Optimizing Your Workstation Investment

Specifying a balanced workstation for SolidWorks CAD

A special report on CAD usage

V4

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Specifying a balanced workstation for SolidWorks CAD

Like being stalled in traffic, waiting for a CAD workstation to finish loading a complex model or drawing or rebuilding one saps productivity and is annoying. Workstations are continuously getting faster. So for computationally demanding tasks it makes sense to upgrade whenever your current system seems too slow. Workstations certified by SolidWorks can be purchased for less than $2,000 in most cases. Amortized over a three-year life, the cost of a new workstation is about $1.83 cent per day, about as much as a daily Starbucks coffee.

When shopping for new workstations, much money can be saved by striking the right balance among the major subsystems that affect 3D CAD performance. For example, graphics add-in boards can cost up to $3,500. But engineers don’t need to spend this much to get the best possible performance from SolidWorks.

Jon Peddie Research developed a series of benchmark tests for SolidWorks 2014 that simulate the most time-consuming tasks in a SolidWorks designer’s day. By running these tests on a variety of workstations, we determined the relative performance improvements to be gained from each one.

The major subsystems to consider when specifying a new workstation are:

- The central processing unit (CPU)
- Main memory, also called random access memory (RAM)
- The disk subsystem, also called the hard drive or non-volatile storage
- The 3D graphics subsystem, also called the graphics card or add-in board

Here is how to evaluate each one.

Central processing unit (CPU)

The CPU is typically the most important subsystem in any workstation used for SolidWorks or similar CAD applications. There are two considerations with respect to selecting the right processor:

**Consideration One**

If you are a CAD user with an old workstation supporting an apparently faster clock, you may be surprised to learn that the Intel® Xeon® processor E3- 1200v3 processor with a slower frequency is faster. The reason for this is that thanks to Moore’s law Intel is able to introduce new instructions and can now execute more instructions in single clock period; helping CAD users complete more work in less time.

Detail or final design engineers engaged in CAD only workloads should opt for as fast a processor as is possible.
Consideration Two
Can your workloads benefit from more computational cores? If you are detail or final design engineers engaged in CAD only workloads the answer is probably not. However, if you are engaged in simulation based design or you regularly create photo-realistic rendering or ray traced images of your design, then you will want to explore CPUs that support more computational cores. These workloads scale with more resources.

Tests by Jon Peddie Research found that processors with four cores significantly outperformed dual-core chips at comparable clock rates. However, systems with eight or 16 cores had no advantages compared with four-core systems. Moreover, systems with more than four cores generally run at lower clock rates than four-core systems. So SolidWorks designers only engaged in CAD will see faster performance from a four-core system at a higher clock rate than a six- or eight-core system running slower.

The exception to this rule is rendering of ray-traced realistic images by the PhotoView add-in software that comes with the SolidWorks Professional package. JPR tests showed that 16-core systems rendered images 3.6 times faster than four-core systems at comparable clock rates. Moreover, when setting up a new workstation, the use of the hyper-threading option found in Intel microprocessors reduced rendering times in four-core systems by 16 to 28 percent compared with hyper-threading disabled. Otherwise, hyper-threading made little difference in tests of SolidWorks.

![Figure 1: Ray-traced rendering of a SolidWorks assembly produced with the PhotoView 360 add-in software](image)

Newer microprocessors have architectural improvements that enable them to perform SolidWorks functions relatively faster than differences in clock speeds would suggest. For example, comparing a three-year-old Intel Xeon E3-1240 “Sandy Bridge” four-core processor with a new Xeon E3-1240 V3 “Haswell” microprocessor showed a 15 to 32 percent improvement in SolidWorks tests even though the clock speed of the newer chip is only 9 percent faster.

Main memory
A simple rule of thumb to consider – invest in enough memory to be at least twice the size of your largest model. Today memory is extremely affordable. The minimum memory for a
workstation employed by detail and final design engineers engaged CAD workloads should be 8GB and trending towards 16GB.

Main memory, also called synchronous dynamic random-access memory (SDRAM) or sometimes just RAM, is the second most important consideration in a CAD workstation. The most critical aspect of memory is to have enough to hold all the programs and data you are using. If the RAM fills up, SolidWorks performance deteriorates rapidly and the system may issue warning messages.

In our tests, we found that 8 gigabytes of RAM is adequate for even very large SolidWorks models. However, if a designer commonly has several large models or drawings open at once, 8 gigabytes may not be enough.

Most economically priced workstations have four slots for holding double data rate (DDR) SDRAM and can accommodate up to 32 gigabytes in modules of 8 gigabytes each. For SolidWorks CAD, the best policy is to buy two 4-gigabyte modules installed in two of the four slots. This tactic enables designers to upgrade to 16 gigabytes in the future, if necessary.

The Microsoft Windows Task Manager shows the amount of physical memory used when the system is running. If you find that the available memory approaches zero, it’s time to add more.

A second less important consideration when buying memory is the data transfer rate or memory bus speed. As with all aspects of computing, faster is better. Today memory is offered in 1600 MHz and 1333 MHz varieties. The faster variety is the better choice.

**Disk subsystem**

**Consideration** – If you can benefit from up to a 2X increase in productivity, then an investment in SSD technology is obvious.

The hard disk drive (HDD), invented in 1956, has become the standard for non-volatile, rewritable storage in personal computers and workstations. It stores information on a spinning disk coated with magnetic material. A mechanical arm bearing a reading head reads and writes binary information on the disk.

Recently, HDDs have begun to be displaced by so-called solid-state disks (SSDs) that contain no moving parts. Instead SDDs employ an array of non-volatile secure digital (SD) RAM similar in concept to the memory cards used in smart phones and digital cameras. Because they contain no moving parts and have no mechanical tolerances, SSD are faster, more rugged, and more reliable than HDDs.

The superior performance of SSDs helps SolidWorks users in a few important ways. First, it enables the software to load faster when the computer is turned on or restarted. Second, it reduces the time needed to open large assembly models and drawings by more than 2X. The time required to resolve lightweight models can be shortened by 40 percent and the time needed to save files can be reduced by 20 percent.
The disadvantage of SSDs is that at present, they cost more per unit of storage capacity than HDDs. Consequently, the best choice for an SDD is the primary disk drive (the C: drive in Microsoft Windows systems). This drive is used to store programs and current active work. If your workstations store data on a networked server, no other drive may be necessary. For stand-alone workstations, a second HDD could be added to store files that are needed less frequently.

**Graphics subsystem**

**Consideration** – if you are a final or detailed design engineer engaged in CAD only workloads you may find that entry-level professional graphics solutions ranging from Intel processor graphics to entry-level discrete graphics cards from Nvidia and AMD can deliver the features, functions and performance you need. Enabling users to balance workstation investments with SSDs, more memory and faster CPUs.

3D graphics are among the most misunderstood subsystems used in CAD workstations. Most graphics systems consist of add-in boards (AIBs) that plug into the workstation’s PCI Express slot. Within the past few years, however, Intel Corporation has integrated 3D graphics subsystems with some of its processor chips. Graphics displays are attached to the workstation via ports (connectors) on the motherboard instead of on an add-in board.

3D graphics systems render three-dimensional scenes in real time. For 3D games such as World of Warcraft or first-person shooters, such rendering tasks are very demanding because of the large
number of picture elements that must be illuminated in each frame. For smooth motion, up to 24 or even 30 frames per second must be processed.

![Nvidia's Quadro K4000 was the highest performing and costliest AIB used in JPR's tests of SolidWorks. (Image courtesy of Nvidia.)](image)

3D CAD is not so demanding. Most of the time, there is no background to process, and models themselves are shaded simply, without shadows or reflections. Such shading can be handled by 3D graphics of only modest power, such Intel’s P4600 graphics integrated on the processor.

![An 11,983-part assembly model with 1,121 unique components used in JPR’s benchmark tests shown with simple shading. Most designers work most of the time in this mode.](image)

Designers who work with transparent, or semi-transparent objects may benefit from more powerful 3D graphics add-in boards. SolidWorks also offers more sophisticated shading modes such as RealView and RealView with ambient occlusion. These modes simulate reflections and shadows in near real time, although they are not yet as realistic as ray-traced rendering.
Designers who routinely work with advanced shading techniques may wish to invest in higher-performing graphics AIBs having 2 GB of display-list memory. However, for most SolidWorks activities a more economical 3D graphics system is adequate.

Graphics subsystems only speed up the shading of models when they are repositioned on the display. They don’t help with creating or editing complex features, loading or rebuilding large models, resolving lightweight models, or performing various types of simulation or realistic rendering.

**Summary and conclusions**

Detail or final design engineers employing CAD only workloads will benefit from a balanced workstation investment. The investments consist of four parts.

**CPU** – CAD only users should opt for as fast a processor as is possible. Users employing ray tracing, rendering or simulation based design workloads will benefit from workstations that supply six, eight, sixteen or more computing cores.

**Memory** – Any workstation purchased today should be at least 8GB, with strong consideration given to being at least twice the size of the largest model expected over three years.

**Storage** – SSDs, capable offering up to a 2X increase productivity, should a de facto standard. They will impact a broader array of workloads.

**Graphics** – users should employ professional graphics solutions and the typical workloads employed detail or final design engineers will benefit from either integrated graphics on the Intel Xeon processor E3-1200v3 product family or entry-level discrete cards from AMD or Nvidia.