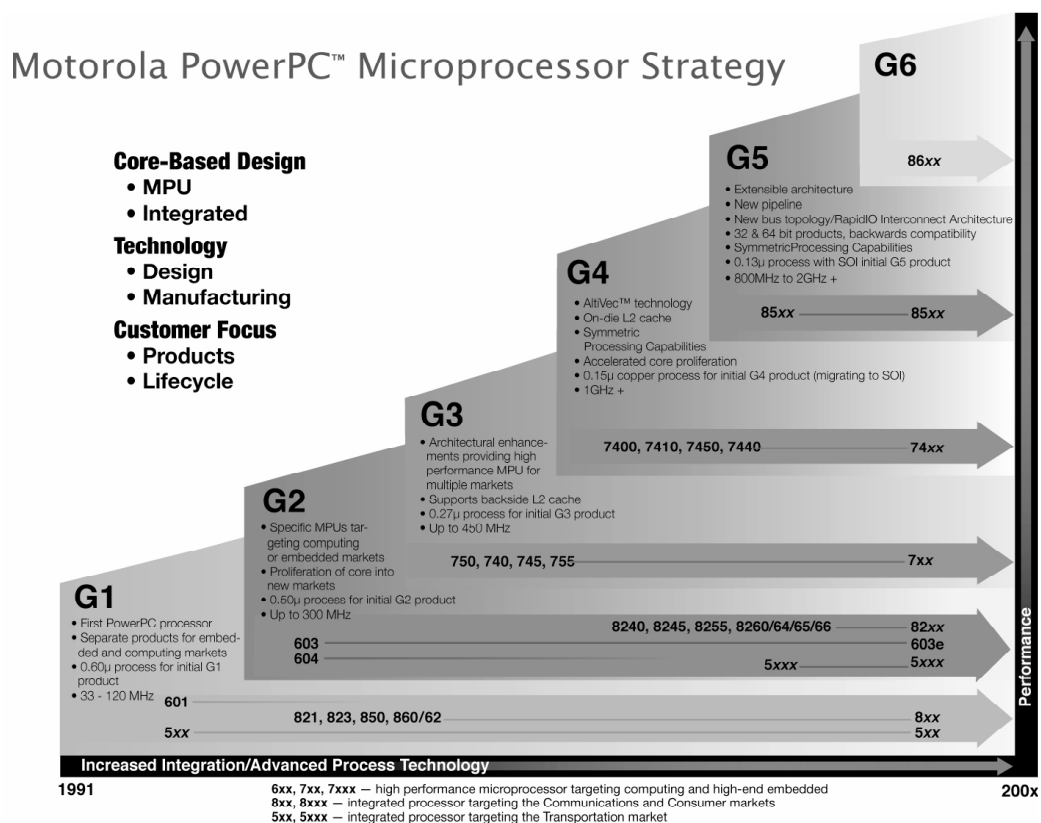


# Mac OS X

A presentation to the MUUG, January 8<sup>th</sup>, 2002.

## Introduction

In 1994 Apple Computer Inc. introduced the PowerMac 6100. The first personal computer to use a RISC based processor as the CPU. That CPU was a 60MHz version PowerPC 601 which was jointly developed by IBM, Motorola and Apple.



The introduction of the 601 began the conversion process of the code base of the Macintosh operating system to this new RISC processor, from its CISC Motorola 68k

heritage. At some time during this process, the Apple engineers came to the realization that the Macintosh OS needed to not merely be ported, but needed to be significantly advanced. However, after several starts and a change in the CEO, 1996 saw Apple still without an advanced operating system. In 1996, Gil Amelio was brought in as CEO. He immediately set about rebuilding Apple Computer to become profitable once again. This including shopping around for a solution to advance the Macintosh operating system.

There were two main contenders: NeXT Computer Inc. owned by then former Apple CEO Steven Jobs, and Be Inc. owned by former Apple Europe VP Jean-Louis Gassée. Apple closely examined BeOS. However, the national press reported that Jean-Louis Gassée wanted approximately 200 million for Be. Ultimately Apple purchased NeXT computer for \$430 million USD in 1997. For that they got an enterprise class operating system in the form of OPENSTEP™, WebObjects™ (web application development environment; similar to Macromedia Cold-Fusion™, only more scalable) and Steven Jobs as Interim-CEO (presently he holds the position of CEO). Be Inc. ceased operations in Q4 of 2001, after concluding its sale to Palm Computing Inc. for \$11 million USD.

In April 1999, the first product from Apple since the acquisition of NeXT Computer began shipping; this was Mac OS X Server version 1.0 which looked like a hybrid of Mac OS 8 and OPENSTEP. Mac OS X version 10.0 for the desktop computers wouldn't ship until March of 2001. The first major version was in September of that same year, the current version number is 10.1.2 (Build 5P48).

## Darwin

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At the core level of Mac OS X resides a Unix foundation, known as Darwin. This is the foundation of Mac OS X (currently at version 1.4.1 for both PowerPC and Intel processors). Darwin integrates a number of technologies, including Mach 3.0, operating system services derived from 4.4BSD (Berkeley Software Distribution), high-performance networking facilities, and support for multiple integrated file systems.

Darwin is also an Open Source project. Apple has made the full source code of Darwin available to open source developers via the Internet, who, along with Apple, will work collaboratively to ensure that the platform continues to evolve and improve.

In fact, the modern Mach kernel in Mac OS X was originally developed at Carnegie-Mellon University, and like Linux and UNIX, it's been part of the open source community, undergoing continual development and evolving through the crucible of peer review for many years. Apple has taken these time-tested technologies and greatly enhanced them with their own technologies, which not only improve the foundation of Mac OS X, but was also returned to the open source community through the Darwin open source project.

Apple believes that open source development is vital to the formation of exceptional technologies, creating a model for the evolution of operating system design. The Darwin community has 70,000 developers, producing incredible improvements like new file system support, security, and new networking technologies.

At the center of Mac OS X is Darwin, an industrial-strength UNIX-based core foundation. It features the Mach 3 kernel and some of the most advanced technologies available from the BSD community. Darwin is the pivotal component of the operating system, designed to handle the interactions between the operating system, applications, and

computer hardware. It provides Mac OS X with much-improved stability and performance over previous Macintosh operating systems.



## Darwin – Basic Benefits of Unix

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It offers complete memory protection for crash-resistant computing. Because Darwin protects an application's memory space, applications that behave poorly and crash no longer affect the rest of the system. In addition, Darwin is modular by design, components (e.g. device drivers, etc.) can be added, modified without compromising the stability/functionality of the operating system.

Preemptive multitasking lets you get on with your work while your system is busy doing something else. So time-intensive image transforms or video rendering operations no longer keep you from using your system. The advanced memory management in Darwin means you do not have to worry about an application's memory requirements, and you'll never get an out-of-memory message. Together these two features make the system much more responsive, allowing you to work more efficiently.

Darwin includes support for symmetric multiprocessing (SMP). All applications automatically benefit from SMP support because Darwin knows how to schedule both processors efficiently for the tasks being performed. And multithreaded applications can run almost twice as fast because Darwin can allocate a single application's threads across both processors.



## Darwin – I/O

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Darwin includes a high-performance I/O subsystem for quickly moving large chunks of data from locations like storage devices, printers, digital video cameras, and the network. The new I/O features build on the Macintosh tradition of plug-and-play ease of use by including built-in support for USB and FireWire (a.k.a. IEEE-1394, iLink), providing out-of-the-box connectivity for peripheral devices.

Because networking and the Internet are considered fundamental services today, Darwin has built-in networking based upon Internet standard protocols that support the ultra-high-speed Gigabit (10/100/1000-Mbps) Ethernet interface and AirPort™ (a.k.a. ISO-802.11b) wireless networking.

Darwin can connect to the Internet, via a dialup modem, ISDN, DSL, cable modem, or Ethernet connection. Darwin supports the most prevalent Internet standard protocols (e.g. TCP/IP, PPP and PPPoE) and file formats (e.g. pdf, mpg, mov).



## Darwin/Mac OS X – Supported Standards

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Apple has been very deliberate to stating that they are trying to support as many standards as possible, provided that they are ready for primetime. Specifically, that they are far enough along in their development cycle that they are stable, do not create instabilities in other operating system services, function as expected and do not create security issues.

Currently supported standards include but are not limited to:

**Networking Connection Protocols:**

TCP/IP; PPP; PPPoE; DHCP; BootP.

**File Sharing Protocols:**

Apple File Protocol (AFP), Samba (SMB/CIFS), WebDAV and NFS.

**File Systems:**

HFS; Enhanced HFS; UFS; UDF, ISO-9660; DOS.

**Internet Protocols and Applications installed as standard in Mac OS X:**

RTP/RTSP; LDAP; PHP (limited install); FTP; CGI; MacPerl; Apache; Telnet.

**Security:**

OpenSSL; OpenSSH; Kerberos. Apple works closely with security watchdog organizations CERT and FIRST.

**Optional Installs available via the Internet:**

tcl/tk; XFree86; PHP (full-install); MySQL; PostgreSQL; this list continues to grow.

Multimedia File Formats Supported in Mac OS X via QuickTime:

Import Formats	Export Formats	Video Compressors	Sound Compressors
3DMF	AIFF	H.261	24-bit integer
AIFF	AU	H.263	32-bit floating point
AU	AVI	Animation	32-bit integer
Audio CD DATA (Mac.)	BMP	Apple BMP	64-bit floating point
AVI	DV Stream	Apple Video	Alaw 2:1
BMP	FLC	Cinepak	AU
Cubic VR	Image Sequence movie	Component Video	IMA 4:1
DLS	JPEG/JFIF	DV NTSC and PAL	MACE 3:1
DV	MacPaint	Graphics	MACE 6:1
FlashPix*	MIDI	Microsoft OLE	MS ADPCM
FLC	Photoshop	Microsoft Video 1	QDesign Music 2
GIF	PICT	Motion JPEG A and B	Qualcomm PureVoice
JPEG/JFIF	PNG	Photo JPEG	
Karaoke	QuickTime Image File	Planar RGB	
MacPaint	QuickTime Movie	Sorenson Video 1, 2, & 3	
Macromedia Flash 4	SGI		
MIDI	System 7 Sound		
MPG-1	Targa		
MP3	Text		
M3U	TIFF		
Photoshop*	WAV		
PICS			
PICT			
PLS			
PNG			
QuickTime Image File			
QuickTime Movie			
SF2			
SGI			
Sound			
Targa			
Text			
TIFF*			
TIFF Fax			
Virtual Reality (VR)			
Wave			

\*Quicktime also supports the import of multiple images and layers in TIFF, FlashPIX, and Photoshop files.

## Darwin / Mac OS X – Differentiation

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As stated earlier, the core level of Mac OS X resides a Unix foundation, known as Darwin. What distinguishes Darwin from Mac OS X are the multimedia/imaging models and application environments, which are not open source. The imaging models are: Quartz, OpenGL, QuickTime, and Core Audio. The application environments are: Classic, Carbon, Cocoa, Java and AppleScript™.

### Quartz

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Quartz is probably the single most significant component of Mac OS X. It is a powerful graphics system that provides on-the-fly rendering, anti-aliasing, and compositing of two-dimensional graphics. The two-dimensional drawing component is PDF-based. Any Mac OS X application that has a print command has the capability of generating a pdf file of any open document.

*For further details see*

*<http://developer.apple.com/techpubs/macosx/CoreTechnologies/graphics/Quartz2D/quartz2d.html>*

### OpenGL

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Apple decided to build OpenGL into Mac OS X, rather than continuing to develop its own QuickTime-3D. Currently, Apple is on the OpenGL Architecture Review Board (ARB) along with 3Dlabs, ATI, Compaq, Dell Computer, Evans & Sutherland, Hewlett-Packard, IBM, Intel, NVIDIA, Microsoft, SGI, and Sun.

*For further details see <http://www.opengl.org/>*

### QuickTime

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QuickTime is a multimedia abstract layer. It is this layer of Mac OS X, which allows native applications to support numerous image file types (e.g. JPG, GIF, TIFF, etc.), audio file

& codec types via Core Audio (e.g. MPG-1 L3, AIFF, WAV, etc.), and video-file & codec types (e.g. MPG-1, 2 & 4, MOV, AVI, etc.).

*For further details see <http://developer.apple.com/quicktime/>*

## Core Audio

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Core Audio is comprised of low-level APIs. It is those APIs, which allow developers to build audio into applications, or build advance audio editing software. This audio layer manages all audio as 32-bit floating-point data and has latency as low as 1-millisecond. Enabling Core Audio to handle 96KHz 24-bit audio without the addition of specialized audio hardware.

*For further details see <http://www.apple.com/macosx/technologies/audio.html>*



## Classic

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Classic is essentially Mac OS 9 launched within a protection area of RAM. It was developed to allow users to continue to use their legacy applications within Mac OS X, including the ability to pass information from legacy applications to native Mac OS X applications. This greatly reduces the need to reboot when the user wants to launch a legacy application (this excludes hardware level device drivers, e.g. printer drivers). It therefore enables users to upgrade their legacy applications at their own pace, not on Apple's schedule.

## Carbon

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Apple realized that it was time for some changes: In the 15 years it has been around, the Macintosh operating system had acquired some 8000 APIs (Application Programming Interfaces). Apple found that over 2000 would inhibit the advancement of the Macintosh OS, so they removed them. The remaining 6000 APIs are collectively called Carbon. To quote Steven Jobs (CEO Apple Inc.), "We've named that API set Carbon," Jobs said, and quipped, "All life forms will be based on it." The most significant aspect of Carbon for



developers was that these sets of APIs are contained in both Mac OS 9 and Mac OS X. Thus allowing developers to maintain their current code-base and customer base, while at the same time progressing their code on to the new platform, more specifically write once, compile once, deploy twice (OS9 and OSX). The Carbon APIs are built using the C and C++ languages.

*For further detail see <http://developer.apple.com/carbon/index.html>*

## Cocoa

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Cocoa has its origins in OPENSTEP. The Cocoa application environment is designed specifically for Mac OS X-only native applications. It is comprised of a set of object-oriented frameworks that support rapid development and high productivity.

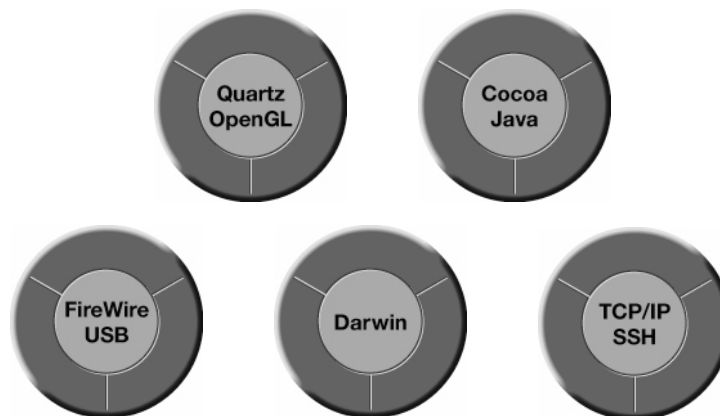
*For further details see <http://developer.apple.com/cocoa/index.html> ; or <http://developer.apple.com/techpubs/macosx/Cocoa/SiteInfo/NewToCocoa.html>*

## Java

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Apple's decision to include Java 2 Standard Edition 1.3 (J2-SE, including the client version of the HotSpot virtual machine) in Mac OS X, again shows their commitment to supporting standards. But they did not stop at merely supporting Java in Mac OS X, but deployed Java in such away as to enable it as a full deployment language. The only other company, which has done this to their operating system, is the creator of Java, Sun Microsystems™.

*For further details see <http://developer.apple.com/java/index.html>*



## Copyright

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The intent of this document is to provide concise and general information regarding the personal computer operating system developed by Apple Computer Inc., known as the Macintosh Operating System X (commonly abbreviated as Mac OS X). Any content of this document that is protected by trademark, copyright or patent is still held by their respective creators and/or businesses. Should anyone desire to reference information contained this document; it is recommended that they cite the original sources (see below). This document may not be distributed without this copyright page.

## Sources

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Apple Computer Inc.:

[www.apple.com](http://www.apple.com)

[www.apple.com/developer](http://www.apple.com/developer)

Be Computer Inc.:

[www.beos.com](http://www.beos.com), also see [www.palm.com](http://www.palm.com)

Motorola:

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