

The latest Photoshop splash screen, Red Pill.... you can access it by selecting 'About Photoshop' from the Photoshop menu in the menubar while pressing the command key.

Photoshop Acceleration Basics 2.4

A MacGurus Guide to Photoshop Performance Acceleration

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An Overview



The purpose of this article is to help users optimize performance with common-sense guidelines- not only with the newest fastest machines, but with older hardware as well. Workflow requirements vary widely and many users operate Photoshop quite nicely with “vintage” Macs. While they probably could benefit from a modest investment in RAM and perhaps a larger hard drive- upgrading to a new machine may not be worth it.

On the other hand, many of today’s Photoshop users need every bit of muscle their Mac’s can muster. From complex filter operations and huge many-layered high-bit files, to massive batch-processing and workflows requiring multiple open applications- all of these can quickly push a Mac’s capabilities to the extreme. These users need the fastest, most powerful setups: the latest Mac Pros, Mac OS 10.4 “Tiger”, CS3, large quantities of RAM, fast hard drives- even RAID arrays.

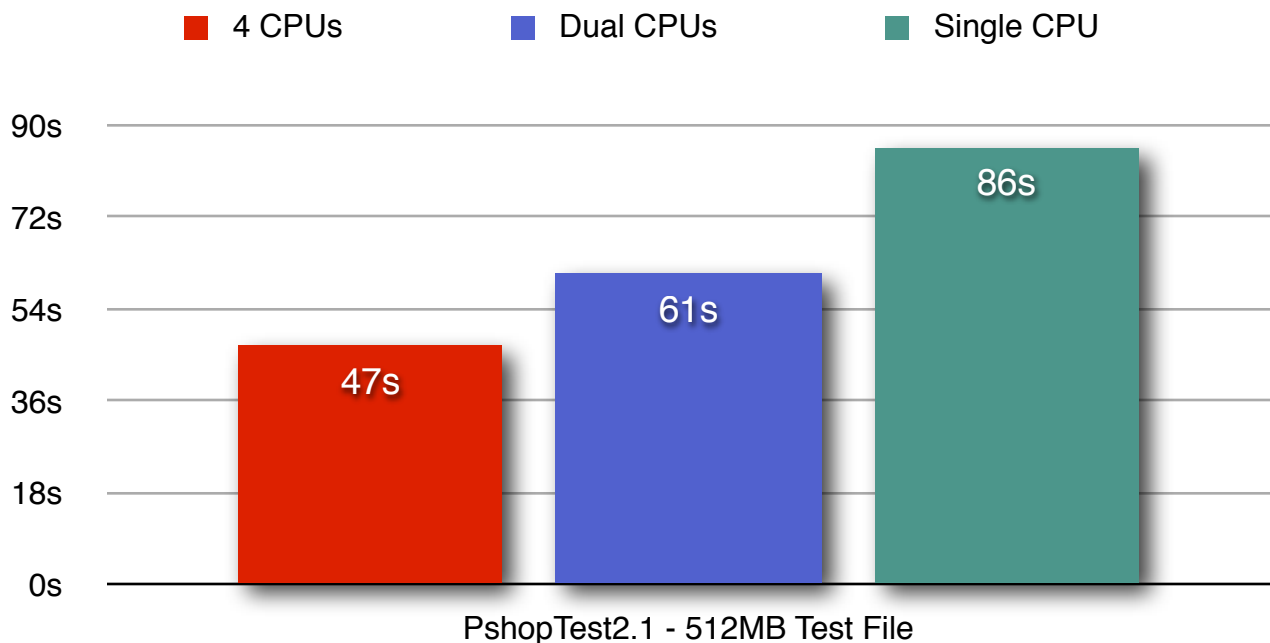
To help you get the most out your existing setup or help plan your new one, the pages that follow focus on factors which have the greatest impact on Photoshop performance.

As always, appropriate care and caution should be used before you perform any alteration to your existing installation. The importance of maintaining frequent and multiple backups of your precious data cannot be over-emphasized.

Multiple-processor Macs

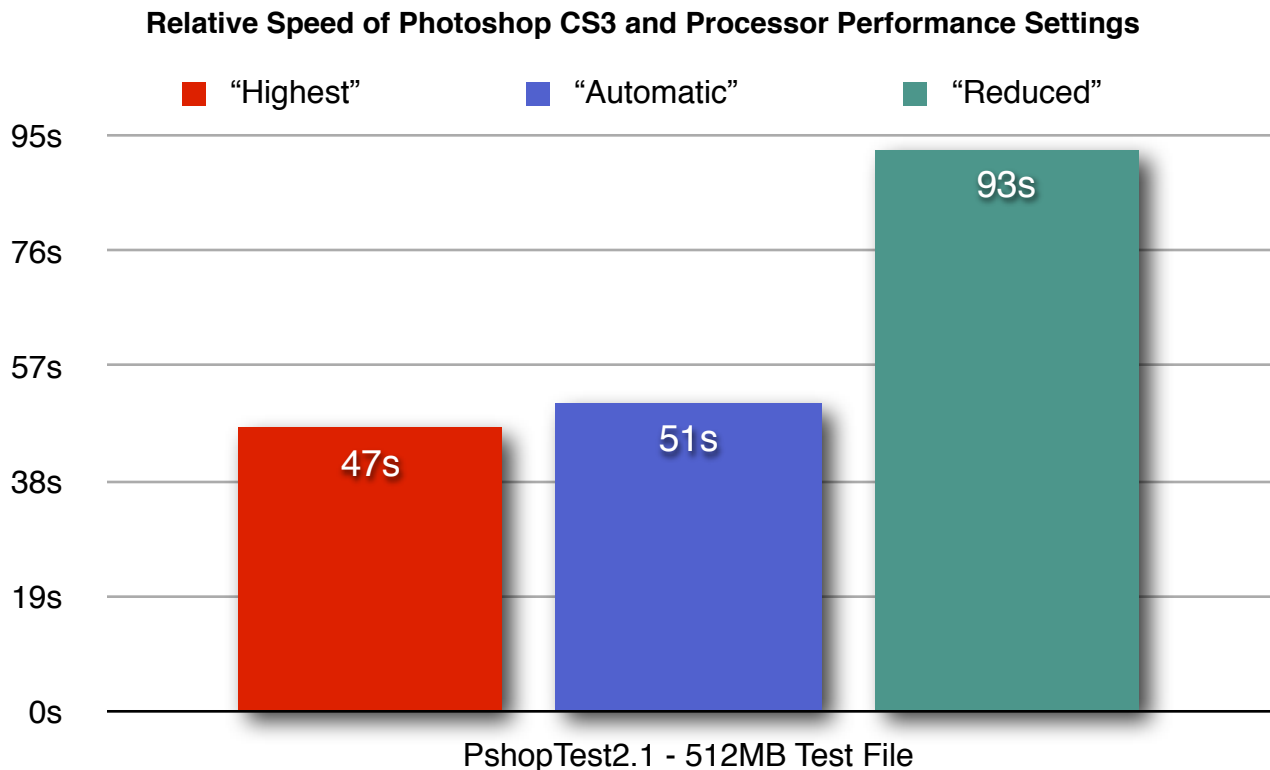
The choice of which Mac model to use with Photoshop has the biggest overall impact on performance. Dual and Quad processor G5s and Intel Macs are much faster than earlier single-processor machines. Photoshop runs faster on the newer multi-core machines. All Photoshop features are faster on a multiple-processor system, and some features are much faster.

Relative Speed of Photoshop CS3 with Single and Multiple Processors



While Photoshop will run adequately on Apple G3 and G4 computers, these models are said to be "bus-limited". What this means in practice, is the relatively slow FSB (Front-side Bus) speed of G3 and G4 architecture is the over-riding limiting factor in data thru-put on these systems. They are also limited to substantially less RAM capacity than G5 or Mac Pro workstations. Both of these factors hobble Photoshop performance significantly when working with larger image files. To some extent, these limitations can be offset by using faster hard drives and installing maximum RAM. However- G5s and Intel-based Macs are much faster computers right out of the box; the FSB thru-put is many times faster, and with most models the installed RAM capacity is much greater.

✿ **Tip** • For the fastest performance, set the "Processor Performance" to "Highest" in the Energy Saver preference pane. Un-check the "Put the hard disk(s) to sleep when possible" checkbox to avoid performance delays after periods of inactivity.



Mac OSX

While Photoshop 7, CS, and CS2 can be used with earlier versions of Mac OSX- Photoshop CS3 requires Mac OS 10.4.8 or newer. "Tiger" is the fastest version of OSX to date. For superior speed and stability, use the earlier versions of Photoshop with Mac OS 10.4 as well as CS3.

✿ **Tip** • Use a "lean 'n mean" approach when installing the Mac OSX system and other software. Keep disk clutter to a minimum with custom installs, eliminating unneeded language localizations and extra printer drivers. Remove unnecessary applications, plug-ins, and unused fonts (or use font management software). This can help keep your system and data files closer to the outer area of your hard drives for faster performance- and minimize any chance of software conflict.

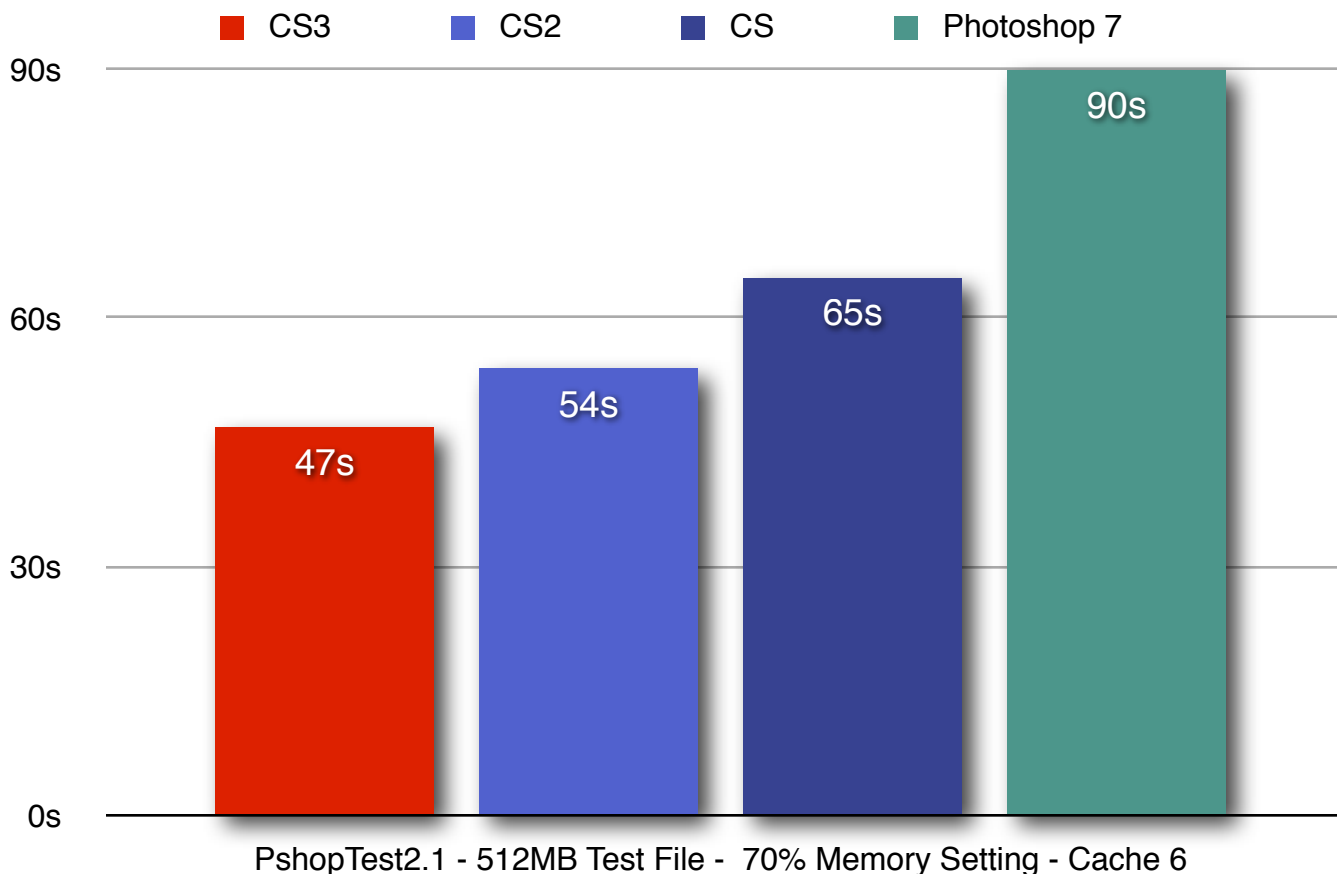
Photoshop Versions



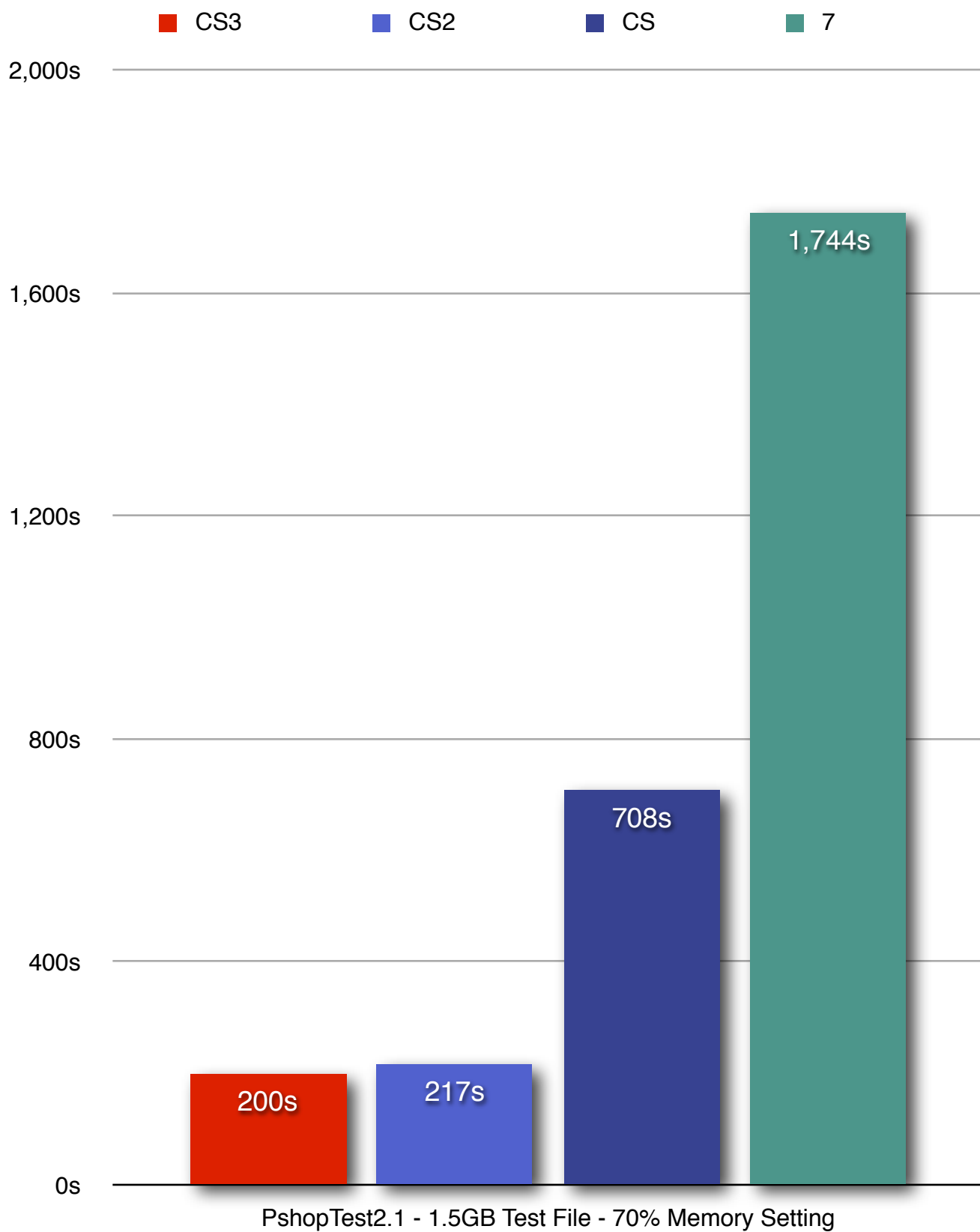
For the fastest and most versatile Photoshop performance, use the latest versions. Photoshop CS3 is faster than Photoshop CS2 on both PPC-processor and Intel-processor Macs. CS2 is faster than Photoshop CS with Mac OS 10.3 or 10.4- largely due to it's higher RAM limits. Overall performance of CS is substantially faster than Photoshop 7.

For best performance on Intel Macs, use CS3; older versions of Photoshop are not written in the Universal Binary code language required for Intel processors. When run on Intel Macs, Photoshop 7, CS, and CS2 must resort to using RAM and processor-intensive emulation software (Rosetta) to function. This can slow performance of these versions on Intel Macs.

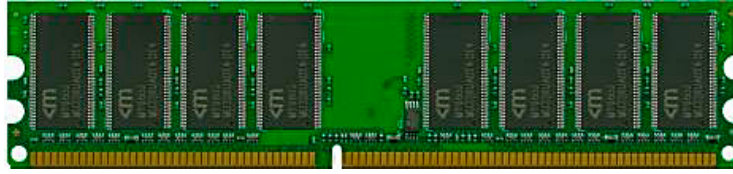
Relative Speed of Photoshop Versions



Relative Speed of Photoshop Versions with 1.5GB Test File



Photoshop and Memory

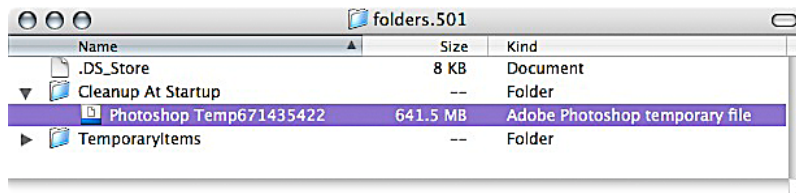


In any Mac, Photoshop uses the two main data storage hardware components- RAM and hard disk drives- to access temporary and permanent data. The data stored in RAM is accessed very quickly because there are no moving parts- and it can read and write data at the same time in no particular order. It is the fastest part of a computer's memory system. In contrast, data on the hard drive is accessed more slowly; it is limited by moving parts which have to travel to different physical locations to find or store the data.

Fortunately, Photoshop tries to do as much work as possible using the installed RAM in the computer- rather than the hard drive. *It thrives on RAM and putting more in your machine can make a big positive difference with performance.*

Both Photoshop and the Mac OSX operating system use space on the hard drive to access permanent data- in the form of application and image files, and temporary data- in the form of the Photoshop scratch disk file and sometimes Mac OSX's "virtual memory" swapfiles. *The speed of hard drives has a substantial impact on Photoshop performance.*

The Scratch Disk

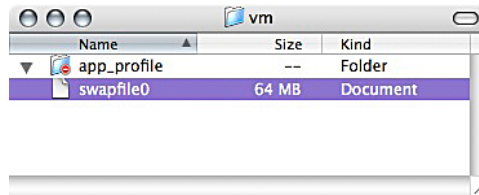


If not enough RAM is available to perform operations, Photoshop must rely heavily on its "scratch disk"- a large temporary file created on the hard drive and used whenever Photoshop is running. The scratch disk stores changes to open image files, and is also used as a substitute memory space when not enough RAM is available to store temporary data. Under ideal conditions, the scratch disk is accessed infrequently, and used mostly passively as a record of changes to open image files- a source of History states.

Heavy scratch disk use slows performance. The best way to minimize heavy scratch disk use is to install a lot of RAM. Sometimes heavy scratch disk use is unavoidable- even with a lot of installed RAM. The best way to minimize the negative impact on performance of heavy scratch disk activity is to *use a fast separate hard drive or RAID array exclusively for the scratch disk.*



The Swapfile



Like Photoshop, Mac OSX also uses a virtual memory system, and creates a temporary file on the Startup disk hard drive called the “swapfile”. Like Photoshop’s scratch disk, the swapfile is present whenever Mac OSX is running. When adequate RAM is available, the swapfile is used infrequently or not at all- but like Photoshop’s scratch file, Mac OSX’s swapfile can be used actively as a substitute memory space when not enough RAM is available to perform operations.

Page-swapping

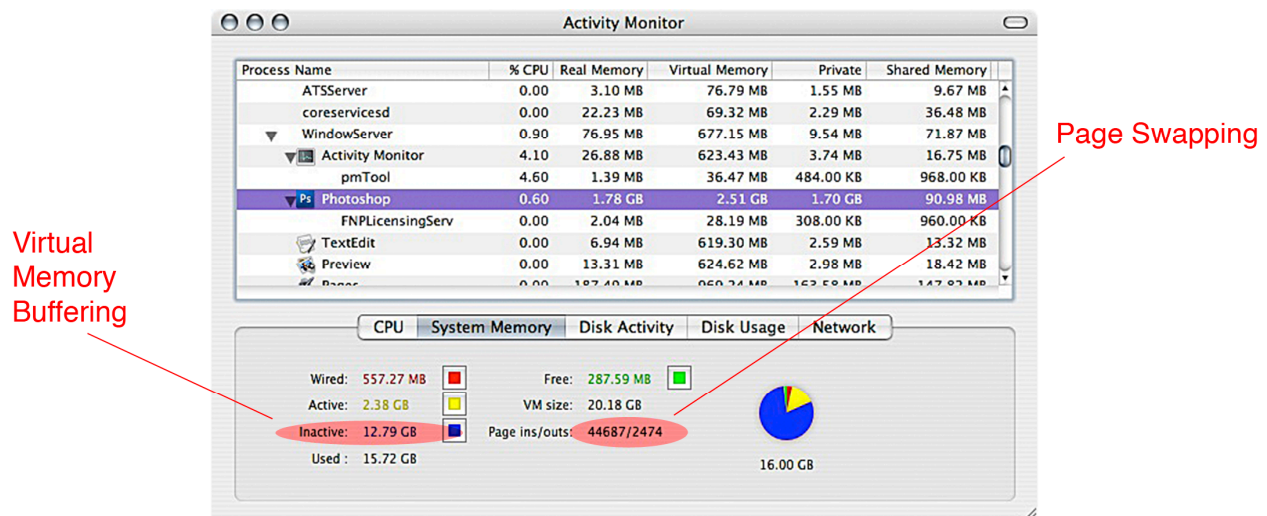


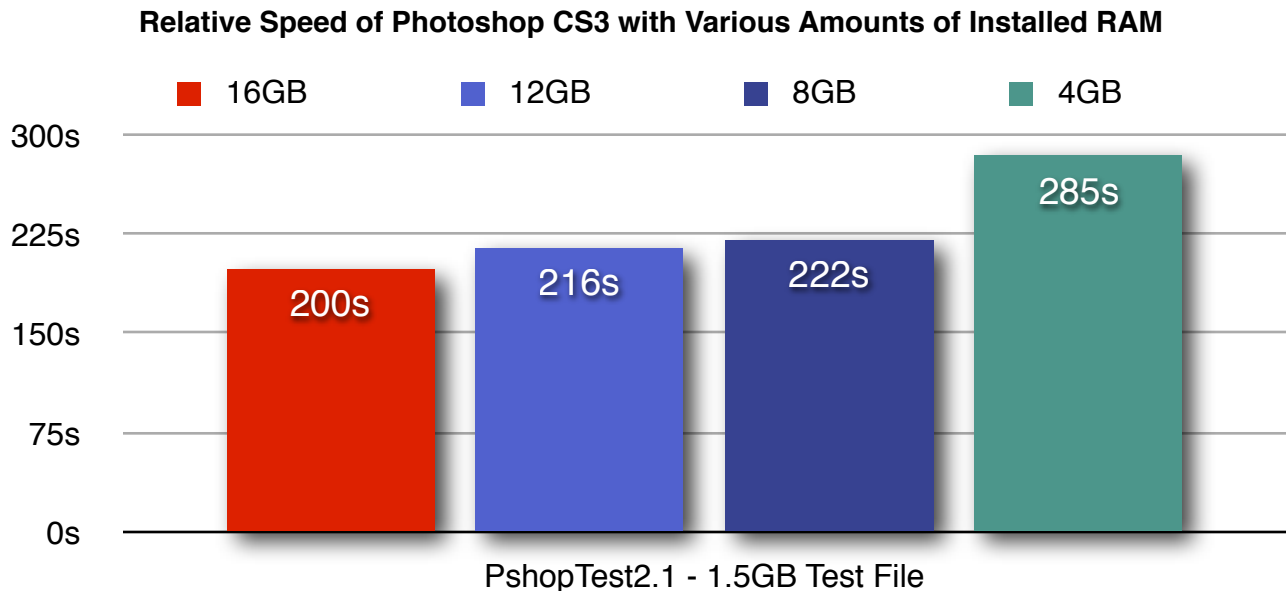
Image files can vary greatly in size. As they increase in size they require more hard drive space for storage, and they occupy more RAM when opened. The installed RAM available to both Photoshop and the Mac OSX operating system can be used up quickly when working with large image files. When all available RAM is already in use but more is required- Photoshop must actively use the scratch disk as a substitute for RAM.

Mac OSX always reserves a certain amount of RAM for itself- regardless of other running applications. But when the amount of RAM Photoshop and Mac OSX are trying to use is more than the total amount of RAM on the computer, Mac OSX also has to use the hard drive as a substitute for RAM, and it begins to actively read and write data to its “virtual memory” swapfile in order to complete whatever operation is in progress. This is known as “page-swapping”, and has a negative impact on performance. Under ideal conditions, page-swapping is infrequent or does not occur. However- sometimes its occurrence is unavoidable- especially when working with really large images. *The best way to minimize the possibility of page-swapping is to install a lot of RAM. The best way to minimize its negative effect when it does occur- use a fast hard drive for the Startup disk.*

In the illustration above, active page-swapping is represented by the second number (to the right of the slash mark) next to *Page ins/outs*: In this case- 2474. When no page swapping has occurred between restarts of the computer, this number is normally 0. Here, all the installed RAM is being used, and more was clearly required.

Disk-thrashing

“Disk-thrashing” is a debilitating condition which can occur when both Mac OSX and Photoshop need more RAM to perform an operation but none is available and 1) Photoshop’s primary scratch disk is the default Startup disk and 2) heavy scratch disk use is occurring and 3) heavy page-swapping is occurring. This causes the mechanical read-write arm of the Startup disk hard drive to have to travel constantly all over the surface of the drive’s platters to read and write data. Disk-thrashing can have a severe negative impact on performance- sometimes forcing progress to a virtual standstill. *The best way to avoid the possibility of disk-thrashing is to install a lot of RAM, and use a separate hard drive or RAID array exclusively for Photoshop’s primary scratch disk.*



The Reality of RAM

In theory, Photoshop 7 and Photoshop CS can use up to 2GB of RAM before resorting to active scratch disk usage. In actual practice, 100% "Available RAM" in Photoshop 7 and CS memory preferences varies between about 1600MB and 1800MB in systems with 2GB or more of RAM. This is because Photoshop 7 or CS "sees" only the first 2 GB of installed RAM, and- assuming this is the total amount installed in the machine, reserves a minimal amount of memory for the Mac OSX operating system.

Both Photoshop CS2 and Photoshop CS3 have larger RAM limits and additional sophisticated features. When used with Mac OS 10.3 or newer and 4GB of installed RAM, CS2 can use more RAM directly for image data- up to 3072MB. An additional amount of RAM- approximately 600MB- is reserved especially for plug-ins, filters, actions, and other operations that need large amounts of contiguous memory- bringing the total used directly by Photoshop to roughly 3.7GB. Both CS2 and CS3 "see" only the first 4GB of installed RAM, and assuming this is the total amount in the machine, reserve a minimal amount of memory for the Mac OSX operating system.

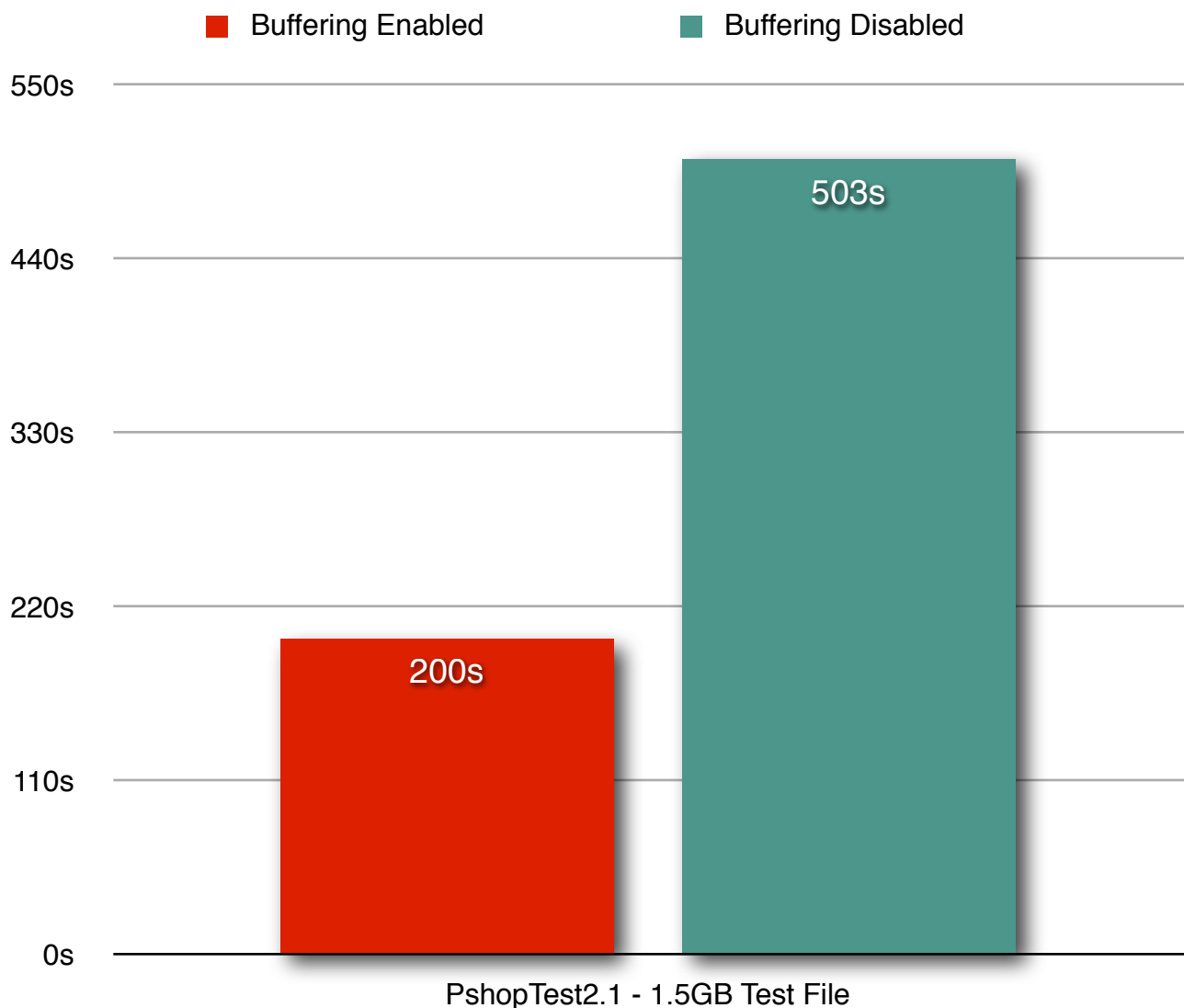
For best performance, provide Photoshop and the Mac OSX operating System with as much RAM as possible. Adding additional RAM to your machine is an excellent investment; it improves overall system performance across a wide range of applications by reducing swapfile activity, and it allows Photoshop to keep more image data in RAM for faster processing and less scratch disk use. Large amounts of installed RAM improve Photoshop performance dramatically.

Virtual Memory Buffering

When 4GB or more of RAM are installed, both Photoshop CS2 and CS3 can use the available RAM above 4GB to “pre-cache” scratch disk data directly in RAM before writing it to disk. This is called “virtual memory buffering”. During operations, Photoshop will try to use this RAM-cached scratch data first before using scratch data stored on the scratch disk hard drive. This results in faster performance- especially with larger image files- and allows CS2 and CS3 to benefit from very large amounts of installed RAM. Virtual memory buffering is enabled by default in Photoshop CS2 but not in Photoshop CS3. Use the “Force VM Buffering” Plug-in to enable it. *Take advantage of VM buffering by installing more than 4GB of RAM.*

In the illustration on page 7, virtual memory buffering is represented by the figure next to *Inactive*: in this case 12.79GB. You can see in the pie chart, represented in blue, a huge amount of RAM being used exclusively to pre-cache Photoshop’s scratch disk data.

Relative Speed of Photoshop CS3 with Buffering Enabled vs Buffering Disabled

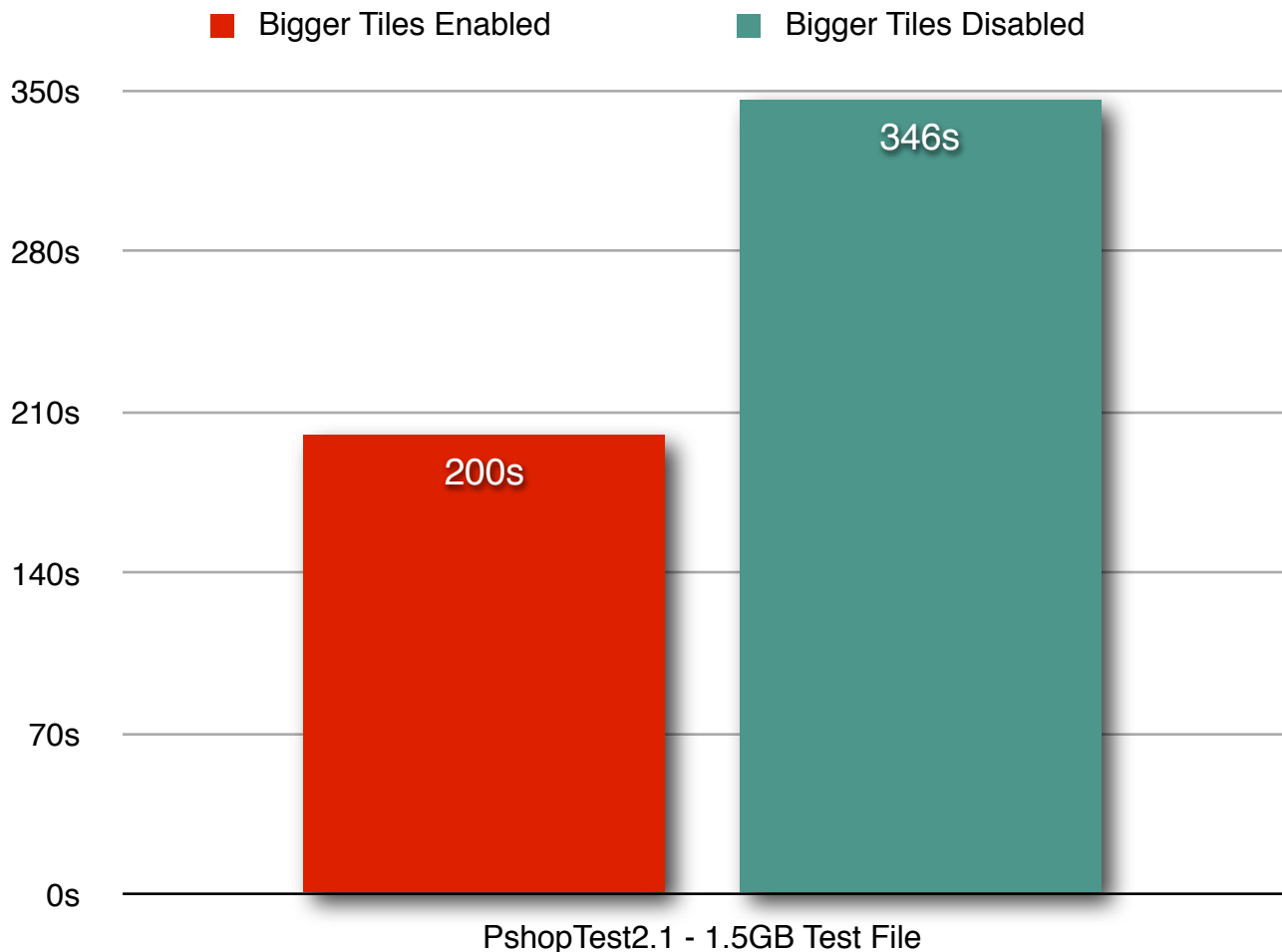


In some systems with 4 or more GB of installed RAM- using virtual memory buffering may cause delays while painting. This is due to a problem with Mac OSX where it “pauses” every 30 seconds for up to several seconds to manage the cached scratch disk data (Hopefully, this will be fixed in Mac OS 10.5). For this reason Adobe provides the “DisableVMBuffering.plugin” for Photoshop CS2. CS3 users can choose not to enable virtual memory buffering by either activating the “DisableVMBuffering.plugin” or de-activating the “ForceVMBuffering.plugin”. Plug-ins are deactivated by quitting Photoshop, then inserting a ~ in front of the plug-in s name, and then re-opening Photoshop.

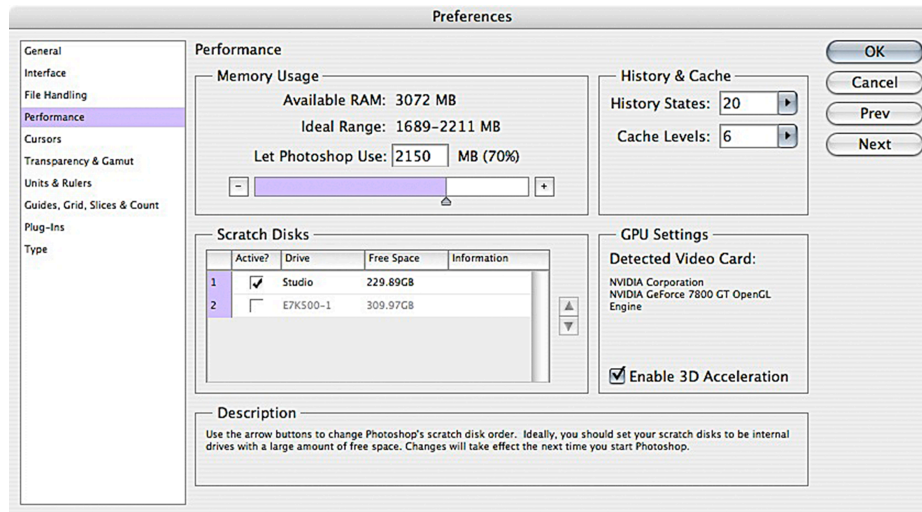
The Bigger Tiles Plug-in

Using the Bigger Tiles Plug-in causes Photoshop to process image data in larger chunks and really helps reduce the overall time to complete many operations, especially on computers with more than 1 GB of installed RAM. Bigger Tiles is enabled by default in Photoshop CS3 but is disabled by default in Photoshop CS2. *Use Bigger Tiles with CS2 & CS3 to boost performance on computers with more than 1GB of RAM.*

Relative Speed of Photoshop CS3 with Bigger Tiles Enabled vs Bigger Tiles Disabled



The Memory Slider



Adobe recommends setting the memory slider in Photoshop's Memory & Image Cache preferences to less than 100% to avoid depriving the Mac OSX operating system of RAM it may need to efficiently do what Photoshop asks it to do. In some cases, if Photoshop is allowed to use too much RAM, excessive page swapping on the Startup disk is the result and performance suffers.

For *your* system, the optimal setting for the memory slider in Photoshop's memory preferences may vary depending on the amount of installed RAM and your workflow. A 70% setting is generally the best for working with smaller and medium-sized image files- though computers with insufficient installed RAM may require settings of less than 70%. When working with larger image files and a lot of installed RAM, a setting of 100% *can* provide the fastest performance- but use caution. You can use a testing utility like [PshopTest2.2](#) to determine the optimal setting for your particular system.

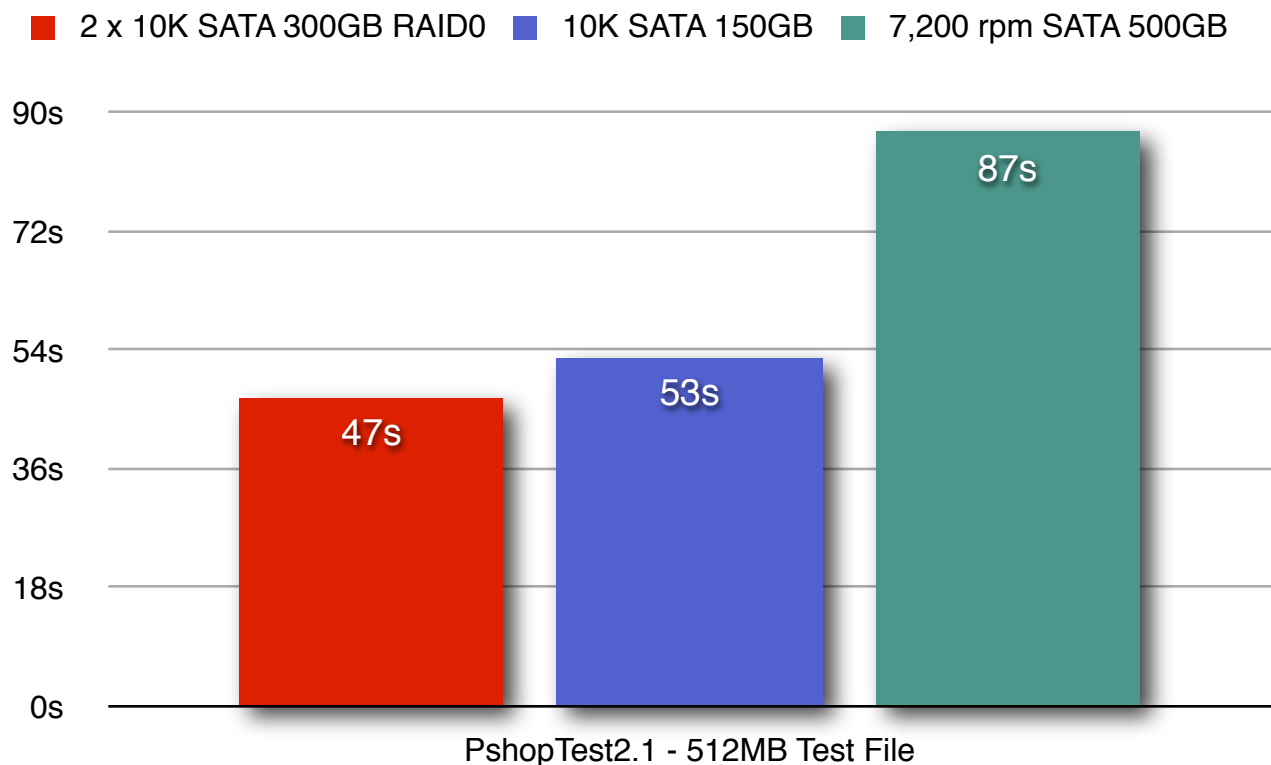
✿ **Tip** • By limiting Desktop icons, startup items, background processes, and other running applications- you can provide Photoshop with the maximum amount of RAM, allowing it to run faster with less scratch disk activity.

Installed RAM Guidelines

- For all pre-G5 models, G5 iMacs, Intel iMacs, MacBooks, MacBook Pro, and Intel Mac Minis- install the maximum amount of memory the machine can handle.
- For all G5 and Mac Pro towers, start with 4GB of RAM. If you work with larger files, install 8GB of RAM, and consider installing more for maximum performance.

✿ **Tip** • Use Activity Monitor to determine if you have adequate RAM installed; watch for evidence of page-swapping during your work sessions. Add more RAM if it occurs on a regular basis.

Relative Speed of Photoshop CS3 with Different Startup Disks



Photoshop and Hard Drives

Photoshop performance improves considerably with the use of faster hard disk drives. For best performance, use fast, modern hard drives, for the Mac OSX Startup disk, image files, and Photoshop's scratch disk. With faster hard drives, Photoshop opens and saves changes to image files more quickly, executes operations more quickly, and reads and writes scratch disk data more quickly.

It is best practice to provide Photoshop with a second hard drive- or even a RAID disk array- to be used exclusively for Photoshop's primary scratch disk. A fast independent scratch disk improves performance, especially when working with large History settings or larger image files. A dedicated scratch disk on a separate physical hard drive or RAID array allows Photoshop large areas of free space for its scratch data so it can be accessed in large, uninterrupted chunks- thus allowing for faster performance. It also reduces the potential for disk-thrashing if page-swapping occurs on the Startup disk.

Disk Guidelines

- If a hard drive or disk array is to be partitioned into multiple "volumes" and also used for Photoshop's primary scratch disk- the dedicated scratch disk should always be the first volume (outer partition) on that hard drive or RAID array.
- If a hard drive or RAID array is to be partitioned into multiple "volumes" and contains the Mac OSX Startup disk, the first volume should always be used for the Startup disk, and the other volume(s) should never be used as a primary scratch disk for Photoshop.

✿ **Tip** • In disk-formatting software, the "first" partition or volume is always created on the outside of the hard drive platters, and is always the fastest.

- Startup disks for Mac OSX should always contain plenty of free space. Adobe recommends a minimum of 20GB. Even with Photoshop's scratch disk pointed to a different hard drive, many kinds and sizes of temporary files are created on the Startup disk by other applications or processes. Disk-burning for instance, requires huge amounts of free space; printing operations can also create large temporary files. If heavy page-swapping occurs, multiple swapfiles can be created, occupying large amounts of space. It is best practice not to "crowd" the Mac OSX operating system and maintain liberal free space on the Startup disk.

- Single-hard drive computers (iMac, eMac, laptops, Mac mini etc) will benefit by replacing older OEM hard drives with newer, faster versions. With these models, using a fast firewire drive as the primary scratch disk when working with large image files can also help performance. If you are using the Startup disk also as the primary scratch disk, try to keep large amounts of free space on the drive. *Don't* partition a single-drive system to make a second volume for the scratch disk; performance will be faster if the "scratch file" is allowed to position itself wherever it can on the one large volume.

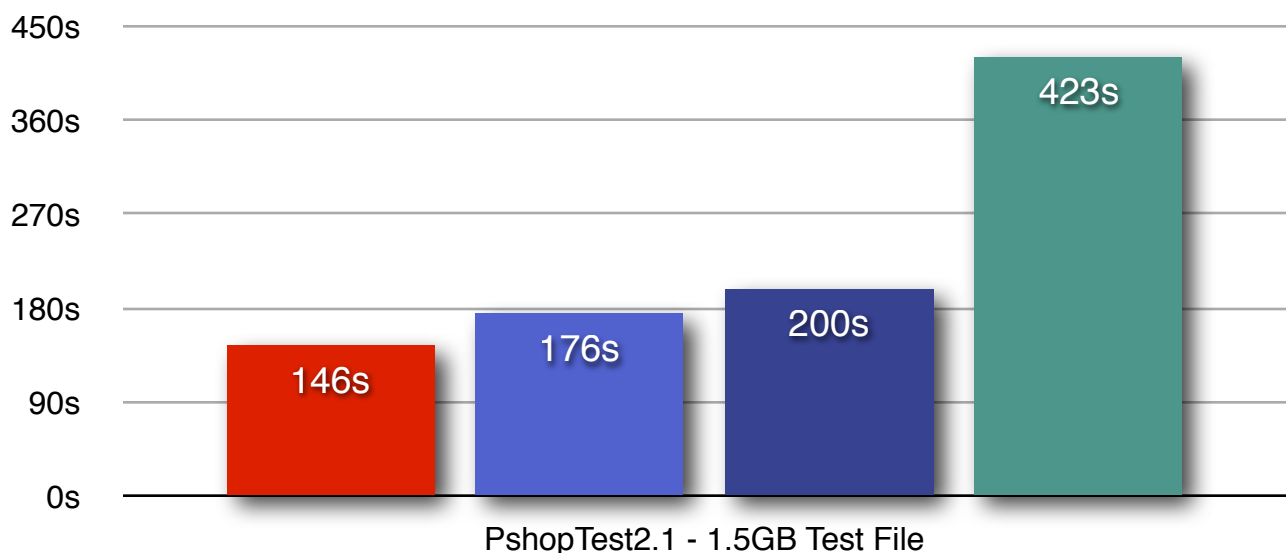
- A hard drive or RAID array used as a dedicated scratch disk should be as fast or faster than the hard drive or RAID array used as the Startup disk. *For an additional performance boost, use the Disable Scratch Compression Plug-in when using very fast scratch disks.*

RAID arrays used for Photoshop are fastest when formatted as RAID0 ("Striped" RAID)- but they offer no protection should a drive should fail. A frequent automatic backup routine to separate standard volumes or other media is considered best practice- and when using RAID0 with real data, it is a "mission-critical" procedure.

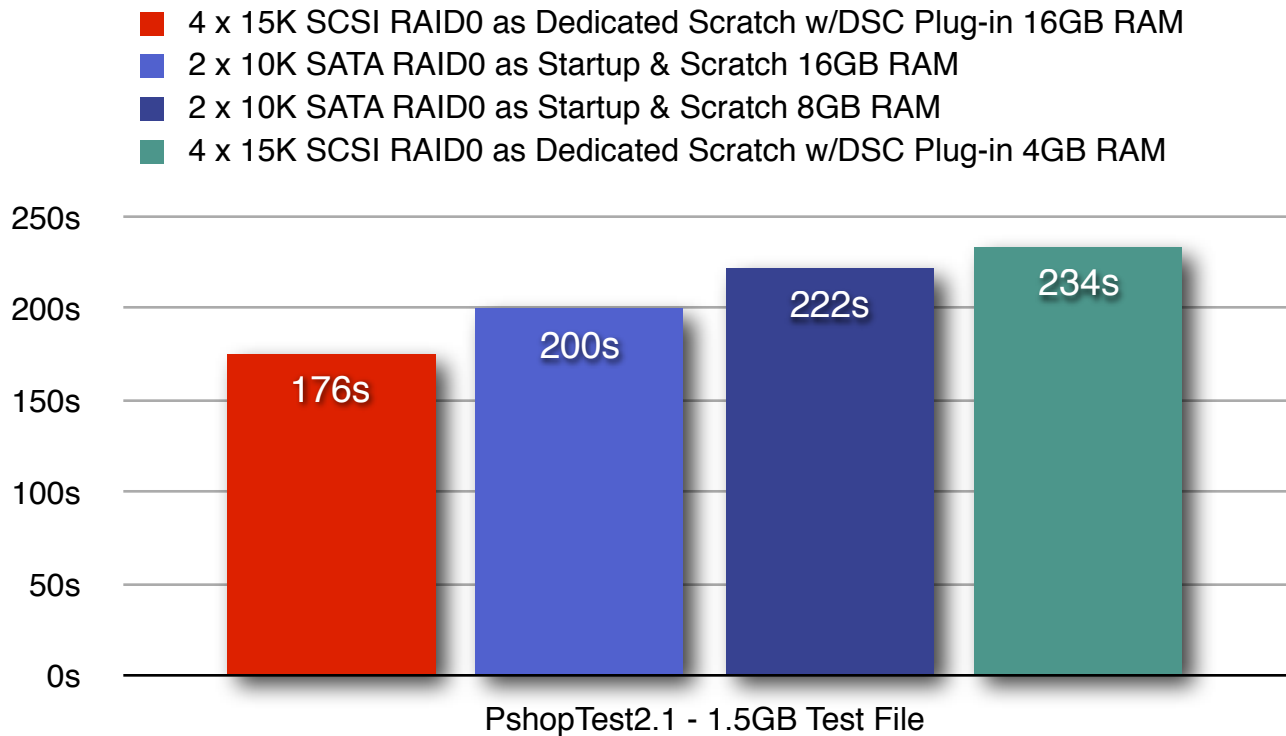
- RAID arrays of 2 to 4 SCSI or SAS drives, or 2 to 6 SATA hard drives offer the best value and optimal performance. RAID0 arrays with more than 6 drives show a much smaller additional benefit.

Photoshop CS3 Default Scratch Disk vs Dedicated RAID Array Scratch Disk

- 4 x 15K SCSI RAID0 as Dedicated Scratch w/DSC Plug-in & 100% Memory
- 4 x 15K SCSI RAID0 as Dedicated Scratch w/DSC Plug-in
- 2 x 10K SATA RAID0 as Startup & Scratch
- 7,200 rpm SATA as Startup & Scratch



Photoshop CS3 RAID and RAM



More on Scratch Disks

- By default, Photoshop assigns the Startup disk volume as the primary scratch disk. You can change the setting in Photoshop preferences, assigning up to 4 different volumes in whatever order you would like them to be used (Photoshop uses the selected volumes in sequential order- not simultaneously). If the first selected volume becomes filled to capacity with scratch data, Photoshop begins to use the second selected volume, and so on with the third and fourth volumes.
- Regardless of the amount of installed RAM, an image file's size, memory settings, or History settings- Photoshop always creates its scratch disk temporary file -the scratch file- on the first assigned scratch volume. This file is present whenever Photoshop is running.
- Though Photoshop tries to do as much processing and updating of changes to open image files directly within the installed RAM in the computer, some filters and operations do use the scratch disk actively regardless of the amount of available RAM.
- The size of the scratch file can vary tremendously, depending on the size of the image, the number of layers and channels in the image, the number of History states, and how much image area is modified with each change. Dedicated scratch disk volumes should be anywhere from 10-100GB or more, depending on your workflow. Monitor the size of your scratch file using the "scratch sizes" information fly-out in the lower left corner of the document's window. As a safety precaution, (if possible) always select at least a second scratch disk volume in Photoshop's scratch disks preferences- just in case you ever run out of space on the first scratch disk. This way you'll avoid "disk full" errors which can freeze Photoshop and the computer- and prevent you from saving changes to open documents.
- When you quit Photoshop, the scratch file on the scratch disk disappears, and the operating system reclaims the disk space.

Optimized Configurations


































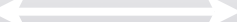

Planning hard drive configurations in Photoshop workstations should balance performance considerations with data safety, storage capacity, and ease of maintenance- including backup routines. Simple setups with minimal hard drive partitioning are often the best solutions; they preserve speed and disk space, simplify maintenance and backup, and reduce the potential for problems. Here are some suggested arrangements for recent Macs...

For single-drive **Notebooks, iMacs, G4 Cube, Mac mini**- boost performance with recent, faster, and larger-capacity internal 7.2K drives. For Intel iMacs and iMac G5s, consider hi-speed 10K SATA drives or the recent faster 750GB SATA drives. For backup- and if a large scratch disk is needed, use a fast Firewire enclosure.



For **G4, G5, and MacPro Towers**- boost performance by adding faster internal drives for the Startup disk, image files, and scratch. For big-file work, use RAID arrays for scratch- and even as image "servers". Backup to external SATA or Firewire drives- frequently if you're storing data on RAID volumes for any length of time!



PLAN ↓	G4, G5, MAC PRO INTERNAL HARD DRIVES				EXTERNAL RAID ARRAY 2-6 Drive 10K SATA or 2-4 Drive 10-15K SCSI/SAS RAID0
	A	B	C	D	
1	7.2K Mac OSX Start-up, User Files & Images  	7.2K Scratch Disk 			
2	2-Drive 7.2K or 10K RAID0 Mac OSX Start-up, User Files & Images  				RAID0 SCRATCH DISK 
3	10K Mac OSX Start-up & User Files  	7.2K Images 			RAID0 SCRATCH DISK 
4	10K Mac OSX Start-up, User Files & Images  	10K Scratch Disk 			
5	7.2K Mac OSX Start-up, User Files & Images  	10K Scratch Disk 			
6	2-Drive 10K SATA RAID0 Mac OSX Start-up, User Files & Images  		2-Drive 10K SATA RAID0 Scratch Disk 		
7	10K Mac OSX Start-up & User Files  	7.2K Images 	2-Drive 10K SATA RAID0 Scratch Disk 		
8	10K Mac OSX Start-up & User Files  	2-Drive RAID0 7.2K Images 		10K SATA Scratch Disk 	
9	10K Mac OSX Start-up & User Files  	2-Drive RAID0 7.2K Images 			RAID0 SCRATCH DISK 

About Graphics Cards and Photoshop

Earlier versions of Photoshop render images using software, and thus performance is not measurably affected by upgrading to more powerful graphics cards. Photoshop CS3- on the other hand, does support GPU (graphics processing unit) hardware acceleration for it's 3D layers and Vanishing Point, and the speed of these operations is improved with faster, more powerful cards.

Maintenance Tips

To preserve acceleration and minimize down time, establish a regular maintenance program for your system:

1. Establish and maintain a frequent and regular data backup routine.
2. Keep your file system organized and up-to-date; throw away unneeded files and archive others to maintain free space on hard drives.
3. Keep Mac OSX system software up to date and "permissions repaired".
4. Manually run the "cron scripts" if you sleep or shut down your computer at night.
5. Perform regular repair and preventative maintenance of hard drive directories with Disk Utility and specialized third party disk maintenance software.
6. Keep disk clutter to a minimum- including Desktop icons which reduce available RAM to Photoshop.
7. For better performance, maintain plenty of free space on your hard drives: 50-70% full max.

A Holistic Approach

A balanced approach to planning hardware acceleration upgrades or new systems for Photoshop-use should employ components of similar vintage, and should address key areas with equal consideration: multiple processors, system and Photoshop software, installed RAM, hard disk drives, and advantageous disk and software configurations. Without adequate RAM, a fast machine is unnecessarily hobbled; even with large amounts of RAM and fast hard drives, slower single processor machines show modest improvement. Earlier versions of Mac OSX and Photoshop are slower and more limited even on a fast machine. Older or slower hard drives penalize performance gains on fast machines. Without a fast dedicated scratch disk, performance may be hampered even when all other factors are optimized. Even with the fastest hardware in place, improper disk and software configurations can reduce the gains of expensive acceleration upgrades. Planning should also include future storage requirements and backup considerations.



About the Author: George Middleton is professional artist and illustrator, a consultant for [MacGurus Tech Forums](http://www.macgurus.com) (www.macgurus.com), and a Photoshop beta tester. He can be contacted by email via boots911@mac.com.

Except where otherwise noted- all chart data in this document was compiled using PshopTest2.1 with Photoshop's default settings: 70% memory allocation, the Startup Disk as the primary scratch disk, a History setting of 20, and Cache Levels of 6. Photoshop 7 and CS memory slider and cache settings were adjusted to match those of CS2 and CS3. Virtual memory buffering was not disabled for CS2, and was enabled for CS3, and the Bigger Tiles plugin was enabled for CS2 and CS3. Except where noted- the test machine is a G5 Quad with 16GB of installed RAM, and the Startup Disk is two 10K SATA drives formatted as a single RAID0 volume containing Mac OS 10.4.10, Photoshop, and the test file. In some tests, an external SCSI 4-drive RAID0 array was used as Photoshop's primary scratch disk with the Disable Scratch Compression plugin activated. PshopTest2.1 is a free standardized Action routine with test file and documentation designed to assist Adobe Photoshop™ users in determining optimal settings and hardware configurations. It can be downloaded at <http://www.macgurus.com/forums/showthread.php?t=20218>