Performance and Productivity Benefits of AutoCAD® 2013 on a Workstation with a Professional GPU

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Title: Performance and Productivity Benefits of AutoCAD® 2013 on a Workstation with a Professional GPU

Description:
It is a common misconception that AutoCAD software doesn’t see much benefit from running on a workstation with a professional, discrete graphics processing unit (GPU). As a result, many users are not getting the full performance and productivity out of AutoCAD that they could be. In addition, a number of Autodesk® software products that are complementary to AutoCAD and enhance the workflow and results from it, benefit enormously from running on a professional workstation with a professional GPU. In this class, we will look at the model sizes, workflows, and application combinations that have a big impact when running AutoCAD and that show measurable benefits when

Learning Objectives
At the end of this class, you will be able to:

- Learn about the differences between workstations and PC’s
- Learn about the benefits of professional graphics
- Most importantly, learn about how this improves your overall experience with AutoCAD 2013

About the Speaker
Scott Hamilton

Vertical Market Strategist, Dell Precision Product Marketing

Scott has over 25 years of experience in the computer industry in various roles. He started as an aircraft engineer using CAD and CAE tools and then transitioned into the software industry working at Alias, Macromedia and Autodesk in various technical roles in Application Engineer, Consulting Services and Management. He recently moved in the hardware side of the business to help Dell build better products for the workstation market. Currently his is focusing his well-rounded expertise to the Engineering, Manufacturing and Media and Entertainment markets for the Dell Precision Workstation Team.

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Dell™

Reliable Memory Technology

Detecting and isolating memory errors

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Overview

Regardless of make, manufacturer or type, almost all computer-based memory has some type of inherent infinitesimal error or defect. A memory manufacturing vendor may spend between 10-15% of the cost of a dual in-line memory module (DIMM) running extensive testing for errors, and still memory can be prone to failure at some point in its life. Any number of variables can cause memory errors – from heat to age to tiny defects.

In fact, dynamic random-access memory (DRAM) error rates are orders of magnitude higher than had been previously reported. In a recent large-scale study of DRAM memory errors in the field based on data collected over a period of more than two years, about a third of all machines and over 8% of DIMMs saw at least one correctable error per year\(^1\). With some platforms seeing nearly 50% of their machines affected by correctable errors\(^2\), only about 1.3% of systems were affected by uncorrectable errors per year, with some platforms seeing as many as 2-4% affected\(^3\).

For a standard office personal computer system, memory errors rarely adversely affect the outcome of standard business-class application software.

However, in the high-end, computation-intensive world of finance, oil and gas research, medical imaging, media production (rendering and editing), among others, data integrity is a crucial component of the overall system architecture. In such high-performance systems, memory replacement ranks near the top of component replacements, with memory errors showing up as one of the most common hardware issues that can lead to system crashes.\(^4\)

Therefore, the ability to detect, report and prevent DIMM errors becomes a necessity in high-performance workstations.

Understanding the critical demand for extreme memory performance, Dell patented an innovative, exclusive technology applicable to Dell Precision™ workstation systems that helps to mark and map out unusable memory. This unique Dell feature helps reduce system downtime, free up IT support time, and drive down overall maintenance costs while increasing memory longevity and user productivity.

This paper introduces the basic concepts of Dell Reliable Memory Technology (RMT) and looks at some of the root causes of memory errors and how RMT helps to remediate and obviate memory errors.

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\(^2\) Ibid, p.195

\(^3\) Ibid, p.196

\(^4\) Ibid, p.193
Memory Primer 101

As computer systems have become more sophisticated with evolutionary advancements in processors, bus speeds, and overall architecture, memory likewise has needed to keep pace with these enhancements.

NOTE: For this discussion of memory, or random access memory (RAM), we reference the memory modules outside of the processor core (known as CPU cache memory, or L1/L2 – which is beyond the scope of this discussion.

Essentially (and very simplistically), DRAM chips are an array of on/off switches that store a state (1 or 0) as long as they have a flow of current (i.e., when the power is off, they reset to a null state). Multiple chips are assembled together to build a memory subsystem and organized onto a circuit board known today as the ubiquitous DIMM (dual in-line memory module).

Most workstations, such as Dell Precision Workstations, use the most advanced type of DIMM known as DDR3 SDRAM (double-data-rate-three synchronous dynamic random access memories). Essentially, compared to earlier versions of memory types (zb: DDR2), DDR3 is faster, has greater through-put, requires less voltage, and can accommodate more memory density.

Memory Errors

Memory errors can be caused by any number of factors, resulting in a single bit of DRAM to spontaneously flip to the opposite state (i.e., it flips from 1 to 0 when it should have remained a 1 during that memory cycle). Factors such as heat, age, defects, etc., can contribute to these errors. In fact, studies have shown that beyond the first 10 months of a DIMMs life the rate of errors increases dramatically.

These types of errors are known as ‘soft errors’, or correctable errors, which randomly corrupt bits but do not leave physical damage and can be corrected via a memory refresh.

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5 IBID, p.202
In many cases, memory errors are dominated by ‘hard errors’, or uncorrectable errors – errors which corrupt bits in a repeatable manner because of a physical defect or other anomaly within the DIMM itself – or when two soft errors occur within the same block of memory. A hard memory error can cause a machine “crash” (reboot required) or applications to fail (generating a system-level Stop Error code such as a kernel panic or the blue screen of death, BSoD). Often soft errors are warning signs of impending hard errors. In field-based research, about 65-80% of uncorrectable errors were preceded by a correctable error in the same month.  

Error Handling

Many workstation class PCs today incorporate memory parity checking algorithms, which to put it simply, ensures that the data sent is the same as the data received every time a byte of data is read.

More sophisticated systems use other types of error correction and detection methods. The most common, error-correcting code (ECC) memory is used in servers and workstations, such as Dell Precision workstations. Essentially, ECC memory includes extra memory bits and an on-board memory controller that checks for memory parity and in the case of a single-bit error, the ECC memory logic can correct the error and output the corrected data so that the system continues to operate. Bottom line: ECC is great at correcting isolated soft memory errors and provides a solid foundation for memory and system stability. However, ECC memory provides no solution for multiple hard errors or soft errors within the same block of memory. In these instances data corruption will occur. This is where Dell Reliable Memory Technology can help.

The Benefits of RMT

When a hard disk drive has physical damage to the platter, that sector is reported, mapped and marked as unusable by the PC system. However, in most PCs today, even workstations running ECC memory, a hard error or multiple soft errors in the same memory block on a DIMM is simply noted, which could cause a system crash. The user must normally report the error to their IT help desk, which in turn must run some diagnostic to detect the error. Most often, a single bit failure may precipitate the replacement of the entire DIMM.

The result: Increased cost in the form of downtime, lost user productivity, IT personnel time, DIMM replacement and possible corruption of key application files.

6 IBID, p. 196
Enter Dell Reliable Memory Technology (RMT). Similar in concept to hard drive error-mapping technology, RMT detects hard errors and multi-bit soft errors in a DIMM, and obviates and remediates the problem. Instead of having to incur costly downtime and IT services such as calling IT, running diagnostics, opening the system, and replacing the faulty DIMM, upon reboot RMT:

- Maps the defective portion of the individual DIMM
- Reports the defect and DIMM location in the BIOS as bad
- Removes these bad cells and a small amount of nearby cells from system memory usage

With a simple system reboot, RMT removes the defective area from visibility to the operating system. Applications and critical systems functions will now by-pass any marked area and continue working without having to replace hardware. It’s as if the bad memory never existed, ensuring smooth, error free operation, helping to reduce system crashes and application errors.

In fact, RMT can help reduce memory hardware costs over time. As memory may deteriorate with increased usage or excessive heat (normally due to extreme usage), physical errors may increase. The “bad memory” information stays with the DIMM, even if it is moved internally within the system. In addition, if DIMM replacement is needed, RMT will display in the BIOS which DIMM(s) are causing errors, making trouble shooting and DIMM replacement faster and easier helping to reduce downtime and overall cost.

RMT extends the lifecycle of existing memory and helps contribute to cost savings over time.

**Conclusion**

Although some error detection schemes can catch memory errors, such as ECC memory, many of these algorithms can only handle soft errors. When physical defects or hard errors within a DIMM occur, Dell RMT provides an extra layer of bad memory detection and correction.
By mapping and removing the bad sectors, RMT helps ensure that compute-intensive applications are accessing good and usable memory. This can result in significant savings in both time and money due to a reduction in replacement DIMM hardware and IT personnel and end user downtime.

When data integrity is crucial, RMT provides a much needed layer of assurance, delivering useable memory to maximize workstation processing capacity and reliability.
Dell Precision™ Workstations

Work at the speed of thought
Tower: T7600 | T5600 | T3600 | T1650
Mobile: M6700 | M4700
Rack: R5500

From office computing to mobile and remote solutions, Dell’s broad workstation line-up is equipped to meet your needs.

Dell.com/precision
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The Essence of Dell Precision

Dell Precision is designed for professionals with the most mission critical and demanding needs. Our workstation-class products offer superb performance, innovative smart design and ISV certified dependability to maximize your productivity and reliability.

Performance
Power through resource-exhausting and graphics-intensive engineering and analysis workloads with superb scalability and performance precisely tuned to demanding and specific user needs.

- Broad range of processor options from Intel Core i3 to Core i7 Extreme Edition to eight-core Intel Xeon
- Massive memory with up to 512GB for desktops and up to 32GB for mobiles
- NVIDIA Tesla GPGPU compute solutions for High Performance Computing (HPC) environments
- Cutting-edge, workstation-class graphics with the latest NVIDIA Quadro® and AMD FirePro™ technologies including the only mobile workstation to offer the AMD FirePro M6000 with PCIe x16 Gen 3 support

Smart Design
Delivering innovative and award-winning workstation design that allows engineers, designers and other professionals to work smarter.

- All new, award winning, best in class tower chassis design offers a straightforward, clutter-free interior providing easy access to components for superior serviceability
- The only mainstream tower workstations with externally accessible, tool free power supply
- The Dell Precision™ T7600 is the only tower workstation from a global vendor with tool-free front accessible hard drives.
- Mobile workstations that are 100% BFR/PVC free®, ENERGY STAR 5.2 qualified and EPEAT registered® to offer you our most environmentally responsible mobile Dell Precision product yet.
- Mobile workstations with flexible storage options including an easy eject drive, minicard and SSD storage devices and RAID 0/1/5 on both the M4700 & M6700.

Dependability
Reliable workstations tested, certified and supported for maximum dependability and uptime.

- ISV certified for professional-grade software
- Secure, manageable and serviceable workstations that seamlessly integrate into your environment
- Dell Data Protection | Encryption provides robust endpoint encryption
- Confidently plan future product roll-outs with long lifecycles, transitions and ImageWatch™ for an advanced look at software and hardware changes
- Three-year Limited Hardware Warranty³ standard on all Dell Precision workstations except the Dell Precision T1650 which offers a one year Limited Hardware Warranty³ standard

Get service and support beyond your expectations
Exceptional work requires exceptional hardware. While your Dell Precision workstation is designed for peak performance from day one, Dell’s advanced service and support options can help you get up and running quickly and reduce downtime in the event of an unexpected issue.

- Dell Configuration Services⁴ incorporates hardware, images, applications, peripherals and documents with your system as it’s being built to help simplify and speed up deployment while improving hardware consistency and compatibility.
- Choose Dell’s premium support service, ProSupport⁵ for 24/7 direct telephone access to advanced-level technicians based in your region to end downtime and resolve problems quickly.
- ProSupport’s Collaborative Support⁶ feature provides assistance even if you have a problem with non-Dell hardware or software. We will leverage our relationships with select third-party vendors to act as your single point of contact to help resolve your issue.
Technology

Dell Precision—the continuous evolution of technology
Boost your productivity by integrating the latest industry-standard technologies into a highly reliable platform.

Processors
The central processing unit, or CPU, initiates the critical tasks that make your Dell Precision perform. You should choose a processor with enough performance to meet your long-term business needs. Bandwidth, clock speed and the number of cores in the processor all help determine processor performance. Dell Precision workstations support a wide array of processor options including 3rd generation Intel Core i5 and i7 processors, Intel Xeon E3-1200 series processors and Intel Xeon E5-1600 and E5-2600 series processors. Intel processors feature Intel Turbo Boost Technology, a processing technology that delivers optimal performance where it is needed most when you need it most.

Memory
Random Access Memory (RAM) temporarily stores information from your operating system, applications and data in current use. This gives your processor easy access to the critical information that make your programs run. The amount of RAM you have helps determine how many programs can be executed at one time and how much data can be readily available to a program. It also helps determine how quickly your applications perform and how many applications you can easily toggle between.

Many Dell Precision workstations can use ECC memory. ECC (Error Correcting Code) memory is a feature for high-end systems that detects and reports memory errors that can cause system crashes or error faults. This is important for highly detailed tasks where accuracy and stability are of the utmost importance. Non-ECC memory does not detect and report memory errors.

RDIMM memory is the type of memory available on our dual processor workstations and, similar to ECC memory, can provide additional data protection and reliability. RDIMM memory, or registered memory, has a register used as a pass-through for address and command signals. This allows workstations to support more RDIMMs per channel. RDIMMs consume more power but are available in larger capacities and higher ranks allowing for extremely large memory configurations up to 512GB on select Dell Precision workstations.

Select Dell Precision tower workstations also offer Dell Reliable Memory Technology. A Dell exclusive, patented technology that maximizes uptime by eliminating virtually all memory errors so Dell workstations can get more reliable over time, providing a stable and reliable platform you can trust.

Storage
Dell Precision workstations support a wide range of performance options including solid state drives, SATA drives, SAS drives and RAID configurations. Solid state drives provide increased performance and reliability in mobile and desktop systems. SAS drives are an excellent option for increased performance over SATA drives for larger workstation storage needs. Dell Precision is designed to be expandable to adapt to your needs.

For improved data protection and performance, our workstations offer a variety of RAID levels; from striping to mirroring to parity, Dell offers a RAID solution to meet your specific storage needs.

Graphics
Dell Precision workstations offer a wide selection of graphics cards, many of which are Independent Software Vendor (ISV) certified. Solutions from AMD, Intel and NVIDIA can satisfy requirements ranging from breakneck 3D performance and OpenGL to affordable 2D performance. Dell continually evaluates the newest graphics technologies to help ensure the most relevant graphics cards are selected for qualification, certification and factory installation in Dell Precision workstations.
Exceptional performance, unwavering dependability, extraordinary execution and outstanding scalability

Enjoy blazing fast, energy-efficient performance even as you tackle the largest data sets and the most complex multi-threaded applications:

- Up to two powerful Intel processors for a maximum of twelve cores of computing power
- Up to 512GB of advanced error correcting memory
- Blazing fast SATA or SAS storage
- A myriad of RAID choices
- Support for up to three professional-grade graphics cards
- Select tower workstations support NVIDIA Tesla GPGPU compute solutions for high-performance computing

Rock solid dependability
Dell understands that downtime is costly. That is why we strive to provide a workstation you can depend on day-in and day-out. Should a problem arise, Dell has the expertise and services to minimize your downtime and get you back up and running quickly.

ISV Certification
Dell partners with leading independent software vendors (ISVs) and technology partners to certify system compatibility. This means hundreds of engineering man-hours and rigorous testing that have been poured into Dell Precision workstations to optimize performance and reliability with leading industry applications. The result is a fine-tuned machine, running at peak performance, bringing you a level of confidence you trust and value.

Dell Reliable Memory Technology (RMT)
Dell patented code programmed at the BIOS level that eliminates virtually all memory errors. RMT extends the capability of ECC memory by detecting the location of the corrected memory error and prevents the system from writing to that spot again following a reboot. Available on the T7600, T5600 and T3600 (when equipped with ECC memory), RMT increases the reliability of the workstations and eliminates the need for extensive full memory tests, IT support calls and memory DIMM replacement.

Multiple monitor support
Expand your productivity with multi-monitor capability. Every Dell Precision tower supports a minimum of two monitors and a maximum of eight monitors (excludes T1650), which can provide additional screen real estate for additional work content.

Tool-free chassis
All new, award winning, best in class chassis design offers a straightforward, clutter-free interior providing easy access to components for superior serviceability. Replacing or upgrading common hardware is fast and easy. In addition, the Dell Precision T7600, T5600 and T3600 are the only mainstream tower workstations to offer an externally accessible, tool-less power supply.
Dell Precision Tower Workstations

Dell Precision T7600
Our most powerful and expandable tower workstation in a completely redesigned tool-free chassis.

- One or two Intel® Xeon® E5-2600 processors
- Up to 512GB 1, 7, 10 ECC memory
- Four 3.5” or eight 2.5” SATA or SAS drives
- SATA 6Gb/s and RAID 0/1/5/10 support standard
- Complete range of NVIDIA® and AMD graphics options
- One or two NVIDIA® Tesla® GPUs optional

**Great for:** Work environments that demand the utmost in computational power such as financial / scientific analysis of massive data sets and advanced engineering / simulation workloads.

Dell Precision T5600
Powerful and reliable dual socket tower workstation in a completely redesigned compact, tool-free chassis.

- One Intel Xeon E5-1600 or E5-2600 processor
- Up to 64GB 1, 10 of ECC or Non-ECC memory
- Two 3.5” or four 2.5” SATA or SAS hard drives
- SATA 6Gb/s and RAID 0/1/5/10 support standard
- Complete range of NVIDIA® and AMD graphics options
- Optional NVIDIA Tesla GPU

**Great for:** Space-constrained environments that need substantial compute capability including financial and scientific analysis, professional engineering and complex 3D modeling.

Dell Precision T3600
Mid-range tower workstation with an excellent balance of performance and scalability in a new tool-free chassis.

- One Intel Xeon E5-1600 or E5-2600 processor
- Up to 64GB 1, 10 of ECC or Non-ECC memory
- Two 3.5” of four 2.5” SATA or SAS hard drives
- SATA 6Gb/s and RAID 0/1/5/10 support standard
- Complete range of NVIDIA® and AMD graphics options
- Optional NVIDIA Tesla GPU

**Great for:** Powerful performance for exacting workstation workloads such as mainstream 3D, advanced engineering, digital content creation, CAD/ CAM, and design environments.

Dell Precision T1650
Our entry-level tower offers certified performance for superb productivity without breaking your budget.

- One Intel Xeon E3-1200 series or 3rd generation Intel Core™ i7 and i5 or 2nd generation Intel Core i3 processor
- Up to 32GB 1, 10 of ECC or 16GB 1, 10 of Non-ECC memory
- Two 3.5” of four 2.5” SATA hard drives
- SATA RAID 0/1/5/10 standard
- AMD, NVIDIA or integrated Intel graphics

**Great for:** Demanding workstation tasks such as professional grade 2D and entry-level 3D applications that push beyond the capabilities of a standard desktop.
Whether you’re at your desk, in a meeting or consulting with a client, Dell mobile workstations have what it takes to power you through a whole range of business settings.

**Superb Performance**
Sacrifice nothing. The Dell Precision M4700 and M6700 combine laptop mobility and workstation-class performance into a dependable, highly agile system that brings your projects to life with:

- 3rd Generation Intel® Core™ i5 and i7 processor options up to Extreme Edition
- AMD FirePro and NVIDIA Quadro graphics options enable you to run high-end graphics for all of your professional needs, from rendering to modeling complex simulations.
- Expansive DDR3 memory with four DIMM slots for up to 32GB1,10 of 1600MHz memory or up to 16GB1,10 of 1866MHz memory for blistering performance
- Big jobs require big storage, and the Dell Precision M6700 and M4700 offer hard drive space to spare, with large drive options, Mini Card and RAID options, plus the flexibility to add even more storage with an optional optical bay module.
- Keep it cool and make it last. Quiet-running dual fans can help increase component longevity and extend battery life.

**Innovative Smart Design**
Work smarter with state-of-the-art design and intuitive purpose driven features. No matter where your work takes you the Dell Precision M4700 and M6700 provide superb mobility and functionality

- Docking is easy and convenient; the M4700 and M6700 are compatible with existing E-family docking solutions which support a broad array of Dell laptops and mobile workstations
- 100% BFR/PVC free8, ENERGY STAR 5.2 qualified and EPEAT registered9 to offer you our most environmentally responsible mobile workstation product yet
- Bring your content to life with the optional NVIDIA 3D Vision® Pro solution that provides true to life 3D visualization available on the M6700
- Astonishing display options provide accurate color reproduction and brilliant images. The Dell UltraSharp™ IPS RGBLED display with PremierColor technology offers 100% Adobe RGB color gamut for the utmost in color precision
- Stand out from the crowd with the M6700 Covet Edition featuring edge-to-edge Corning® Gorilla® Glass 2 display and brilliant Phoenix Red signature color

**Certified Dependability**
Designed for professionals who demand strength and reliability, the M4700 and M6700 is built for a long life of dependable service with:

- Get all day battery life and beyond with optional secondary slice battery and optional NVIDIA® Optimus™ technology which intelligently provides graphics performance when you need it and can help extend battery life when you don’t
- ISV certification to help ensure reliability for demanding applications
- Designed durable with a light yet strong magnesium alloy structure clad in sleek, rigid, anodized aluminum and MIL-STD-810G tested for extreme temperatures, humidity, vibration, dust, altitude and shock
- When security is key Dell has you covered with FIPS certified fingerprint readers, FIPS certified self encrypting drives and Dell Data Protection | Encryption
- Quickly remove your primary hard drive with the tool free easy eject drive bay
Dell Precision M6700 & M6700 Covet Edition

The Dell Precision M6700 is the world’s most powerful 17” mobile workstation, with the performance, battery life and storage for demanding work environments.

- 3rd generation Intel Core i5 and Core i7 processors including Extreme Edition
- Up to four storage devices: one 2.5” drive in easy eject drive bay, one 2.5” drive in internal bay, one 2.5” in optical bay caddy, one solid state minicard
- AMD and NVIDIA discrete graphics options
- 17.3” display options include: IPS RGBLED display with 100% Adobe color gamut, NVIDIA 3D Vision Pro

**Great for:** specialists who need workstation performance for demanding professional-grade applications in a desktop-replacement mobile platform.

Dell Precision M4700

Dell Precision M4700 is the world’s most powerful 15” mobile workstation, with the performance, battery life and storage for demanding work environments.

- 3rd generation Intel Core i5 and Core i7 processors including Extreme Edition
- Up to three storage devices: one 2.5” drive in easy eject drive bay; one 2.5” drive in optical bay caddy; one solid state minicard
- AMD and NVIDIA discrete graphics options
- 15.6” display options include: IPS RGBLED display with 100% Adobe color gamut

**Great for:** professionals in need of processing power and graphics performance for demanding jobs, plus dependability and long battery life for mobility.

**Mobile**

Rack

Dell Precision R5500

Superb, world-class rack workstation with uncompromised performance, ISV certification and responsive remote access.

- One or two Intel Xeon 5600 series processors
- Complete range of NVIDIA graphics
- Up to five 2.5” SATA or six SAS drives

**Great for:** users who need ISV-certified workstation performance in a rack chassis, businesses that need to centralize data in a clean, secure environment and who require a world-class remote workstation solution.

**Dell Precision Workstations**

Dell Precision M6700 / M6700 Covet Edition / M4700 / R5500
Rack Workstation

Dell Precision R5500
A dual-socket 2U rack workstation with uncompromising performance, extensive flexibility and world-class remote access.

Why a rack? Because your work demands it.
When the job calls for more security and flexibility than a standard tower or mobile workstation can provide, the Dell Precision R5500 rack workstation delivers.

- For organizations where security is top priority, you need more than a lock and key. The Dell Precision R5500 can help safely house your intellectual property by keeping it contained in the data center
- Does your work involve inhospitable, hazardous or extremely remote environments? The Dell Precision R5500 can provide workstation-class performance remotely while your employees stay productive and comfortable at their own workspaces using the Dell FX100 Remote Access Device
- For end-users who work in space-constrained areas or temperature- or noise-sensitive environments, the FX100 Remote Access Device is small, cool and quiet
- By providing remote 1:1 access to your Dell Precision R5500 from virtually anywhere, the FX100 Remote Access Device can also help to boost productivity among offsite contractors, rotating workforces and geographically diverse employees

Get true workstation performance, minus the workstation.
Never compromise your productivity. Dell Precision R5500 offers true workstation-class components, giving you the tireless performance you need to get the job done.
Technology features include:

- Powerful Intel Xeon processor options with up to six cores to help boost your work output
- Top-level performance with optional dual graphics cards or dual GPGPU cards and up to 450W of available graphics power
- Superb flexibility with options for up to five standard, full-length, full-height PCIe x16 cards
- Up to 192GB\(^1\) of system memory, enabling high productivity on even the largest data sets
- Up to five SATA drives and up to six SAS drives to provide ample storage capacity for your large projects
- ISV (independent software vendor) certification on the applications that matter most to you, helping to ensure that you can deliver mission-critical projects without delay
- Optional dual redundant power supplies to help keep you up and running

Work powerfully from virtually anywhere.
The Dell FX100 Remote Access Device is designed to give your workforce seamless remote access to the Dell Precision R5500 rack workstation. Using PC-over-IP\(^2\) hardware-based compression technology from Teradici\(^3\), this compact, quiet device can deliver the responsiveness of a traditional desktop workstation solution, but can be accessed from almost anywhere.

- PC-over-IP hardware-based compression transfers only the rendered graphics pixel data over the network, ensuring a fast and responsive user experience
- A dedicated half-height PCIe slot for a PC-over-IP remote host card enables you to save precious PCIe slots for other needs
- Quad monitor support via dual FX100 devices allows you to vastly expand your visual real estate (quad monitor support only available on select configurations)
- For situations when you need access via a soft client, the Dell Precision R5500 also offers VMware\(^4\) View™ support

Not sure what you need?
Dell’s easy-to-use Workstation Advisor can recommend a Dell Precision workstation based on your needs and the applications you use: www.dell.com/wsadvisor

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1 GB means 1 billion bytes and TB equals 1 trillion bytes; significant system memory may be used to support graphics, depending on system memory size and other factors.
2 Available on select processors.
3 For copy of Local Hardware Warranty, write Dell USA LP, attn: Warranties, One Dell Way, Round Rock, TX 78682 or see www.dell.com/warranty
4 Availability and terms of Dell Services vary by region. For more information, visit www.dell.com/serviceldescriptions.
5 Subject to wireless provider’s broadband subscription and coverage area; additional charges apply.
6 Requires removal of optical drive.
7 Configurations over 192GB of memory are only supported with Red Hat Linux
8 Excludes external power brick and power cord. Dell follows the iNEMI definition of BFR/PVC free. For more information on Dell's policy and progress, please see our www.dell.com/environment site.
9 EPEAT registration can vary by country. Please see www.epeat.net for the latest registration level and country participation.
10 A 64-bit operating system is required to support 4GB or more of system memory.
11 Dell PCs use Genuine Microsoft Windows. Intel, the Intel logo, Xeon and Xeon Inside are trademarks or registered trademarks of Intel Corporation in the U.S. and other countries. Microsoft, Windows and Windows Vista are trademarks or registered trademarks of Microsoft Corporation in the U.S. and other countries.
12 Dell is a trademark of Dell Inc. ©2012 Dell Inc. All rights reserved.
Solid state drives (SSDs) have made substantial inroads into client workstations, and Dell has been one of the market leaders in their adoption. As the technology has become more established, it has reached an inflection point. Its inherent reliability and performance advantages are now coupled with increasing capacities and falling costs. As a result, SSDs offer compelling advantages when compared to traditional hard-disk drive (HDD) technologies. Falling costs and continuing advances in flash memory are largely attributable to the adoption of more cost-effective multi-level cell (MLC) technology in SSDs.

SSD designs balance the technology’s inherent reliability, quiet operation, form factor, energy efficiency and performance strengths with its cost and endurance characteristics. Though SSD technology is maturing rapidly, its implementation still requires careful attention to design quality. When implemented well, as in Dell Precision™ workstations, SSDs meet the needs of a growing range of customers.

### What is an SSD?
An SSD is a PC storage device that uses solid state memory to store information, instead of the magnetic heads and rotating media found in a traditional HDD. In most cases, an SSD uses nonvolatile NAND flash memory, which enables it to retain data when the power is removed.

### Reliable and rugged
One of the SSD’s greatest strengths is its inherent reliability and ruggedness compared to HDDs. Because an SSD is an electronics-only device with no moving parts, there is no risk of the “head crashes” possible with HDDs or sensitivity to vibration while the HDD head is reading or writing data. The SDD also has wider tolerances to environmental factors such as shock and vibration, temperature and altitude (or air pressure), which makes them more durable overall.

In fact, industry data reveals that most SSDs have over 8x the shock tolerance of a standard notebook HDD, making them particularly suited to mobile workstations such as the Dell Precision M6500 and M4500.

### Low power consumption, silent operation
With no moving parts, SSDs operate silently and typically consume less power and generate less heat than mechanical HDDs. Unlike SSDs, the standard HDD motor can contribute significantly to its power usage in both active and idle modes. In contrast, SSDs consume little power when idle, usually drawing power only during actual read and write operations. This contributes to an SSD’s overall lower power consumption.

### Flexible form factors
With just solid state electronics and no motors or disks, an SSD can be made physically smaller than its HDD counterpart, enabling more flexible form factors. These range from traditional lightweight form factors shared by some HDDs to innovative new designs, such as SSD mini-cards that enable three-drive configurations in Dell Precision mobile workstations.
High performance

Typically, SSDs have higher sequential and random read performance than HDDs, particularly random reads. SSDs aggregate the bandwidth of multiple flash memory components and, in this way, achieve higher data rates than are possible reading from a single flash memory component. A central controller is attached to banks of flash memory through several channels, or communication paths. Reading and writing in parallel over these channels enables high SSD data rates.

While traditional HDDs can achieve reasonably high sequential data rates, random read performance is greatly hindered by the requirement for a mechanical actuator to move or “seek” between tracks of stored information. These seek times are significant, greatly limiting random performance. An SSD has no such limitation, so its random read rates are significantly higher than an HDD. More channels allow for even higher performance.

The SSD’s superior read and random-read performance is also an advantage with applications and tasks that call for intense storage activity. Going forward, SSD performance should continue to improve on storage tasks requiring high read or write performance.

Optimizing SSD design

When designing a new system with SSD technology, Dell takes into account the technology’s strengths and weaknesses, implementation challenges and how the SSD will be used in a particular workstation. Dell works with partners early in the product design stage to ensure that the SSD technology offered in Dell Precision workstations is reliable and tailored to the customer need being addressed. Dell also evaluates technology partners’ development, testing and manufacturing processes to ensure they meet Dell’s requirements.

Moving into the mainstream

SSD cost per gigabyte continues to fall, and the price gap continues to narrow between SSDs and traditional HDDs. When coupled with SSD performance, reliability, power efficiency and other advantages, SSDs are appealing to a broader range of workstation customers than ever before (see Table 1). Although most SSDs still cost more than traditional HDDs, their use is no longer limited to niche scenarios or very high-end products.

Going forward, SSDs are expected to make further inroads into mainstream PC usage environments as the technology advances and costs continue to fall. Though unlikely to completely displace HDDs anytime soon, if ever, a tipping point will arrive when a typical workstation user’s needs can be met by an SSD more cost-effectively than a comparable HDD. If the industry continues as expected, this tipping point is possible in the next five years.

Based on an operating shock tolerance of 1500G for 0.5 ms for Ultra Performance SSD vs. 175G for 0.5 ms for standard Dell 2.5” HDD, per Dell HDD specifications.

<table>
<thead>
<tr>
<th>Usage Scenario</th>
<th>Environment</th>
<th>SSD Advantages over HDD</th>
</tr>
</thead>
<tbody>
<tr>
<td>User is highly mobile</td>
<td>• System often moved and subject to bumps/drops&lt;br&gt;</td>
<td>• Can better withstand damage if dropped or handled roughly&lt;br&gt;</td>
</tr>
<tr>
<td></td>
<td>• Subject to wide range of temperatures such as system being left in car for extended period&lt;br&gt;</td>
<td>• Lower power usage&lt;br&gt;</td>
</tr>
<tr>
<td></td>
<td>• Small size, low weight, and battery life are important</td>
<td>• Lighter weight&lt;br&gt;</td>
</tr>
<tr>
<td>User works at desk in congest office with space constraints</td>
<td>• Noise/heat from multiple PCs in small space&lt;br&gt;</td>
<td>• Can withstand wider range of temperatures&lt;br&gt;</td>
</tr>
<tr>
<td></td>
<td>• Small size is important</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Power efficiency is important, particularly for companies running desktop PCs 24x7</td>
<td></td>
</tr>
<tr>
<td>User works in harsh computing environment</td>
<td>• Wide range of temperatures, altitudes, vibration, or moisture&lt;br&gt;</td>
<td>• Silent drive operation&lt;br&gt;</td>
</tr>
<tr>
<td></td>
<td>• High level of dust/particles</td>
<td>• Lower power usage and heat emissions&lt;br&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Smaller form factor can contribute to smaller system size</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1: SSD Advantages in Workstation Usage Scenarios
Note: An updated version will be supplied at a later date.
GET THE MOST OUT OF AUTOCAD WITH NVIDIA GPUs.

DO YOUR BEST WORK.

Boost your AutoCAD performance by **3x over integrated graphics** with NVIDIA® Quadro® GPUs1. You can work more quickly, explore your ideas, and still get your projects done faster. With 1 GB of built-in memory in the **Quadro 2000**, NVIDIA GPUs can handle even the most complex data sets with superior scalability for your evolving visualization needs.

NVIDIA professional graphics provide leading performance that also lets you easily use the other applications in the AutoCAD Design Suite—such as 3ds Max—with complete confidence. This is something integrated just can’t handle.

---

**AUTOCAD BENCHMARK RESULTS**

<table>
<thead>
<tr>
<th>Graphic Card</th>
<th>Relative Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadro 2000</td>
<td>3x</td>
</tr>
<tr>
<td>Quadro 600</td>
<td>3x</td>
</tr>
<tr>
<td>Integrated</td>
<td>Below Recommended Performance</td>
</tr>
</tbody>
</table>

Meets Recommended Performance

---

1 Results are based on AutoCAD Benchmark results.
Create Fast Photorealistic Renders.

With 3ds Max in your suite, creating stunning photorealistic renderings for client reviews or marketing materials is always faster and easier. 3ds Max also takes full advantage of your graphics card, so what you use can greatly affect how fast the renders will finish. Why wait overnight and catch mistakes too late?

Now, you can render up to 9x faster in 3ds Max using NVIDIA Maximus technology\(^2\) while still working in all your other apps. This makes creating expensive and time-consuming physical prototypes a thing of the past.

MAXIMUM PERFORMANCE FOR 3DS MAX 2012 WITH IRAY
Relative Performance Scale vs 8 CPU Cores

<table>
<thead>
<tr>
<th>GPU Configuration</th>
<th>Relative Performance vs 8 CPU Cores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tesla C2075 + Quadro 6000</td>
<td>8x</td>
</tr>
<tr>
<td>Tesla C2075 + Quadro 5000</td>
<td>7x</td>
</tr>
<tr>
<td>Tesla C2075 + Quadro 4000</td>
<td>6x</td>
</tr>
<tr>
<td>Quadro 4000</td>
<td>5x</td>
</tr>
<tr>
<td>8 CPU Cores</td>
<td>1x</td>
</tr>
</tbody>
</table>

Now renderings are up to 9x faster

Create stunning photorealistic renderings using 3ds Max and NVIDIA GPUs. | Image courtesy of Jeff Patton.

RECOMMENDED GRAPHICS SOLUTIONS

<table>
<thead>
<tr>
<th>APPLICATION</th>
<th>NVIDIA® MAXIMUS™</th>
<th>QUADRO 4000</th>
<th>QUADRO 2000</th>
<th>QUADRO 600</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensive use of rendering or CAE</td>
<td>Occasional use of 3ds Max with AutoCAD</td>
<td>AutoCAD use only</td>
<td>AutoCAD use only</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>USAGE</th>
<th>QUADRO 4000</th>
<th>QUADRO 2000</th>
<th>QUADRO 600</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; Highest-performance rendering engine</td>
<td>&gt; Excellent 3ds Max performance</td>
<td>&gt; Medium assemblies and complex surface models</td>
<td>&gt; Small assemblies with simple parts</td>
</tr>
<tr>
<td>&gt; Simultaneous rendering/CAE and design application usage</td>
<td>&gt; Largest assemblies and complex surface models.</td>
<td>&gt; 2D drawings with excellent response time to pan, zoom, and redraw.</td>
<td></td>
</tr>
<tr>
<td>&gt; Excellent Moldflow and ANSYS performance</td>
<td>&gt; Best choice for complex geometry, transparency, and hidden line removal</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GPU MEMORY</th>
<th>QUADRO 4000</th>
<th>QUADRO 2000</th>
<th>QUADRO 600</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visit <a href="http://www.nvidia.com/maximus">www.nvidia.com/maximus</a> for Maximus configurations</td>
<td>2 GB</td>
<td>1 GB</td>
<td>1 GB</td>
</tr>
</tbody>
</table>

Built For Professionals: Autodesk and NVIDIA collaborate closely on product development to deliver a reliable user experience, so everything will perform just the way you expect from day one. Quadro graphics solutions are engineered, built, and tested by NVIDIA to provide you with the performance and reliability you need, whenever you need it. And with a three-year warranty, plus direct support from NVIDIA, Quadro solutions ensure the highest standards of quality, delivering industry-leading performance, capabilities, and reliability.

For more information, including real life success stories, visit [www.nvidia.com/autodesk](http://www.nvidia.com/autodesk)

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1. AutoCAD performance test. NVIDIA benchmark consists of a collection of models manipulated under typical usage in AutoCAD 2013 with wireframe, shaded, and x-ray display modes turned on. The test is with a Xeon E3-1245 CPU, 4 GB RAM, Intel Integrated P4000 and the specified Quadro graphics card running Windows 7 64bit.

2. 3ds Max Benchmarks. Test consists of a collection of hard surface objects rendered outdoors in 3ds Max with iray 1.2 comparing an NVIDIA Tesla C2075 and the indicated Quadro GPU with the CPU relative to an Intel 3ghz x5570 Xeon CPU with 8 cores rendering. ECC has been turned off for all GPUs. Values shown are percent increase in render speed relative to CPU.

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SEE YOUR DESIGNS AS QUICKLY AS YOU ENVISION THEM.

The NVIDIA® iray® renderer used in 3ds Max provides 3D artists with intuitive means for creating images that rival photographs—in a fraction of the time of traditional workflows. Use materials and lights that correspond and react like those in the physical world to quickly bring your visions to life, rather than juggling a variety of computer graphics controls to merely approximate it.

Experience edits immediately as you adjust and perfect your camera, lighting, materials, and geometry with the ActiveShade interactive rendering window in 3ds Max. The iray renderer takes full advantage of your graphics cards, so the more GPUs you have, the faster your renders will be.

Now, you can render up to 9x faster using NVIDIA Maximus™ technology—while still working in all your other apps1. This makes creating expensive and time-consuming physical prototypes and photo shoots a thing of the past.

GET THE MOST OUT OF 3DS MAX WITH NVIDIA GPUs.
Find out what the experts are saying.

"With the introduction of NVIDIA Maximus, I think we have finally achieved both 'quality' and 'speed'. This new technology enables CLEAT and a client to carry out business smoothly by communicating with each other while viewing the same picture and changing colors and viewing angles. And because the NVIDIA Maximus environment dramatically decreases rendering time, the fee charged to clients can be reduced. Lower fees mean that clients can place more orders until they obtain accurate images that suit their needs."

— Kensuke Yamashita, President of Cleat

"With iray, our customers see what they’re going to get - the lighting, textures, color, perspectives. Everything is lifelike."

— John Chipman, AIA, Chipman Design and Architecture

"Previously, rendering an image took 40 minutes, so it might take a whole day of test images to produce something we could show to a client. Now it only takes 15 minutes and we can do test images in about 10 seconds. We can do multiple tests, a fully rendered image and get client approval in half the time. It will take us a month or two to recoup our investment in the NVIDIA system."

— Dionissios Tsangaropoulos, founder/CEO of Delta Tracing

"With photorealistic renderings we create articles that would be impossible or prohibitively expensive to build in the real world. We can reuse the same background with different furniture, change the materials of the background set, and sell products before even a prototype exists, which provides better numbers for production."

— Dionissios Tsangaropoulos, founder/CEO of Delta Tracing

For more information, including real life success stories, visit www.nvidia.com/autodesk

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GET THE MOST OUT OF INVENTOR WITH NVIDIA GPUs.

DESIGN WITHOUT LIMITATIONS.

NVIDIA professional graphics provide fast, responsive experiences for Inventor, as well as all the other applications in the Product Design Suite. This means you can now dial up the complexity of your designs, visualize every angle faster, and work out issues earlier in the design cycle.

The latest NVIDIA® Quadro® GPUs provide almost 3x faster performance¹ over previous generations in Inventor, so you can explore all your ideas and still get your projects done on time. With 2 GB of built-in memory in the Quadro 4000, NVIDIA GPUs recommended for Inventor can handle just about any amount of work you throw at them.

Quickly Prepare For Design Reviews.

NVIDIA lets you take advantage of Showcase in the Product Design Suite for reviews and product walk-throughs. As you can see, the more graphics horsepower you have, the faster Showcase will run. So you no longer need to worry if you have enough time to set up that perfect scene.

### INVENTOR BENCHMARK RESULTS¹

<table>
<thead>
<tr>
<th>Relative Performance</th>
<th>Quadro 4000</th>
<th>Quadro 2000</th>
<th>Quadro FX3700</th>
<th>Quadro FX1700</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below Recommended Performance</td>
<td>0</td>
<td>2x</td>
<td>3x</td>
<td>4x</td>
</tr>
<tr>
<td>Meets Recommended Performance</td>
<td>2x</td>
<td>3x</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### SHOWCASE BENCHMARK RESULTS²

<table>
<thead>
<tr>
<th>Relative Performance</th>
<th>Quadro 4000</th>
<th>Quadro 2000</th>
<th>Quadro 6000</th>
<th>Integrated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below Recommended Performance</td>
<td>0</td>
<td>2x</td>
<td>3x</td>
<td>4x</td>
</tr>
<tr>
<td>Meets Recommended Performance</td>
<td>2x</td>
<td>3x</td>
<td>5x</td>
<td>6x</td>
</tr>
</tbody>
</table>

¹ NVIDIA® Quadro® GPUs provide almost 3x faster performance over previous generations in Inventor.
² NVIDIA Benchmarks based on Pathfinder and other benchmarks available at nvidia.com/benchmarks
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MAXIMUS PERFORMANCE FOR 3DS MAX 2012 WITH IRAY

RECOMMENDED GRAPHICS SOLUTIONS

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