

Amiga Operating System

A brief discussion about history and specifications

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Abstract

This report discusses the history of the Amiga Operating System, including its commercial origin and its present non-commercial nature. In addition, features such as file management, memory management, and deadlock prevention are examined

Section 1 – The Beginning

1.1 Amiga's Origins

The Amiga Operating System has a long history that dates back to 1982. Three men had had money to invest and wanted to create a new gaming computer system. They recruited several talented people that had experience in creating computer gaming systems, including Jay Miner from Atari and Dave Morse from Tonka Toys. They created the Amiga computer system which used the Amiga Operating System.

After two years of developing the Amiga, funding for the project began to run out. The three men that had originally began the project wanted to find a way out. They wanted somebody to buy the project to get it off their shoulders. So, they took the Amiga system to the Consumer Electronics Show where Commodore Business Machines bought Amiga.

In 1985, Commodore introduced the Amiga 1000 to the public for sale. It ran the Amiga Operating System, which was developed by a British software company called Metacomco. Metacomco was able to create the OS in only a few weeks because they had already created an OS for the Motorola MC68000 processor, which was used in the Amiga computer.

Commodore created the Amiga 2000 as the successor to the Amiga 1000. The new system still used the original operating system that was used for the first system. However, the Amiga 500, introduced in 1987, had a new operating system—Amiga OS 1.2.

In 1990, Commodore developed the first fully 32-bit computer—the Amiga 3000. It had a Motorola MC68030 processor and the new Extended Chip Set (ECS) with 2 MB of RAM for improved graphics capabilities. The Amiga 4000 was the first computer to utilize the new AmigaDOS – version 3.0.

The End of the Amiga Computer

By 1994, Commodore Business Machines was a huge financial disaster. However, the Amiga computer became very popular in the market just before the company was ready to call it quits. However, nothing could save the company and the meager spurt in sales was not enough to save the company.

Marketing mistakes caused the end of the Amiga. The Amiga was a great computer system, but it was overtaken by competitors. The Amiga got lost in the middle of Nintendo and Sega, with their superior gaming systems. Microsoft and Apple produced home computers that outperformed Amiga's personal computing functionality.

Escom bought the rights to Amiga in 1995, but they had little interest in continuing development. They only wanted to use the name to help sell products. After two years, Escom sold the right to Gateway computers, who continues to own Amiga today. They

funded the Amiga Incorporated subdivision and hired several new employees to advance the development process. Gateway decided that Amiga Inc. would only produce new operating systems for the Amiga system. (amiga-israel.hypermart.net, 2003)

State-of-the-art developments

The Amiga computer system offered several new features to the computer world. In 1985, the original release of the Amiga marked the first personal computer to have a color graphical user interface. Many people attribute the development of the GUI to Apple computers who developed a black and white GUI in 1983 with the Apple Lisa computer. The Amiga is also known for its two button mouse, fast graphic subsystem, and support for animation and sound. (Sassenrath, 2003)

Multiple screens with different resolutions were available on the Amiga OS. This is a unique feature that is specific to Amiga. It allows one window to have a small resolution and another to have a bigger resolution. This could be done all in one monitor without having to change the overall system settings.

The Amiga had the capability to connect to a television ever since its original creation. This is a feature that most modern computers still do not even have. To implement this, a Digital to Analog converter was developed.

Amiga's autoconfig feature gave it the plug and play capabilities that are used in current Windows operating systems. In fact, Microsoft purchased the rights to Amiga's autoconfig so they could include plug-and-play in Windows 95. (Clayton, 2000)

Cult following

The Amiga managed to develop an amazing following of loyal customers. In the 1980's, Amiga overtook Atari and had more new games being developed for it. Games, perhaps, are the reason why so many people feel attached to their Amiga computers. The people that spent hours playing games on the Amiga would obviously develop a strange attachment for their systems.

Versions

There have been several versions of the Amiga operating system ranging from Version 1.0 to Version 3.9. Version 1.0 was included in the first Amiga computer systems that were sold beginning in 1985. Version 3.9 is the most current completed version. It has the capabilities of most modern-day operating systems including support for all types of hardware storage devices like CD-ROM, Zip, and Jaz.

1.2 Amiga Research Operating System

The Amiga Research Operating System is another project that has been going on for several years. It began in 1993 when several Amiga-users realized that the Amiga was going to fade away. Several developers got together to try to debug the Amiga OS and make it a more widespread system. A posting was made to the AOS mailing list that suggested that work begin on an open source OS that would be comparable to Amiga OS 3.1.

Work on the Amiga Research Operating System continues today. Nightly builds of the system are available on the website (www.aros.org). It is designed to run on the Intel 386 processors.

Section 2 – File Management

In the Amiga OS, the workbench and AmigaDOS control file management. So, the metaphor involves different terminology than the normally used desktop. Instead of folders there are drawers and executable files are depicted as tools. In most other respects, the Amiga environment looks like most other operating systems. There is a feature that allows multiple screens like the X Window system used in Linux. Each different screen can have its own resolution and color depth. The workbench and AmigaDOS are comparable to the Windows desktop and MS-DOS in Microsoft Windows or the X Window system and the terminal in Linux. (wikipedia.org, 2003)

Files in Amiga are stored just like they are in many other operating systems. There are directories, subdirectories, and files. This creates a tree-like structure. There are .info files that are included in each directory that appears on the graphical interface. The .info file stores information about the selected icon and where the icon should appear.

2.1 Naming conventions

Names of files and directories can be up to 30 characters long. They can have both upper and lower case letters and punctuation marks that are not reserved. Colons and slashes are reserved. The capitalization in names is preserved; however, Amiga is not case sensitive, so it really wouldn't matter if the capitalization information were disregarded. Spaces are also acceptable. (nwamiga.net, 2003)

2.2 File System

The Amiga file system comes in two variants: Amiga Original File System (OFS) and Amiga Fast File System (AFFS). AFFS is the later version of the file system and it is used in most versions of Amiga OS. Both versions store a boot block at the beginning of the disk. There is a root block stored in the middle of the disk. There are not any pointers to the root block on the disk, so its location has to be determined from the size of the disk. The following calculation is used to determine where the root block is stored.

$$\begin{aligned}\text{numCyls} &= \text{highCyl} - \text{lowCyl} + 1 \\ \text{highKey} &= \text{numCyls} * \text{numSurfaces} * \text{numBlocksPerTrack} - 1 \\ \text{rootKey} &= \text{INT}(\text{numReserved} + \text{highKey}) / 2\end{aligned}$$

AFFS is highly portable. Several other operating systems, Linux for example, possess the capability to read and operate with AFFS. (perso.club-internet.fr, 2003)

2.3 Disks

On the Amiga, Double Density disks can be formatted to 880 Kbytes. DOS-formatted disks of the same type have a capacity of only 720 Kbytes. High Density disks can hold twice the data of Double Density disks, 1.76 Mbytes on the Amiga, and 1.44 Mbytes using the DOS formatting. Variations in disk formatted sizes are also possible within the same system. An example is the Amiga's Original Filing System (OFS) which has a more redundant data structure than the newer Fast Filing System (AFFS). This results in a small difference in capacity so that Double Density disks formatted with the Amiga OFS can actually only contain a maximum of 838 Kbytes of user data and not 880 as when the FFS is used. The Amiga disk controller and filing system were developed after the PC's. This is in part reflected by the Amiga's higher storage capacity for floppy disks and its ability to read both Amiga and PC disks. Once the High Density disks hit the market it was too late to change the Amiga custom chips to support the additional storage because twice the data needed to be read for each disk rotation. "This problem was solved by introducing special Amiga High Density drives which could spin at half the standard speed, allowing the Amiga drive controller to handle the data as if it came from Double Density disks." These floppy drives were on the last generations of the Amiga 3000 and 3000T. (Introduction to Data Sharing)

Section 3 – Exec Microkernel

The Multitasking Executive, or the Exec, is the heart of the Amiga operating system. One of its greatest qualities is that it uses much less memory than other operating systems that offer the same features. It uses minimal redundancy to provide multitasking and windows service while using one-half to one-fourth of the memory that Apple and IBM computers need.

Exec deals with the resource handling. When a program asks for a specific resource from the OS, Exec will check to see whether that resource has already been requested and if it has if it is still in use or not. If the specific resource has been allocated and loaded into memory then Exec will not load it a second time but will return the asking program a pointer to the requested resource. If the resource had not been requested then Exec loads it and then returns the pointer. (Rotondo)

3.1 Processors

Amiga systems were generally contained a single Motorola MC68000 processor. However, there is nothing in the Exec kernel that prevents multiple processors. Multiprocessing could be accomplished by serializing the access to the system lists. The Amiga 2500 utilized multiprocessing by having one processor sleep at boot time. (Holloway, 1991)

As it now stands with release 4.0, Amiga OS can run on a variety of processors. It also offers the ability of using multiple processors on a single system. This is done through symmetric multi processing (SMP). Figure 1 shows the processors that Amiga systems have supported.

Release Date	System Name	Processor Used (Clock Speed)
1985	Amiga1000	Motorola68000 (7.16MHz)
1987	Amiga500	Motorola68000 (7.16MHz)
1987	Amiga2000	Motorola68000 (7.16MHz)
1990	Amiga3000	Motorola68030 (25MHz)
1990	A3000T	Motorola68030 (25MHz)
1991	A600	Motorola68000 (7.16MHz)
1991	CDTV	Motorola68000 (7.16MHz)
1992	A4000T	Motorola68050 (50MHz)
1992	A1200	Motorola68EC020 (14MHz)
1993	CD32	MotorolaMC68EC020 (19MHz)

Figure 1: Partial History of the major releases of machines by Amiga over a span of nine years and the processors implemented in their design.

Amiga not only increased the clock speed available on their machines by slightly more than three fold, but also continued to offer a variety of systems with different clock speeds. (Millican, 2003)

3.2 Processes

From its inception in 1985, the Amiga OS has been a multithreaded operating system. (Arvidsson, 1999) Multithreading allowed and brought to light the GUI that the Amiga originally shipped with. And this was years before Windows debuted with its GUI. While arguably the multithreading and GUI incorporated into Amiga at its inception would have made it very appealing to home users as a PC, Amiga failed to market or price the Amiga in a way which made it a visible or viable option. (DeSantis, 2001)

There are several states of individual processes that can exist in Amiga OS. For example, Running—the process is currently executing on the CPU, Runnable—the process is ready and capable of execution on the CPU, and Blocked—the process is currently not able to execute on the CPU (whether it be waiting for an I/O request or another operation). The exact names (if they exist) for the ready-nonresident and waiting-nonresident states of a process in the Amiga OS could not be determined. However, given that the modern releases of Amiga OS support virtual memory it seems very likely that they do exist. (Amiga Inc., 2003)

3.2 Semaphores

Originally, the Amiga OS using the Forbid() and Disable() functions which turned off interrupts. However, newer versions include semaphores.

The Exec semaphore functions are: AddSemaphore(), AttemptSemaphore(), FindSemaphore(), InitSemaphore(), ObtainSemaphore(), ObtainSemaphoreList(), ObtainSemaphoreShared(), ReleaseSemaphore(), ReleaseSemaphoreList(), RemSemaphore(). The operation that each other these functions perform is adequately described in the name.

3.3 Deadlock

Deadlock is waiting for some event that will never occur. Unfortunately, the Amiga Operating System has no deadlock prevention, deadlock avoidance techniques, or deadlock detection and resolution. Deadlock is not dealt with at all by this operating system. (Amiga RKM Libraries, 2003)

Section 4 – Scheduling

The Amiga was known for providing an innovative feature of pre-emptive multi-tasking. This allowed several processes to be running at the same time. Amiga was able to control the resources needed by each program and it could share CPU time. This is something that many people feel that Microsoft Windows still *cannot* do.

4.1 Pre-emptive multi-tasking

The Amiga Operating System is a timesharing system that uses pre-emptive multitasking. Multitasking allows the system to run more than one application simultaneously. To do this, the programs must be able to share memory and other resources in a way that does not conflict with the other. This was something that was not possible in any home computers at the time. The PC and Macintosh did not have comparable multitasking abilities. The three most common methods were:

1. Task switching which was used by Microsoft Windows,
2. Cooperative multitasking which was used by Mac OS,
3. Preemptive multitasking used by Amiga.

Task switching allowed multiple programs to be loaded into memory, but only one could run at any time. Cooperative multitasking allowed each program to run a specific period of time at which point it is stopped so another program could start. Preemptive multitasking worked on a priority system where the operating system is balancing the processing based on the relative priority of each program and the nature of the processing that it wished to do.

The advantages to using pre-emptive multitasking is that Amiga can run a number of programs in the background at a lower priority than other applications (such as menu programs and virus checkers) which are started when the operating system is booted up. The main advantage is that individual programs do not have to be large monolithic pieces of code; instead object oriented programming can be implemented. There are two main disadvantages to using this type of multitasking. One is that a single program can hog the processor and lock out other programs. The second is the ability for one program to overwrite or corrupt another. This was a problem because the Amiga did not have a Memory Management Unit, so some cross-memory problems occurred. (Amiga Auckland Inc., 2001)

Section 5 – Memory

The Amiga operating system is unusual in that it doesn't partition memory for applications, or even the operating system itself. What it does do is maintain a free memory list where each chunk of free memory has certain attributes and requests are matched against them. This way, theoretically speaking, no application runs out of memory until the system itself runs out of memory. Plus there is no requirement to juggle segments. (Halloway, 1991) Amigas 32 bits system means that it has 32 bit addresses giving access to 4294967296 individual cells. The Chip RAM and Fast RAM are most likely to have their own memory banks. These banks would be sitting at specific addresses that are fixed by the hardware. To allow programs to dynamically allocate memory, the early versions of AmigaOS used the simple free memory lists covering each consecutive memory location. As it sounds free spaces would be part of the list and those that were occupied would be left off the list. So, initially the whole memory bank is covered by the list and as one node. When memory is allocated the list is scanned and the first block that is either larger or the same size is taken and removed from the list. If it is larger then the requested amount, the chunk gets split and the remaining piece is returned to the list. One problem with this system is that it allows programs to allocate up to the amount of memory installed in the machine. Say 8MB of memory is installed, more than that amount is not possible to allocate even though the 32-bit address space allows for 4 GB of addressable memory. Fragmentation becomes another major problem due to the list approach. (Frieden, 2003)

A set of low-level functions can be used to acquire and free the memory. “Exec also provides a set of functions to manage memory within pools acquired by the application” (Halloway, 1991). This system has several advantages. It lowers the overall memory fragmentation, lowers overhead since the entire pool can be released as a unit, instead of piecemeal that tends to happen due to the list setup, and the ability to pre-allocate enough memory for applications that have a lot of dynamic memory usage. As mentioned before, there is not a memory in use list. Therefore, if an application fails and doesn't have a cleanup routine, or if the programmer neglects to free up all the memory that it pulled aside for itself, the memory is lost until the system is rebooted (Halloway, 1991). This system required that programmers be strict with what the program could do.

The initial Amiga was introduced with 512K of Chip RAM and up to 8MB fast RAM could be added. Chip RAM is the memory addressable by the display chips and other custom chips along with the CPU. Because it is shared the application must lock any memory before it can change it. This prevents other applications from updating it at the same time. As soon as the update is complete the application must release the locked memory (Coughran, 1995). Programs can be run in this space if the main memory is exhausted. When the main CPU and the peripheral chips all want access to the Chip RAM a traffic jam occurs. Both the main CPU and the peripheral CPUs can access their respective memory independently of each other and without hurting each other's performance. Because of this, Amigas tend to always have some memory reserves when they need it. (“HARDWARE & OS”)

Fast RAM is the memory that the CPU has exclusive access to with never having to wait on the custom chips. This RAM is also much larger. On the original Amiga the maximum memory that could be used was one Meg of chip ram and 8 megs of fast ram.(Coughran, 1995) Fast RAM, when requested by an application, has the requested size reserved exclusively for that program. Therefore locking does not need to be done freeing up some time making it seem faster than the Chip RAM. (Amiga Auckland Inc., 2001)

Section 6 – The State of Amiga

6.1 Amiga OS 3.X

Today, most of Amiga users use Amiga OS 3.0 or 3.1. This version of the OS provided a lot of useful features when it came and still today has many nice features that do not exist in other OS's (such as Windows95, MacOS and Unix). The support for localization and datatypes are features that no other OS provides today. Although this is nice, Amiga OS 3.1 has not been updated in the last couple of years. This means that the user interface is not state-of-the-art anymore and support for external hardware and network services are not supported the way they are in Windows95 and MacOS. Another important feature Amiga OS is lacking is the support for process control and virtual memory. Future versions will look to improve on these deficiencies. Amiga OS 3.X and older is now defined as "Amiga Classic". Version 3.5 of the OS includes network support, updated graphical user interface (GUI) and better support for external hardware devices (Amiga, 2003a).

6.2 Amiga OS 4.X

The next version of Amiga OS will be the Amiga OS 4.0. AmigaOS4.0 is the first release of AmigaOS4. It provides the first stage on the road to a PPC AmigaOS designed to take full advantage of the potential of the zico based computers being developed. It is designed to take the key elements of the current AmigaOS and re-implement them as PPC native systems, providing for the biggest increase in performance. The remaining elements will be left as 68k code for this release and be executed via a PPC 68k emulator, which will also be used for the execution of 68k based application code. In addition, it will add new features that have never before been available in the AmigaOS.

This new version of the OS will include such features as memory protection, SMP, updated hardware support (PCI, AGP, DVD), updated GUI, advanced multimedia support, network support etc (Amiga, 2003b). The main intention for Amiga OS 4.0 is to let developers gradually migrate software from Amiga OS3.1, MS Windows and MACOS to Amiga OS 4.0. The kernel of the operating system will be based on Amiga OS as well as possibly Linux, Java or BeOS.

6.3 Amiga OS 5.X

The Amiga OS Version 5.0 will be the big release of Amiga OS to the end-users. The Amiga 5.0 will run on new and super fast Amiga hardware that is under planning and development. The new Amiga hardware is based on a new power chip (PPC) that should be five to ten times faster than the fastest Pentium processor today and have incredible

powers when it comes to multimedia, 3D and graphics processing (AmigaForever, 2003). This is the OS that will supposedly take Amiga back to the top in the OS wars. The target for Amiga OS 5.0 is not only for personal computers, but also for other electronic devices such as network computer, video-games, set-top devices etc.

6.4 A Look into the Future

As Amiga reemerges from the ashes it has made a strong commitment to develop its OS. After the release of Amiga's newest OS, 4.0, Amiga will continue to develop and improve upon the initial version. The future of Amiga's commitment hinges on the success of these developing OS's. If they are a success then we will mostly likely see development of an OS 4.5 and OS 5. This project will be accomplished via a staged set of releases which will allow Amiga Inc. to build from the bottom up. This gives developers the maximum increase in performance across the releases and ensures that the users can look forwards to regular and better products rather than having to wait over a long and frustrating period of time until they get a workable copy.

Bibliography

- [1] *Amiga History*. Accessed 28 November 2003 <http://amiga-israel.hypermart.net/amiga_history.htm>
- [2] *Carl Sassenrath – History*. Accessed 28 November 2003 <<http://www.rebol.com/bio-carl.html>>
- [3] *Amiga OS – Wikipedia*. Accessed 28 November 2003 <<http://en2.wikipedia.org/wiki/AmigaOS>>
- [4] *Amiga OS 3.5 Manual*. Accessed on 28 November 2003 <<http://www.nwamiga.net/docs/os35/dos/index2.html>>
- [5] *The Amiga Disk File format FAQ*. Accessed on 29 November 2003 <http://perso.club-internet.fr/lclevy/adflib/adf_info.html>
- [6] Holloway, Tim. (January 1999) *The Object-Oriented Amiga Exec*. Byte Magazine, McGraw-Hill Inc.
- [7] Clayton, M.L., (10 June 2000) *History of the Amiga Computer*. <<http://www.heartbone.com/comphist/AmigaHistory.htm>>
- [8] Amiga RKM Libraries. Accessed on 29 November 2003 <http://amiga.nvg.org/amiga/reference/Libraries_Manual_guide/>
- [9] Amiga Inc. (2003). *AmigaOS4 Feature Set: Release 1*. <<http://os.amiga.com/os4/OS4Features.php>>
- [10] DeSantis, Matthew (2001). *Amiga Models: Historical Significance*. <<http://www.matthewdesantis.com/infor.htm>>
- [11] Arvidsson, Magnus (1999). *Amiga Hardware*. <http://home3.swipnet.se/~w-31858/Amiga_Hardware.html>
- [12] Millican, Donald (2003). “The Amiga Computer” <<http://www.stonelawdrive.free-online.co.uk/dwm/wsdcoursework/>>
- [13] Rotondo, Fabio, “Amiga Resource Management.” <http://home.intercom.it/~fsoft/ablast97/proud/proud_2.html>
- [14] Halloway, Tim(1991), “THE OBJECT-ORIENTED AMIGA EXEC.” <http://www.cunningham-lee.com/misc/amiga_exec.html>

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- [15] Frieden, Thomas(2003),”ExecSG in detail: Memory.”
<<http://os.amiga.com/cam/index.php?I=7&p=7>>
- [16] Coughran, David(1995), “Amiga Design.” <<http://www.moa.sonnet.com/drc/amiga-hw.html>>
- [17] Amiga Auckland Inc.(2001), “Amiga Memory.”
<<http://www.titan.co.nz/amigaak/AA020270.htm>>
- [18] “HARDWARE & OS.” <http://home3.swipnet.se/~w-31858/Amiga_Hardware.html>
- [19] “Introduction to Data Sharing.” <<http://www.amigaforever.com/datasharing.html>>
- [20] AmigaForever(2003). “Amiga Forever V5.0.”
<<http://www.schatztruhe.de/softe/amiga4ever4.html>>
- [21] Amiga(2003a). “Enhanced Operating Environment for Amiga Classic Systems.”
<<http://os.amiga.com/3.9/?PHPSESSID=ae5f42e98d6922588825f4bb711d42b1>>
- [22] Amiga(2003b). “Features and Screenshots of AmigaOS 4 in 2002.”
<<http://os.amiga.com/os4/?PHPSESSID=ae5f42e98d6922588825f4bb711d42b1>>
- [23] Amiga(2003c). “The Amiga is Back.” <<http://os.amiga.com/products/one/>>

Glossary of Terms

Atari (n) – The most prominent video game company in the 1980's.

Drawers (n) – The Amiga OS equivalent of folders in Microsoft Windows.

Exec (n) – The kernel of the Amiga operating system. It is responsible for most system processes including memory management and CPU scheduling.

Appendix A – Work Breakdown

Kevin G. Marinak

- Formatted and edited report
- Wrote sections 1-2
- Wrote abstract summary
- Created Glossary of Terms
- Created Bibliography
- Created PowerPoint slides

Jonathan Bradley

- Wrote sections 3
- Created PowerPoint slides
- Created Bibliography

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- Wrote sections 5
- Created PowerPoint slides
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- Wrote section 6
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