Area:

Casablanca Multimedia GmbH
Wiemelhauser Straße 247 a
D - 44799 Bochum

Tel +49 234 72035
Fax +49 234 72060

The Netherlands:

Barlage Computer Hardware
Kaalheidersteenweg 262
NL - 6467 AH Kerkrade

Tel +31 45 425881
Fax +31 45 424411

Danemark:

Epic Data
Østerlyngvej 1
DK - 4500 Nykøbing Sjælland

Tel +45 59 93 10 25
Fax +45 59 93 20 54

Sweden:

ProComp
Box 46
S - 340 36 Moheda

Tel +46 472 70845
Fax +46 472 71680
Bbs +46 472 71270

France:

Cuda Informatique sarl
31, rue de Trevis
F - 75009 Paris

Tel +33 1 42 46 47 48
Fax +33 1 42 46 47 01

Greece:

Multi-RAK
Karnassiotis & Radouniklis GBR
Prinz-Regent-Straße 70
D - 44795 Bochum

Tel +49 234 9489411
Fax +49 234 9489444

Australia and New Zealand:

Amadeus Computers
34 Tecoma Drive

Tel +61 2 652-2712
Fax +61 2 652-1515

Glenorie NSW 2157
Australia

Italy:

Db-Line srl	Tel +39 332 767270
Viale Rimembranze 26/C	Fax +39 332 767244
I - 21024 Biandronno VA	Bbs +39 332 767329

Italy (OEM):

CTO spa	Tel +39 51 753133
Via Piemonte 7/f	Fax +39 51 753418
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Cloanto - Company Information

Cloanto Italia srl
PO Box 118
33100 Udine
Italy

Tel +39 432 545902
Fax +39 432 609051
Bbs +39 432 545905
E-mail <info@cloanto.it>
