Why Choose a Personal Workstation?

Personal workstation technology is different to that of a PC; these differences generally allow professionals to get more from their IT investment. This includes higher levels of performance and applications support.

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Introduction

Professionals prefer to use the highest-quality, highest-performing tools. Such tools best enable the talents of an engineer, animator, analyst/trader, or a programmer, allowing them to express themselves, their vision, and their skills to the greatest effect. The result is that organizations employing these tools get products to market more quickly, and with higher quality than organizations that employ lesser tools.

The key difference between a workstation and a PC is that a PC is a general-purpose machine designed for a broad range of tasks, such as running productivity suites, whereas a workstation has been designed to meet the requirements of a number of more specific markets and applications.

A summary of the key differences between a workstation and a PC include:

- **Overall system reliability.** Workstations are fitted with higher reliability technology than PCs. Features such as error checking and correcting (ECC) memory, larger power supplies, and more sophisticated cooling mechanisms ensure greater expandability while maintaining high reliability. Moreover, workstations are designed for quick (and often "tool-less") upgrades and repairs.
- **Applications Tuning**. Workstations are tuned and designed for the demands of specific applications. Because workstations often have features geared towards specific applications requirements (e.g., graphics), and these combinations are rigorously tested, users are assured that they are using a tried-and-true combination of hardware, system software and applications.
- **Enhanced performance**. Workstations are engineered to provide the best 32- and 64-bit performance available for applications that have large resource requirements (i.e., memory, disk, I/O, and/or graphics subsystems).
- **Wide range of graphics.** Professional graphics cards for the largest and toughest 3D visualization, OpenGL support, and specific application support to maximize on-screen performance
- **High degree of serviceability.** Availability of a workstation and its applications is critical, so the cost and quickness of returning a workstation to service is paramount to an IT organization. Serviceability involves multiple facets of component access, including tool-free repair and replacement of major components.
- **Greater expandability**. Workstations are designed with more headroom for additional components. For example, additional (and higher-powered) PCI slots, higher RAM capacity through increased number of memory slots, higher disk capacity and higher capacity power supplies.

The best reason to buy a workstation is to improve productivity and increase return on investment. A workstation provides high levels of stability, performance and expandability.

This paper helps users with tougher computing demands decide whether they need a PC or a personal workstation. It will help IT departments make a choice that provides the best return on investment, and the best hardware match available for users' applications.

User Requirements

It is useful to frame the differences between a workstation and a PC with a discussion on how users employ their systems. This directly influences the technology that manufacturers use as the basis for the product.

There are a number of key applications that benefit from the power of a workstation. These include:

- **Power office users:** day-to-day users that perform complicated and data-intensive office functions. This includes graphics, video and web design (Adobe Photoshop/Illustrator/After Effects/Premier), complex linked calculations, database storage/access and spreadsheet manipulations (Microsoft Office Suite), not to mention areas where there is a high degree of collaboration with engineering organizations (graphics and/or database management software).
- **Design and simulation in engineering and manufacturing:** including Mechanical Computer Aided Design (MCAD), Computer Aided Engineering (CAE), and Electronics Computer Aided Design (ECAD)—from aeronautics to automotive, industrial design to product prototyping and simulation.
- **Digital Content Creation (DCC) and entertainment**: for worry-free graphical performance in modeling, animation, rendering, non-linear video editing, and graphic arts.
- **Financial applications**: where quad and higher monitor support ensures that the maximum amount of information is on hand in real time to keep pace with today's busy markets; or where computationally intensive financial analysis is required.
- **Geographical Information Systems (GIS):** requires desktop systems with high-end capacities for modeling, topological overlays, data acquisition, and integration for all kinds of surveys.
- **Architecture, engineering, and construction (AEC):** the planning for a major project is usually carried out with the help of workstations such that clients and engineers alike can see the final outcome long before ground is broken, thanks to photo-realistic rendering.

These users require professional graphics solutions, large memory and disk capacity, and the highest degree of hardware/software reliability (after all, a company's livelihood is often at stake here). All of these applications demand the highest levels of performance, reliability and flexibility from a personal platform. Further, users of these applications insist on a high level of support and expertise from their IT departments, equipment suppliers and applications software vendors.

The Differences between a Workstation and a PC

Product Features

More Processing Power

The tough computational demands of the workstation business often requires the use of processors not often seen on business desktops, such as the AMD Opteron™ and Intel® Xeon™ processors, both of which feature multiprocessing capabilities. In some cases, processors can be deployed in dual-core configurations, resulting in systems with up to four processor cores in a single workstation enclosure.

All modern operating systems that run on workstations (e.g., Microsoft® Windows® and Linux) take advantage of multiple cores and/or processors, either through multitasking (running multiple applications simultaneously) or multithreading (running parts of a single application simultaneously). The use of multiple processors in either environment allows for balancing the processing load between processors and reducing overall application time-to-solution and increasing user response time.

For example, Adobe Photoshop has computationally intense effect filters that can be applied much faster when spread across multiple processors. Microsoft® Excel has also been optimized to take advantage of multiple processors, and the powerful floating-point capabilities of the Opteron™ and Xeon™ processors provide excellent support for the power office user.

Finally, the choice of processor technology and wide range of configuration options allow personal workstation users to “match the power to the problem;” to select the processor technology that best fits the needs of specific applications.

32- and 64-bit Processing

The performance and processing capacity of newer processors from AMD and Intel allow users to utilize a 64-bit address space, greatly increasing problem solving capabilities. Workstations with these processors and an appropriate operating system (e.g., Microsoft Windows XP Professional x64 Edition, Linux) can handle traditional 32-bit applications side-by-side with large, 64-bit capable applications[1].

More Robust Memory Subsystems

Plenty of memory is important to ensure the balance between application, data, and operating system requirements, especially in a 64-bit environment. For example, large physical memory is required to work interactively with larger models or to "render to RAM" for a fast preview of a movie frame or model.

Workstations typically support Error Checking and Correction (ECC) memory, a server-like feature that provides protection against soft errors in the memory that could lead to process and application failures. Higher end workstations also support registered DDR-SDRAM[2]. Registered memory allows more cost-effective large configurations, and larger memory configurations, overall

High Performance and Expandable I/O Subsystems

Additional I/O performance and capacity are important to workstation applications and the large files that they often generate. Many workstations use hard drives with higher rotational speeds—this reduces latency and increases data transfer bandwidth. For example, personal workstations routinely employ disk technology such as 15,000rpm SCSI or 10,000 rpm SATA II drives. Workstations also use higher-performance interfaces, for example Ultra320 SCSI.

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[1] See “Advantages of 64-bit Processor Technology in Workstation Applications,” HP, July 2005.
[2] Double Data Rate Synchronous Dynamic Random Access Memory

Workstations can manage a large number of connected devices and, in some cases, have high-bandwidth buses to ensure the fastest data transfer rates. Workstations usually have a large complement of PCI slots and standard I/O ports (such as Gigabit Ethernet, Firewire 800 and USB 2). Many workstations also support integrated SATA II with RAID capability and integrated multi-channel SCSI controllers. Since these standard ports are often integrated onto the main system board, PCI Express slots are freed for other purposes such as expansion cards used in non-linear video editing.

Other I/O benefits include providing multiple PCI Express lanes (at 5.0 Gbits/sec per lane, bidirectional) for PCI Express cards, and especially the high performance of the x16 (8 Gbytes/sec bidirectional) channels for graphics support.

Operating Environments

Although both a business desktop and a workstation are likely to run very similar (if not identical) operating systems, such as Microsoft® Windows® XP, or Red Hat Linux, there are still particular advantages that workstations possess.

Microsoft® Windows®

Microsoft Windows operating systems are by far the most popular workstation operating systems. Windows is the standard, with the greatest amount of mature applications ported and optimized. In addition, Microsoft Windows allows simultaneous use of standard productivity suite software along with other applications. The workstation group within HP has a dedicated Windows R&D team with over twenty years of experience and provides the foundation of enabling, testing and supporting Windows on all HP workstation platforms.

Examples of the solutions that this team has developed specifically for workstations include:

- A single boot on initial power-on.
- A recovery process set up to boot to recovery by default.
- A recovery process that loads all correct drivers by default.
- A single point of support
- HP provides OS bug fixes on preinstall, recovery media and availability on the web.

Linux

Customers looking for an UNIX-like environment, high levels of programmability, or lower licensing costs are interested in Linux. HP was the first vendor to offer pre-configured, fully tested and supported Red Hat Linux on workstations, and has in-depth experience with desktop and clustered Linux implementations.

HP has a dedicated Linux R&D team and with 20+ years of experience developing UNIX® libraries and device drivers, HP's Linux R&D team provides a foundation for enabling, testing, and supporting Linux on HP Workstations.

HP allows users to customize their own Linux image. The new HP Installer Kit for Linux facilitates the installation of various Linux operating systems, allowing users to make their own image, and to customize Linux to meet their needs. Preloaded/preconfigured Linux is also available for those users that prefer their workstations to run right out of the box. HP qualifies and delivers an engineered solution of Red Hat Linux tailored to each HP Workstation platform. This includes the latest driver updates.

HP provides a single point of support for hardware, operating system, and warranty concerns. In addition, HP offers extremely flexible support solutions for Red Hat Linux by reducing the number of necessary releases. HP's technical support people are well versed in Linux technology, permitting them to assist customers with a wide variety of questions or issues.

The HP Linux R&D team works closely with the leading Independent Software Vendors, graphics vendors, Red Hat, and other open-source providers to provide reliable, turn-key solutions. HP meets regularly with major graphics vendors to discuss issues relevant to accelerated OpenGL graphics on HP workstations. Accelerated graphics drivers are closed source and are not in Red Hat distribution because Red Hat will only support open source drivers. The HP closed source drivers match users' performance demands and provide higher levels of software quality.

HP provides a Linux solution on workstations that offers the freedom and flexibility of an open source development technology combined with the convenience of a single point of accountability. HP is a strong supporter of the Linux Standards Base and is active in strengthening the open source community through organizations such as the Open Source Development Lab, Free Standards Group, GNOME Foundation, KDE League, and Apache Foundation. The result: if your choice is Linux, HP has the products and experience to directly influence your bottom-line cost of ownership.

Professional Graphics

A PC or business desktop is often supported with an integrated graphics chipset or a low- to mid-range commercial graphics card. These cards, while fine for everyday 2D tasks or gaming, do not have the hardware power and drivers that differentiate a professional graphics card. The graphics card plays a large part in defining the role of a workstation, as shown in Figure 1.

Workstations are designed to support the most powerful graphics cards. For example, these cards may offer 256 or 512 MB of fast DDR memory, have additional graphics pipelines and engines, and support higher graphics processing unit clock speeds. Workstations are able to support the additional power and cooling requirements of these cards. Further, most personal workstations are able to support multiple graphics cards—especially important where many displays are required, or a single display can take advantage of parallel graphics processing like NVIDIA's Scalable Link Interface (SLI)[3].

HP has over 20 years experience in providing superior graphics technology—through seven generations of graphics accelerators development and across three operating systems. This Leadership Graphics Program combines HP's graphics expertise with available products to provide the industry's most expansive, fast, and flexible set of graphics solutions.

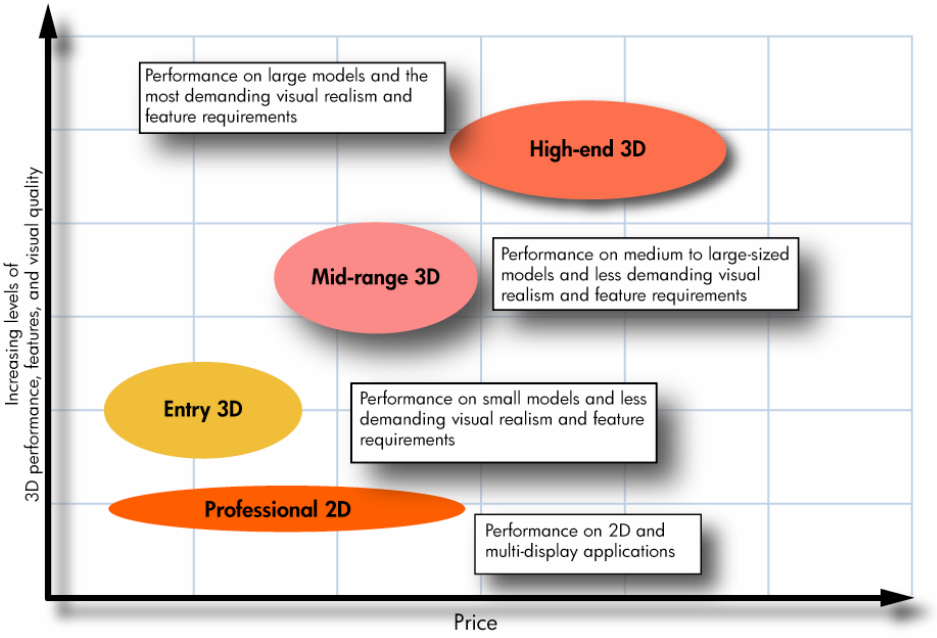
Current personal workstation products have a wide range of graphics devices available as either a standard offering (integrated with the workstation), or an "HP Tested and Certified" product—one that isn't offered as an integrated option but is still completely tested and certified to work in an HP personal workstation.

HP's Leadership Graphics Program is unique to the industry in:

- Expertise
- Strategic partnerships/ISV certification
- Feature and performance leadership
- Time-to-market advantage
- Broad product portfolio with a single point of support

[3] See http://www.slizone.com/

Figure 1. Workstation graphics segment positioning.



HP has consolidated many of its graphics tests into a certification test suite. This test suite is distributed to graphics vendors for incorporation into their test plan. This has a noticeable increase in reliability and stability of industry-standard graphics products.

Finally, professional workstation-class graphics cards offer options that no low-end card can easily match, such as multi-monitor support for up to eight monitors, or multiple I/O options for professional video or TV connections.

Packaging and Chassis Design

HP Personal Workstations differ from business PCs in another important way—that of chassis design. The workstation chassis must accommodate increasingly powerful I/O cards (and more of them), larger memory and disk capacities, and more and higher-performing (hotter) processors. Further, the workstation must be designed for security, ease of serviceability and upgradeability.

Because availability of a workstation and its applications is critical, serviceability is a primary concern to a corporation's IT department. Serviceability means the ease with which internal workstation components may be accessed for upgrade, repair or replacement, and involves multiple facets of component access, including unobstructed access to components, tool-free removal of PCI and graphics cards, optical drives and hard drives. HP innovations in packaging are directly applicable to reduced deployment costs, increased efficiency of IT staff, and improved performance of service teams.

Another highly relevant workstation design element is that of acoustics and thermal management. HP workstations support active fan control technology that optimizes the fan speed for each system. The fans will adjust to actual power load, ambient air temperature, and CPU temperature to find the quietest fan setting with adequate cooling. This ensures that systems in more demanding environments get all of the cooling required to keep them running reliably.

HP workstations also come standard with larger power supplies than that of business PCs. This allows for easier upgrades, while still maintaining a high level of reliability.

Why Choose a Workstation?

While product features are an important part of the decision to buy a workstation over a PC, other important factors have a strong impact on return on IT investment. These include product reliability, application availability and support, and vendor service and support.

Applications Support

ISV certification is a critical factor that distinguishes a desktop from a workstation, and is a key reason to purchase a workstation instead of a high-end desktop. HP teams up with leading ISVs to work closely with them, often with HP personnel on-site at the vendor.

HP engineers are often on-site at leading ISVs to ensure that their workstations will pass the most rigorous tests. For example, some application regression tests may require as many as 10,000 iterations to ensure completeness. This work has two goals—the first is to ensure that an ISV's application is certified on the workstation—passing a battery of tests to ensure that the possibility of any software/hardware conflicts are minimized. The second is to achieve the best application performance possible on HP Workstations.

ISV certification delivers a high degree of compatibility of the application on the HP hardware, and promotes the maximum possible application performance. In addition to the ISV performance testing, industry-standard or publicly available benchmark tests are used to measure actual application performance in an environment as close as possible to what the user will experience.

Optimization of subsystems and BIOS settings enables the compatibility of some applications and hardware solutions. All of this effort provides a high-level of assurance to the user that the application will run at top performance on the HP workstation.

Support for 64-bit Addressing

The ever-expanding data and performance needs of business, academic, engineering, and scientific organizations push the limits of workstation technology, and executing many of these large applications are virtually impossible on commercial PC systems. To address the needs of these large applications, both AMD and Intel have introduced 64-bit extensions to their processor technology. These extensions not only provide increased performance and problem-solving power, they also provides a smooth transition for today's 32-bit UNIX or Windows applications.

Employing a 64-bit processor allows users to generate much larger models and to manage a much greater amount of data in memory, instead of working the data back and forth to disk. With a 64-bit address space, personal workstations can efficiently utilize tens of gigabytes of physical memory instead of the four GB limitation found in many PCs.

HP is working with many of the independent software vendors to migrate their applications to leverage 64-bit technologies. As these applications come on-line, workstation users can step up to new levels of problem-solving power.

ISV Certifications & Partnerships

HP can offer certified application support through the power of its partnerships with IHVs (Independent Hardware Vendors) and ISVs (Independent Software Vendors). HP has excellent relationships with leading application and hardware vendors so they can offer powerful application solutions for popular application areas such as:

- Mechanical Computer-aided Design (MCAD)
- Mechanical Computer-aided Engineering (MCAE)
- Digital Content Creation (DCC)
- Financial markets
- Oil and gas

- Geographic information systems (GIS)
- Software development
- Scientific research
- Electronic Design Automation (EDA)

HP supports an extensive list of application partners for each of these industry segments. In most cases, HP works closely with these vendors to ensure a high-quality, highly optimized application on HP workstations.

Onsite certification at application partner sites

HP systems are certified by application vendors to run the software required by workstation users. A key benefit to these partnerships is the presence of HP engineers onsite at many vendor locations to certify the systems, tune the code, and improve application performance. Since the application knowledge and expertise reside onsite, questions and issues are resolved quickly.

Performance Tuning

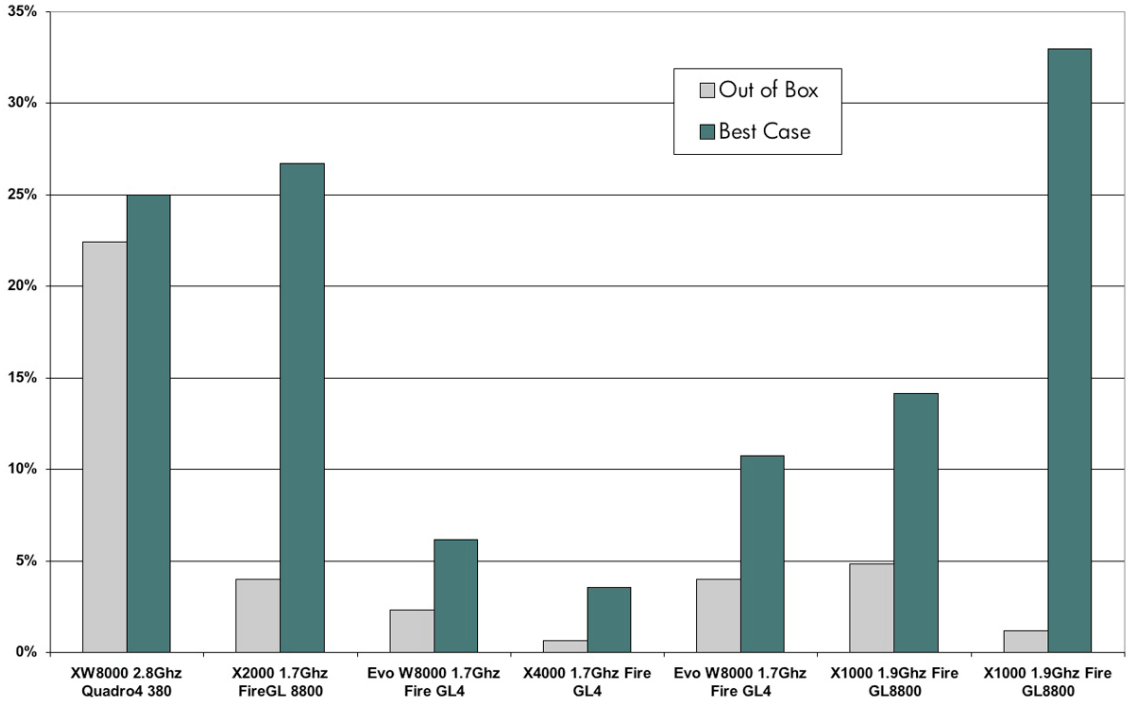
HP has developed a configuration and application-tuning framework for technical workstation users who want to configure and tune their machines for optimal performance with certain third-party applications.

This framework is a utility that administrators can run on their workstations. The utility performs configuration optimizations based on a database of tuning options for specific applications. For example, some applications are able to take advantage of a feature in Windows XP that allows applications to address over 2 GB of memory—the framework recognizes these applications and automatically configures the system and the application to recognize the extra memory.

This software framework will guide your system setup, allowing a "custom" configuration that best matches the workstation to user requirements. This customization facilitates availability of the latest graphics cards and drivers and removes some memory restraints. It can be downloaded at no charge.

The framework also manages the organization of graphics drivers. It determines the best fit of the latest graphics driver to the selected applications, enabling important performance options if applicable. Further, the framework provides ongoing optimizations by automating the download, installation, and configuration of the most appropriate driver version. Figure 2 illustrates the effects of graphics driver optimizations as performed by the framework.

Figure 2. Performance Improvements with the Application Tuning framework.



Today's workstations are composed of an infinite number of combinations of hardware and software components, operating systems, and applications. System setup is a very difficult task, given the enormous number of configuration possibilities. To reduce complexities, systems are frequently set up without considering the specific needs of the individual user.
It enables an optimal configuration of Intel Pentium® 4/Xeon-based HP workstations, delivering stability and improved performance.

The Framework's extensible design permits new configuration functionality and application support to be easily integrated over time. To facilitate the delivery of such new features, the Framework automatically updates itself when newer versions become available.

HP Performance Tuning Framework can help save both time and money and increase overall productivity.

Service and Support

HP offers industry-leading proactive, flexible support services that enable SMB customers to have a worry-free experience not only with their HP equipment, but also with other vendors applications and products. This ensures that businesses will stay up and running and that data will be available and protected.

Conclusions

The best reason to buy a workstation is to improve productivity and increase return on investment. The differences between a workstation and a business PC discussed in this paper promote this improved productivity and ultimately improve return on investment. The differences between the products yield the following reasons to select a workstation:

- System reliability
- Application stability
- Enhanced performance
- Wide range of professional graphics
- Increased serviceability
- Greater expandability

Application and operating system testing and certification, performance and graphics are also all critical elements of the users' productivity. All of these are important considerations when choosing the right product for your application and business requirements.

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