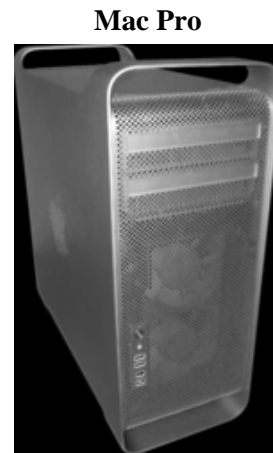


# Mac Pro

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The **Mac Pro** is a workstation computer manufactured by Apple Inc. The machines are based on Intel Xeon microprocessors and a PCI Express architecture, but are similar to the Power Mac G5 they replaced in terms of



<b>Type:</b>	Workstation
<b>Developer:</b>	Apple Inc.
<b>Released:</b>	August 7, 2006
<b>Processor(s):</b>	Intel Xeon, 2 × dual-core 2.0, 2.66 or 3.0 GHz 64-bit 2 × quad-core 3.0 GHz 64-bit
<b>Base Price:</b>	USD\$2,200 (standard configuration US\$2,499)
<b>Website:</b>	<a href="http://www.apple.com/macpro/">www.apple.com/macpro/</a> ( <a href="http://www.apple.com/macpro/">http://www.apple.com/macpro/</a> )

outward appearance and expansion capabilities. They are currently the most powerful desktop computers in the Macintosh lineup.

The Mac Pro was formally announced on August 7, 2006 at WWDC.<sup>[1]</sup> Along with the Mac Pro, a new Xeon-based Xserve was also announced, completing Apple's transition from the PowerPC to x86 architecture. On April 4, 2007 Apple unveiled the first 3.0 GHz, 8-core Intel Xeon-based Mac Pro.<sup>[2]</sup>

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## Overview

An Intel-based replacement for the PowerMac G5 had long been expected prior to the release of the Mac Pro. The iMac, Mac mini and laptops had moved to an Intel-based architecture starting in January 2006, leaving the PowerMac G5 as the only machine in the Mac lineup still based on the PowerPC. Speculation about the G5's eventual replacement was common. Rumors initially expected the machine to differ physically from the existing G5 and considered a number of different possible internal configurations based on different chipsets. But the coincidence of Intel releasing a new Core 2-based Xeon workstation platform just prior to the 2006 Worldwide Developers Conference (WWDC) made it fairly obvious that the resulting machine would be based on it. Even the naming was "obvious"; Apple had dropped the term "Power" from the other machines in their lineup, and started using "Pro" on their higher-end laptop offerings, the name "Mac Pro" was widely used before the machine was announced.<sup>[3]</sup>

The Mac Pro is a high-end computer, similar to the most powerful Unix workstations from vendors such as SGI or Sun Microsystems. Although the high-end technical market has not traditionally been an area of strength for Apple, the company has been positioning itself as a leader in non-linear digital editing for high-definition video,<sup>[4]</sup> which demands storage and memory far in excess of a general desktop machine. Additionally, the codecs used in these applications are generally processor intensive and highly threadable, speeding up almost linearly with additional processor cores. Apple's previous machine aimed at this market, the Power Mac G5, had up to four processors, but lacked the storage expansion capabilities of the newer design. In order to serve this market, Apple sells a variety of standardized bundles combining a Mac Pro with fairly high-end components; for instance, all available setups can support the 30" Cinema Display.

In general, the Mac Pro has been well received in the press.<sup>[5]</sup> The combination of high performance, reasonable expandability, very quiet operation and superb mechanical design makes it routinely appear as the comparison system against which other systems are measured. The Xeon platform is, however, Intel's "high end" system and not aimed at more general purpose use. Nevertheless, current-generation Xeons are priced competitively with their high-end desktop platforms, allowing Apple to sell a very powerful system at price points that are considered quite competitive, even by reviewers that do not normally review Apple systems.<sup>[6]</sup>

Marketing materials for the Mac Pro generally refer to the middle-of-the-line model with 2 × dual-core 2.66 GHz processors. In the past Apple has featured the base model with the words "starting at" or "from" when describing the pricing, but the online Apple Store lists the "Mac Pro at \$2499", the price for the mid-range model. The base model can be configured at US\$2200, much more comparable with the former base-model dual-core G5 at US\$1999, although offering considerably more processing power.

There is a fairly large performance gap between the Mac Pro and Apple's most powerful consumer machine, the iMac. A particular sore point for many is that the Mac Pro is the only machine in Apple's lineup that can easily change its graphics card; other machines in the lineup use integrated graphics or hard-to-replace expansion cards and higher cost laptop parts, while the Mac Pro uses the industry standard PCIe slots. However, buying a workstation platform just to allow for upgradable graphics is something many people and reviewers have complained about. This has led to calls for an "xMac"; a smaller machine with more limited expansion capabilities but retaining a 1-2 PCIe slots.<sup>[7]</sup>

## Description

*The specifications below are from Apple's "tech specs" page<sup>[8]</sup> or developer notes<sup>[9]</sup>, except where noted.*

The Mac Pro uses either two Xeon 5100 "Woodcrest" 64-bit CPUs for a total of four processor cores or two Xeon 5300 "Clovertown" 64-bit CPUs for a total of eight processor cores. Each CPU chip has 4 MB (Quad-Core) or 8 MB (8-Core) of on-chip cache shared among its processor cores. Each processor slot has its own independent 64-bit 1.33 GHz front side bus, offering an aggregate throughput between the CPUs and the "northbridge" of 21.3 GB/s.

The computer's main memory uses 667 MHz FB-DIMMs installed in pairs, one each on two riser cards. The cards have 4 DIMM slots each, allowing a total of 32 GB of memory (8 x 4 GB) through aftermarket additions.<sup>[10]</sup>

Notably, due to its FB-DIMM architecture, installing more RAM in the Mac Pro will improve its memory bandwidth, but may

also increase its memory latency.<sup>[11]</sup>

With a simple install of a single FB-DIMM the peak bandwidth is 8 GB/s, but this can increase to 16 GB/s by installing two FB-DIMMs, one on each of the two buses, which is the default configuration from Apple. The Mac Pro makes particular demands on the cooling capabilities of the DIMMs, which initially led to some minor problems with 3rd party RAM,<sup>[12]</sup> but has since been addressed (see notes below).

For internal expansion the Mac Pro has four PCI Express (PCIe) 1.1 expansion slots, providing them with up to 300 W of power in total. The first slot is intended to hold the main video card, and is arranged with an empty area the width of a normal card beside it in order to leave room for the large coolers modern cards often use. In most machines, one slot would be blocked by the cooler. Instead of the tiny screws typically used to fasten the cards to the case, in the Mac Pro a single "bar" holds the cards in place, which is itself held in place by two "captive" thumbscrews that can be loosened by hand without tools and will not fall out of the case.

The PCIe slots can be configured individually to give more bandwidth to devices that require it, with a total of 26 "lanes", or 13 GB/s total throughput. Although this is slightly less than bandwidth offered by late model Power Mac G5, which featured 32 lanes with a total throughput of 16 GB/s, the G5 lacked the Mac Pro's user-configurable bandwidth allocation. When running Mac OS X, the Mac Pro currently does not support SLI or CrossFire, limiting its ability to use the latest "high-end gaming" video card products; however, individuals have reported success with SLI installations when running Windows XP.<sup>[13]</sup>

The Mac Pro also has room for four internal hard drives, each with its own SATA-300 port. The hard drives are mounted on individual trays, provided with the machine, by captive thumbscrews similar to the one used for the PCIe slots. There are no cables to be attached, the SATA and power connectors are firmly attached to the case, and the drive is connected to them simply by pushing it in. The case lock on the back of the machine locks the trays into position. The Mac Pro lacks built-in hardware RAID circuitry, but RAID protocols 0, 1, 0+1 and 1+0 are supported over all internal and external drives through included software<sup>[14]</sup>. Two optical drive bays are available, each with a SATA-300 port and an ATA-100 for each of the two bays. Many optical drives still use the older ATA ports, including those currently being shipped with the machines. The Mac Pro also has two internal SATA ports that are not connected to drive bays; these can be put into service through the use of after-market extender cables.<sup>[15]</sup>

For external connectivity the system includes five USB 2.0 and four FireWire ports, two of the latter being FireWire 800. Networking is supported with two built-in Gigabit Ethernet ports, while 802.11 a/b/g/draft-n<sup>[16]</sup> WiFi is supported via an optional AirPort Extreme card. Bluetooth is also a build-to-order option. Unlike other recent Mac products, the Mac Pro does not include the infrared receiver needed to use the Apple Remote. However, Front Row was found to be installed on some Mac Pros, but was not accessible using the normal Cmd-Esc key combination. The system also provides both optical and electrical "headphone jacks" for sound in and out, the latter available on both the front and back of the case. Like most recent Apple machines, the Mac Pro microphone-in line requires a powered mic, which is difficult to find.

The exterior of the aluminum case is similar to that of the Power Mac G5, with the exception of an additional optical drive bay, and a new arrangement of I/O ports on both the front and the back. The case is somewhat larger than a typical PC of the same generation, at 20 × 18½ × 8 inches, compared to a typical desktop PC (the Dell Dimension 9100) at 17½ × 17½ × 6½ inches. Some of the difference in height is due to the "handles" on the top and bottom of the case. The case can be opened by operating a single lever on the back, which unlocks one of the two sides of the machine, as well as the drive bays. All of the expansion slots for memory, PCIe cards and drives can be accessed with the one panel removed, and require no tools for installation.

The Xeon processors generate much less heat than the previous dual-core G5s, so the size of the internal cooling devices has been reduced significantly. This allowed the interior to be re-arranged, leaving more room at the top of the case and thereby allowing the drives to double in number. Less heat also means less air to move out of the case for cooling during normal operations; the Mac Pro is very quiet in normal operation, quieter than the already-quiet Power Mac G5<sup>[17]</sup>, and proved

difficult to measure using common decibel meters.<sup>[18]</sup>

## Specifications

- Processors: Two dual-core Xeon 5100 Series ("Woodcrest" Core microarchitecture with EM64T instruction set) processors at 2.0, 2.66 or 3.0 GHz, or two quad-core Xeon 5300 Series ("Clovertown") processors at 3.0 GHz.
- Memory: Minimum 1 GB 667 MHz DDR2 buffered ECC RAM (upgradeable to 32 GB), in eight FB-DIMM slots
- Graphics: nVidia GeForce 7300 GT 256 MB (up to four total), ATI X1900 XT 512 MB (requires use of the x16 PCI-Express slot) or nVidia Quadro FX 4500 512 MB (also requires use of the x16 PCI-Express slot)
- Storage: Four drive bays for Serial ATA hard disks: included disks have 8 MB cache (16 MB on each 750 GB hard drive) and run at 7200 RPM (total storage with four 750 GB hard drives, 3 TB)
- Optical Drive: 16× SuperDrive (multiple DVD write formats) (Pioneer DVR-111D or Sony DW-D150A), optional second drive. Optical bays support ATA/100 and SATA.<sup>[9]</sup>
- Networking: two Gigabit Ethernet ports, optional AirPort Extreme 802.11 a/b/g/pre-n, optional Bluetooth
- I/O: five USB 2.0 (two on front), two FireWire 400 (one on front), two FireWire 800 (one on front), optical audio input and output, 3.5 mm stereo audio input and output (one output on front)
- Software: Mac OS X v10.4 Tiger, iLife '06, Comic Life, OmniOutliner, various trial software.

## Operating systems

The Mac Pro comes with the BIOS successor EFI

1.1 and handles booting differently from the more common antiquated BIOS-based PC.

With Apple's Boot Camp

(current version beta 1.3) a backwards-BIOS-compatibility can be added, and dual and triple boot configurations can be achieved.<sup>[19]</sup> These operating systems are easily installable on Intel x86 based Apple computers:

- Mac OS X 10.4.7 and later (native, OS supports BIOS and EFI)
- MS Windows XP and Vista (hardware drivers are included in Boot Camp) (only supports BIOS)
- Linux (most late 2006 or 2007 distributions, including Fedora Core 6<sup>[20]</sup> and Ubuntu 7.04 Feisty Fawn) (supports both BIOS and EFI)

Other x86 operating systems should be easily installable too. Such as x86 Solaris, Dos, Be OS, BSD (which is very closely related to OSX anyway) and so on. This is made possible by the presence of a x86 Intel architecture as provided by the CPU and the BIOS emulation Apple has provided on top of EFI.

There are a number of challenges that one must face when trying to establish a multi-booting configuration on a single hard drive that uses the new GPT partitioning standard that Mac OS takes advantage of at the same time as MBR, which is commonly used by Windows and Linux (though Linux can use GPT). One must synchronize their GPT and MBR partition tables multiple times during the setup of such configurations. The key challenge being that a maximum of 4 partitions can be made on any such hard drive (including the EFI partition). This is because logical & extended MBR partitions are not possible which means that more than 4 partitions can not be referenced for the MBR component of the configuration. Thus having more partitions would force MBR and GPT to have differing partitioning schemes. The diskutil command-line app in OSX can non-destructively resize a single partitioned HFS+ formatted volume to a scheme usable for dual/triple boot configurations with BIOS/MBR.

## Compatibility

### Software

- Software (PPC Emulation) - PPC-Native Applications: Note that many high-end PPC-native applications will need to

be modified specifically to take advantage of the new Intel-based processor architecture in order to maximize on the Mac Pro's processor strengths, and PPC-native applications (such as Adobe Photoshop CS2 and earlier) may successfully run through translation software called Rosetta, which adds overhead and reduces actual software execution speed for those applications as it translates PPC-native instructions to Intel-native code. Speeds for some of these PPC-native applications may be lower on the Mac Pro than on the G5 models it replaces, and Rosetta does not support G5-processor-specific emulation.

- Software (Classic Emulation) - Classic (Mac OS 9.x and earlier): Intel-based Macs do not support Classic software, although third-party emulators such as SheepShaver may allow these applications to run.
- OS Minimums - The lowest version of the operating system that will support the Mac Pro is Mac OS X version 10.4.7. Earlier versions will not boot the computer.

## Hardware

- PCI-Express slots are not backwards compatible with prior versions of PCI hardware, such as PCI/33, PCI/66 or PCI-X.
- Apple recommends an Apple-specified heat sink on each memory DIMM for cooling, and the required on-chip thermal manager may shut down memory, or increase fan speed, if it starts to overheat.<sup>[12]</sup>  
At least one company, MaxUpgrades.com, has released self-installable, Apple-specified heat sinks for use with third-party memory, and a number of companies now sell DIMMs with heat sinks matching Apple's specifications.
- It is important to note that even though the Mac Pro uses industry standard PCIe X16 expansion slots (which are used for modern PCIe X16 video cards), a user cannot simply buy a new PCIe X16 video card and install it into a Mac Pro and use it normally. Using a standard video card will work with Windows XP or Vista under Apple's Bootcamp setup, but will not work under Mac OS X or before the machine starts to boot into Windows. The reason for this is that Apple uses the EFI BIOS, which requires a video card that features a EFI compatible video card bios. Mac OS X requires an EFI Bios, but Windows XP runs under a standard BIOS emulated with Apple's Bootcamp. Thus a Mac user could use a powerful video card, such as a GeForce 8800 GTX, under Windows on a Mac Pro. With one monitor this would require investing in a VGA/DVI video or KVM switch for the user to switch between the "Mac" video card and the new "PC" video card when the user wishes to play games or other 3d applications in Windows.

If a user wishes to get a more powerful video card for their Mac Pro and wishes to use it with Mac OS X, then they only have the option of getting a new card from Apple. Mac Pro EFI PCIe video cards are significantly more expensive than standard PCIe video cards with similar or the same configuration and graphics chip. As of July 11, 2007 Apple charges \$249 for a Radeon x1900 XT, while a user can get a standard "PC" ATi Radeon X1950 XT for less than \$200 on newegg.com. The X1950 XT is a faster card than the X1900 XT.

The Strangedogs.com forums have had users having some success flashing a "PC" PCIe video card to an EFI BIOS. This may require extensive modification to the video card however physically and in software.

Not all PCIe slots on the Mac Pro are electrically X16; only the "double wide" slot is electrically x16. PCIe X16 cards will fit in the other slots physically, but will suffer with lower performance as these other slots are dynamically allocated lanes based on what cards are installed.

- The Mac Pro does not support ATI's Crossfire technology, Despite having 300w of power to supply PCIe slots, having multiple X16 slots and having an crossfire compatible Intel chipset.

## References

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## External links

- Apple's Mac Pro website (<http://www.apple.com/macpro/>)
- Close-up pictures of the Mac Pro (<http://www.engadget.com/2006/08/07/apple-mac-pro-hands-on/>)
- Review of the Mac Pro (<http://arstechnica.com/reviews/hardware/macpro.ars/>)
- A Mac Pro with two 3.0GHz quad-core Intel Xeon processors (<http://www.digitmag.co.uk/news/index.cfm?NewsID=7692>)

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*Italics denote discontinued products.*

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