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April 1998

Compaq Computer Corporation

Marketing, Workstation Division

Compaq Professional Workstation 5100 Key Technologies White Paper

The purpose of this paper is to provide an overview of the key technologies incorporated into the Compaq Professional Workstation 5100 product. This paper concentrates on covering those features and technologies that have unique customer benefits and that demonstrate Compaq's technology leadership. The objective is to provide the technical information and benefits of these features so that the geographic regions can market them successfully.

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The Compaq Professional Workstation

The Compaq Professional Workstation 5100 is an industry standard workstation designed for the highest performance in a desktop form factor. The Compaq Professional Workstation 5100 supports up to two Pentium II 266MHz, 300MHz, or 333MHz processors with a 512KB L2 cache. Combined with the Compaq Highly Parallel System Architecture, this workstation provides customers with industry leading system performance.

To enable the workstation to meet the demanding needs of Financial, CAD, and electronic design automation (EDA) users, the Compaq Professional Workstation 5100 comes in a 5-bay towerable desktop form factor with five expansion slots, memory expandable to 512 MB, integrated Wide-Ultra SCSI controller and an auto-sensing 10/100TX Ethernet NIC. In addition, the Compaq Professional Workstation 5100 incorporates new technologies such as Remote ROM Flash, Remote Wakeup, Fail-safe Boot Block ROM, PremierSound™ and enhanced multiple monitor support.

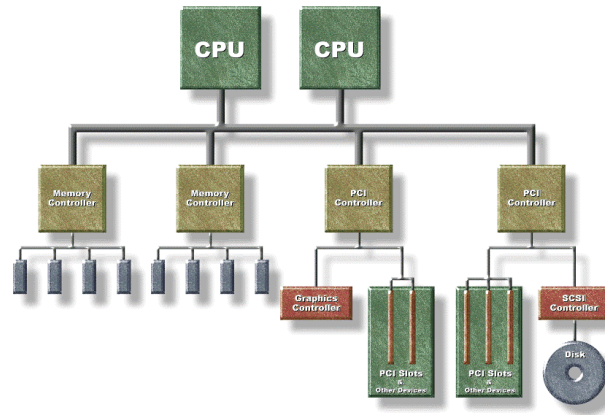
The Compaq Professional Workstations are powerful, industry standard workstations specifically designed to deliver leading performance with today's demanding CAD/CAE, digital content creation (DCC), EDA, and financial analysis applications. The Compaq Professional Workstations are backed by strong partnerships with leading ISVs to provide highly integrated and optimized solutions, which can be confidently deployed in the most demanding, business critical environments. The Compaq Professional Workstation product line combines powerful industry standard components, strong partnerships with leading ISVs, and traditional Compaq quality and reliability, to give users the time to market advantage they need to succeed.

Compaq Highly Parallel System Architecture

The Compaq Professional Workstation 5100 has been designed with a Compaq Highly Parallel System Architecture that maximizes system bandwidth to improve performance in demanding, resource-intensive applications. Most workstations in the Windows NT / x86 market support two CPUs to process instructions concurrently. However, overall system bandwidth is limited since each CPU must compete with the other for access to critical subsystems, such as memory and I/O whose bandwidth has not been correspondingly increased.

The Compaq Highly Parallel System Architecture used with the Compaq Professional Workstation 5100 is based on industry standard components and addresses the need for greater overall system bandwidth by using dual memory controllers, dual-peer PCI buses, and advanced multiprocessing support.

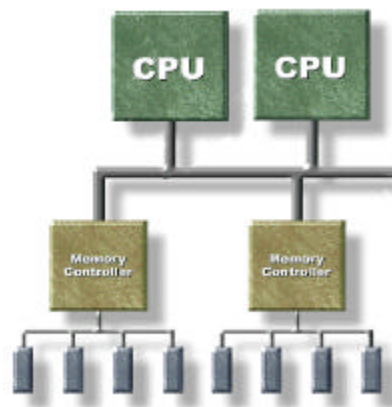
Diagram 1: Compaq Highly Parallel System Architecture



Dual Memory Controllers

The Compaq Professional Workstation 5100 uses dual memory controllers that can process memory requests in parallel, effectively increasing overall memory bandwidth. Other workstations in the Windows NT / x86 market offer memory bandwidth of either 267 MB/second or 533 MB/second depending on the core logic chipset they use. The Compaq Professional Workstation 5100 uses two memory controllers, each with memory bandwidth of 533 MB/second. Therefore, total memory bandwidth increases to 1.07GB/second: two to four times faster than other systems.

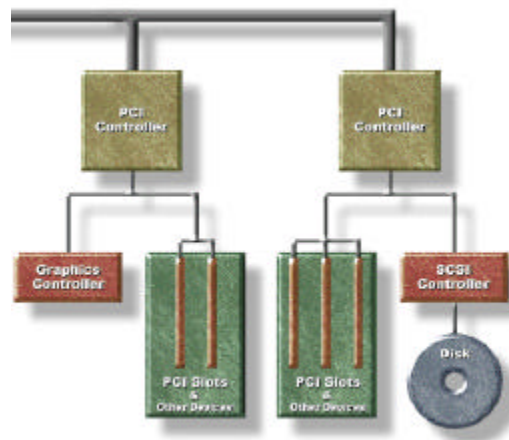
Diagram 2: Dual Memory Controllers Architecture.



Dual-Peer PCI Buses

The Compaq Professional Workstation 5100 also uses dual-peer PCI buses to increase system I/O bandwidth. A single PCI bus provides I/O bandwidth of 133 MB/second that must be shared by many key peripherals such as the graphics controller, hard disk, and NIC. With dual-peer PCI buses, each bus can provide peak bandwidth in parallel with the other controller, allowing an aggregate I/O bandwidth of 267 MB/second. This provides twice the bandwidth of single bus architectures. Also, dual PCI buses allow key peripherals to be connected to separate buses to balance overall system throughput.

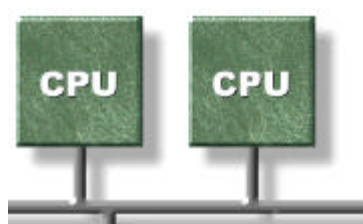
Diagram 3: Dual Peer PCI Buses



Optimized Multiprocessing Support

Finally, with dual memory controllers and dual peer-PCI buses, the Compaq Professional Workstations 5100 is able to deliver optimized multiprocessing support. The Intel Pentium II and Pentium Pro processors enable multiprocessor support by including circuitry that determines how multiple processors can share the CPU bus. However, most multiprocessing implementations in the Windows NT / x86 workstation market take advantage of this support by simply adding an additional processor to an already existing desktop design. Compaq takes multiprocessing to the next step with the Compaq Highly Parallel System Architecture by enhancing memory and I/O bandwidth. Multiprocessor systems designed without the Compaq Highly Parallel System Architecture will quickly encounter a bottleneck as the multiple processors try to access the other system resources, such as memory and I/O subsystems, that have not been enhanced to accommodate the additional data traffic. The Compaq Highly Parallel System Architecture significantly reduces these bottlenecks by incorporating enhanced subsystem resources, such as dual memory controllers and dual peer-PCI buses, to accommodate the increased data traffic from the multiple CPUs.

Diagram 4: Multiprocessing Support



Processor Technology

The Compaq Professional Workstation 5100 uses Intel's newest processor which incorporates Dynamic Execution, MMX™ technology, Dual Independent Bus architecture and advanced multiprocessing support technologies to provide the highest performance workstation.

Dynamic Execution

The Pentium II processor design is based on Intel's Dynamic Execution technology that combines three advanced processing techniques to increase the performance. The three techniques are multiple branch prediction, dataflow analysis and speculative execution.

Multiple branch prediction means that the processor looks ahead several steps in the software and predicts which groups of instructions are likely to be processed next. This increases the amount of work delivered to the processor, improving how efficiently the processor is used and ultimately, system performance.

Dataflow analysis analyzes which instructions are dependent on each other's results, or data. This technique allows an optimized schedule of instructions to be created so they can be processed in the most efficient order.

Speculative Execution means that the instructions are then carried out based on the schedule created by the dataflow analysis. Thus, the entire processor's superscalar processing power is kept busy, boosting overall software performance.

This combination of new technology enables the Pentium II processor to deliver the processing performance workstation applications requires.

Dual Independent Bus Architecture

The Pentium II uses Intel's Dual Independent Bus architecture providing two (dual) independent buses versus the single bus architecture of the Pentium processor. The dual buses are the L2-cache-to-processor bus and the processor-to-main-memory system bus. This design delivers up to three times the bandwidth of a single bus architecture processor because the buses can work independently which essentially doubles the throughput. This technology will enable the evolution of today's 66MHz system memory bus to the faster 100MHz system memory bus.

Pentium II

The Compaq Professional Workstation 5100 uses the Pentium II processor, which is Intel's newest processor that incorporates x86 technology along with Intel's new MMX processor instruction set. The Pentium II will come in 233MHz, 266MHz, 300MHz, and 333MHz versions with 512KB L2 cache. Once again, because performance is a primary requirement for workstation customers, the Compaq Professional Workstation 5100 will only use the 266MHz/512KB, 300MHz/512KB, and 333MHz/512KB processors.

To improve manufacturability, the Pentium II uses a new form factor. Instead of the traditional single chip package, the Pentium II comes with the processor and cache mounted on a printed circuit board (PCB). The PCB, processor and L2 cache are enclosed in a Single Edge Contact (S.E.C.) cartridge. Instead of a socket, the Pentium II now plugs into a slot using the S.E.C. cartridge. This new form factor is similar to a video game cartridge in appearance and measures approximately 4.9" wide by 2.1" high by 0.5" deep.

The Pentium II provides some enhancements over the Pentium Pro. The MMX instruction set improves performance of multimedia processing in MMX-enabled applications. Additionally, the Pentium II uses industry standard SRAMs for the L2 cache. However, the SRAMs run at half the core frequency of the processor. The replacement of the full-speed secondary (L2) internal cache

(Pentium Pro) with the industry standard SRAM cache improves manufacturability, however, this new design takes longer to access the L2 cache versus the Pentium Pro. To compensate for the reduced L2 cache performance, the Pentium II incorporates twice the internal L1 (primary) cache of the Pentium Pro.

The new design also places some limitations on scalability. The current Pentium II systems will only be able to support up to two processors and will be limited to 512 MB of addressable system memory. The Pentium II is only capable of caching 512 MB of system memory so adding memory beyond this will significantly degrade system performance.

Graphics

Five graphics solutions are available in standard models of the Compaq Professional Workstation 5100. All are PCI local bus implementations designed to maximize system performance and have been tested to ensure optimum compatibility and reliability.

- For 2D applications, the Compaq Professional Workstation 5100 includes the Matrox Millennium II graphics controller. The Matrox provides fast 2D windowing for applications such as financial analysis and software development. It comes standard with 4 MB WRAM and is upgradeable to either 8 MB or 16 MB of WRAM.
- For 2D/Entry 3D applications, the Compaq Professional Workstation 5100 includes the ELSA GLoria Synergy. The GLoria Synergy comes standard with 8 MB SGRAM and provides even faster 2D windowing and also provides entry level 3D performance for the occasional 3D needs.
- For multiple display requirements, the Compaq Professional Workstation 5100 includes a model using the STB MVP Workstation graphics controller. Ideal for financial markets, the STB MVP Workstation controller can support two displays in a single PCI slot. The included drivers allow control over dialog box positioning and windows display management. Options include a two port daughter card for a total of four ports per controller for support of up to 8 monitors (2 controllers, 4 ports each) in a single workstation.
- For 3D graphics needs, the Compaq Professional Workstation 5100 includes a model with the ELSA GLoria-XL 3D graphics controller. The GLoria-XL delivers high resolution graphics up to 1920 x 1200 for professional 3D applications. The GLoria-XL uses the new GLINT MX processor from 3Dlabs, and comes standard with 16 MB of Frame Buffer VRAM memory and 24 MB of z-buffer and texture DRAM memory. The z-buffer memory, used for texture, stencil, and z-buffering, is upgradeable to 40 MB.
- For optimized, high-performance 3D graphics needs, the Compaq Professional Workstation 5100 includes a model with the Diamond Fire FL 4000 3D graphics controller. The Fire GL 4000 delivers the highest 3D performance for 1280 x 1024, true color applications. The Fire GL 4000 uses the high performance rendering processor based on the Evans & Sutherland REALimage technology. It incorporates high-performance video memory from Mitsubishi, 15MB 3DRAM from frame buffer and z-buffer memory, 16MB CDRAM (cache DRAM) for fast texture buffering.

Compaq Graphics Driver Compatibility

All five controllers are high-performance graphics solutions, optimized for Windows NT applications that require up to 16.7 million color processing and high resolutions. The drivers for each are developed by their respective manufacturers, and have been thoroughly tested to ensure compatibility with existing applications.

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Matrox Millennium II

The Compaq Professional Workstation 5100 uses the Matrox Millennium II graphics controller to provide fast 2D performance for applications such as software development, electronic design automation (EDA), financial planning, and digital editing and compositing.

Color and resolution support for the Millennium II:

Table 1
Maximum Color Support
Millennium II
Single-Buffer Mode

Resolution	4 MB WRAM	8 MB WRAM	16 MB WRAM
1800 x 1440	256	65,536	65,536
1920 x 1200	256	65,536	65,536
1920 x 1080	65,536	16.7 million	16.7 million
1920 x 1035	65,536	16.7 million	16.7 million
1600 x 1200	65,536	16.7 million	16.7 million
1600 x 1024	65,536	16.7 million	16.7 million
1280 x 1024	16.7 million	16.7 million	16.7 million
1152 x 882	16.7 million	16.7 million	16.7 million
1024 x 768	16.7 million	16.7 million	16.7 million
800 x 600	16.7 million	16.7 million	16.7 million
640 x 480	16.7 million	16.7 million	16.7 million

Matrox Millennium II Technical Specifications

The main enhancements Matrox has implemented in the Millennium II are:

- PCI 2.1 compliant
- PC 97 compliant
- 3D texture mapping
- 16-bit or 32-bit z buffer
- 250MHz RAMDAC to support resolution up to 1920 x 1200@ 75Hz
- Memory expandability up to 16MB WRAM for higher 3D resolution
- Bus mastering with scatter/gather to free-up the CPU for other processing tasks and improve overall system performance in a multitasking environment
- Larger PCI input FIFO buffer for improved 2D and 3D performance (32 double word vs. 64 double word FIFO)
- Supports the Compaq P1610 24" monitor
- 4MB WRAM standard, upgradeable to 16MB WRAM for greater color depth and higher resolutions
- Multiple display support using additional controllers
- Drivers for Windows NT 4.0, Windows NT 3.51, Windows 95, AutoCAD, and Heidi

Table 2: Millennium II technical specifications

Features	Technical specification
Controller	Matrox 2164W
Bus Type	PCI
RAMDAC	TVP 3026 250 MHz
Memory Type	WRAM
Memory Amount	4 + 4 or 12 MB
Max Memory	16 MB
Memory Speed	50 ns
Data Path	64-bit
Controller Clock Speed	50 MHz
Max Vertical Refresh Rate	200 Hz
Max Horizontal Scan Rate	113 KHz
Max Pixel clock	250 MHz
Video Features: Interface Multimedia Connector MPEG HW Acceleration Scaling Color Space Conversion	VGA Feature Connector Optional Multimedia module* Yes – on the optional module* Yes Yes
Engine Acceleration: BitBLT Line Draw Polygon 3D Autodesk Display list driver Heidi drivers support for 3D Studio Max	Yes Yes Yes Yes Yes Yes
Operating Systems	Windows 95 Windows NT 3.51/4.0

* Available from Matrox

3D Capabilities

Although the Millennium II has improved its 3D capabilities as compared to the original Millennium graphics controller, there are significant differences between it and other 3D graphics controllers offered on the Compaq Professional Workstation 5100. The new features in the Millennium II support texture mapping and Gouraud shading along with 32-bit Z-buffering. The Millennium II does not support fogging, alpha-blending, depth-queuing, MIP-mapping, anti-aliasing and bilinear interpolation making it inappropriate for applications in the CAD and DCC segments that require this level of 3D functionality.

Additionally, the Millennium II 3D capabilities are implemented mainly through software (i.e. drivers). Thus, those functions not supported by the hardware graphics controller must be emulated in software and processed by the CPU. This has a significant impact on performance and makes it far slower than a hardware-based implementation. The Millennium II 3D graphics capabilities make it appropriate for 3D games, viewing 3D web sites, and entry-level CAD where rudimentary, low cost 3D capabilities are needed.

ELSA GLoria Synergy Graphics Controller

The GLoria Synergy controller in Compaq Professional Workstation 5100 comes standard with 8 MB of SGRAM memory to provide greater color depth in higher resolution modes. Unified 2D/3D graphics controllers available for the Compaq Professional Workstation provide exceptional performance at a low cost. Professionals who require fast window and menu level performance as well as robust 3D rendering capabilities use 2D/3D graphics. The 2D performance of these solutions is competitive with 2D only controllers such as the Matrox Millennium II.

Requirements for the 2D/3D graphics segment include exceptional 2D/3D-vector performance, 3D shading and lighting, and some texture mapping support. These features used by mainstream OpenGL and Heidi based applications typically offer great price/performance without sacrificing required functionality. This combination is important for mainstream CAD applications, such as AutoCAD, Microstation, and SolidWorks that have recently integrated 3D techniques into their environment. It is also useful in DCC where 2D and 3D animation applications are used in the same environment. Financial analysis and trading environments can benefit from the 2D performance provided by these solutions. Graphics controllers in this segment also provide investment protection as financial analysis application developers add 3D modeling to their environment in FY98.

A low-cost / high-performance leader in this area is the ELSA GLoria Synergy. This controller is based on the new Permedia-2 graphics engine from 3Dlabs. It provides the 2D performance of a Matrox Millennium II while adding a robust 3D environment that rivals the performance of previous GLINT Delta/TX boards, such as the GLoria-L. The GLoria Synergy is the perfect low-cost solution for mainstream CAD, web authoring, pre-print, and 2D/3D animation applications that don't require greater than 1280x1024 resolution for true-color rendering.

ELSA GLoria Synergy Features

- ◆ Provides 2D windowing performance equivalent to the Matrox Millennium II
- ◆ A low-cost solution for professional 3D applications, such as AutoCAD, Microstation, SolidWorks, and 3D Studio Max
- ◆ Supports a wide range of resolutions and color depths for flexibility and performance in a variety of 3D graphics environments
- ◆ Supports up to 4 displays using multiple controllers (depending on slot availability)
- ◆ Uses 3Dlabs Permedia 2 processor for highly integrated 2D and robust 3D rendering requirements
- ◆ Comes standard with 8MB of SGRAM
- ◆ Supports a wide range of resolutions (up to 1600 x 1280) and color depths for flexibility and performance in a variety of 3D graphics environments
- ◆ Optimized graphics drivers for OpenGL and Heidi under Windows NT 4.0 and 3.51; display list drivers for AutoCAD; Direct3D driver for Windows 95

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Table 1: ELSA GLoria Synergy Color and Resolution Support

2D Resolutions*; Max Colors 8MB SGRAM Standard	GLoria Synergy Max Hz Refresh
1920 x 1200; 32K	70
1920 x 1080; 32K	75
1600 x 1280; 32K	75
1600 x 1200; 32K	85
1600 x 1000; 16.7M	60
1536 x 1152; 32K	85
1280 x 1024; 16.7M	70
1152 x 864; 16.7M	85
1024 x 768; 16.7M	100
800 x 600; 16.7M	100
640 x 480; 16.7M	100

* Refer to the Compaq Professional Workstation 5100 Reference Guide for additional display modes and resolutions

Table 2: ELSA GLoria Synergy Technical Specifications

Features	Technical Specifications
Controller	3Dlabs Permedia-2
Bus Type	PCI
RAMDAC	Integrated 230 MHz
Memory Type	SGRAM
Memory Amount	8 MB
Memory Speed	8 ns
Data Path	64-bit
Controller Clock Speed	80 MHz
Max Vertical Refresh Rate	219 Hz
Max Horizontal Scan Rate	281 KHz
Max Pixel clock	230 MHz at 8bpp and 16bpp/5:5:5 135 MHz at 32bpp/8:8:8
Video Features: Interface	VGA
3D Graphics Features: Integrated geometry pipeline setup processor True-color 3D graphics Polygon based with Z-buffer Texture decompression Full scene antialiasing Enhanced GUI Acceleration: Ultra-fast BLT engine and 2D rasterizer Stretch BLTs, monochrome/color expansion	Yes Yes Yes Yes Yes Yes Yes Yes Yes

Features	Technical Specifications
and logic ops	Yes
Fast on-chip SVGA	Yes
Autodesk Display list driver	
Heidi drivers support for 3D Studio Max	Yes
Operating Systems	Windows 95 Windows NT 3.51/4.0

STB MVP Workstation Graphics Controller

For enhanced multiple monitor requirements, the Compaq Professional Workstation 5100 includes a model using the STB MVP Workstation graphics controller. The STB MVP Workstation controller is designed to drive multiple monitors simultaneously from a single PCI slot while providing the ability to display different information on each monitor. Using the STB MVP Workstation controller, the Compaq Professional Workstation 5100 can support two or four monitors using a single PCI slot. The included Mediator™ utility allows control of dialog box positioning and size and placement of application windows.

The STB MVP Workstation controller for the Compaq Professional Workstation 5100 comes standard with 8 MB EDO DRAM (4 MB per port). Available options include a daughter card for an additional two ports (four ports total per controller). The Compaq Professional Workstation 5100 will support up to two STB MVP Workstation graphics controllers with daughter cards for up to 8 monitors.

Table 3: STB MVP Color and Resolution Support

Resolution; Max Colors	STB MVP Workstation Max Hz Refresh
1600 x 1200; 256	60
1280 x 1024; 64K	85
1152 x 864; 256	85
1024 x 768; 16.7M	85
800 x 600; 16.7M	85
640 x 480; 16.7M	100

STB MVP Workstation Features

- Dual monitor support in a single PCI slot
- Upgradeable to quad monitor support with optional daughter card
- Full Video Graphics Array (VGA) compatibility
- Full VESA (Video Electronics Standards Association) compatibility
- 64-bit Graphics Engine for improved display performance
- 4 MB of on-board EDO DRAM per port
- Integrated DAC to support resolutions up to 1600 x 1200 @ 256 colors
- Included STB Mediator™ application controls dialog box and application window positioning

Table 4: STB MVP Workstation Technical Specifications

Controller	S3 ViRGE DX
Bus Type	PCI
RAMDAC	Integrated 170 MHz
Memory Type	EDO DRAM
Memory Amount	4 MB per port
Memory Speed	35 ns
Data Path	64-bit
Vertical Refresh Rate	60 - 160 Hz
Horizontal Scan Rate	31.5 – 91 KHz
Max Pixel clock	170 MHz
Video Features: Interface MPEG HW Acceleration	VGA Feature Connector Yes
Engine Acceleration: BitBLT Line Draw Polygon 3D	Yes Yes Yes Yes
Operating Systems	Windows NT 4.0 or 3.51

ELSA GLoria-XL 3D Graphics Controller

Select models of the Compaq Professional Workstation 5100 include the GLoria-XL 3D graphics controller to deliver high resolutions and color depths for customers running a variety of 2D and 3D applications. This is a new 3D controller based on the 3DLabs MX + Delta graphics processors.

The ELSA GLoria-XL 3D graphics controller provides an optimized hardware pipeline for acceleration of floating-point intensive 3D graphics including hardware support for texture mapping, which is required by certain applications in the CAD/CAM and animation arenas.

The GLoria-XL uses dual-ported Video RAM (VRAM) for the frame buffer. The GLINT processor used on the GLoria-XL also has a separate DRAM-based Z-buffer for Z-coordinates (the third dimension in 3D), alpha data (transparency and fog effects), stencil buffer, and texture maps. The GLoria-XL also incorporates the S3 Trio64V2 processor for VGA boot support, which has its own dedicated DRAM-based frame buffer. The GLoria-XL also supports the new Compaq P1610 24" monitor at resolutions up to 1920 x 1200. It is also capable of processing 16.7 million colors in resolutions up to 1920 x 1080.

The GLoria-XL comes standard with 16 MB of VRAM frame buffer memory, 24 MB of DRAM Z-buffer/texture memory for the GLINT processor, and 1 MB DRAM Frame Buffer memory for the S3 Trio64V2 VGA processor. The Z-buffer/texture memory is upgradeable up to 40 MB DRAM to provide greater Z-buffer and alpha depth in higher resolution modes, and texture-mapping memory. Compaq offers a 16 MB z-buffer/texture memory upgrade option. The maximum resolutions, colors, and refresh rates are outlined in the chart below; lower resolutions are selectable.

Table 5: GLoria-XL Double Buffered Resolutions

Double Buffered Capabilities Resolution; Max Colors	GLoria-XL Max Hz
1920 x 1200; 32K	80
1920 x 1080; 16M	89
1600 x 1280; 16M	90
1600 x 1200; 16M	96
1280 x 1024; 16M	141
1152 x 864; 16M	186
1024 x 768; 16M	235

GLoria-XL Features

Features of the GLoria-XL 3D graphics controller include:

- Support for major industry 3D APIs, including
 - OpenGL – Open Graphics Library is a software interface to graphics hardware developed by Silicon Graphics Inc.
 - Direct3D – A set of APIs for real-time 3D graphics that are an addition to the Microsoft DirectX interactive media technologies. They provide a comprehensive 3D solution for software developers building interactive media programs and games
 - Heidi – 3D API from Kinetix (an AutoDesk company) that provides an immediate 2D and 3D mode drawing interface for 3D Studio Max.
 - Display list drivers – Provide performance acceleration for AutoCAD R13 and Microstation.
- On-board VGA support with S3 Trio64V2 chip for full-screen DOS box support on Windows NT Workstation 3.51 and 4.0.
- GLoria Setting, an applet that allows the user to optimize the performance of the GLoria-XL for a specific application with the click of a button. This applet automatically optimizes the GLoria-XL for a specified application by changing the driver parameters to values that “Tune” it for that application. All users have to do is select their program from a list that is provided. The supported applications include Pro/E, AutoCAD, SoftImage, and 3Dstudio Max.
- Hardware accelerated 3D, 32-bit z-buffering for realistic depth perception and texture mapping.
- Full, 32-bit double buffering for smooth animation by allowing the next image to be created in off-screen memory while displaying the current image.
- Gouraud shading for smooth surfaces.
- Texture mapping for creating realistic images.
- Fog for fading effects, atmospheric effects, and depth-queuing.
- Anti-aliasing to provide smooth colors for rendered scenes by blending the colors of neighboring pixels.
- Alpha-blending for creating transparent effects such as an object behind a window.
- 1 million Gouraud-shaded, depth-buffered, 25-pixel triangles per second with 32-bit color, 32-bit Z-buffer, dithering, stenciling, clipping, and fogging enabled.

Bi-linear texture filtering: a technique used to improve the ability to scale 3D graphics, especially texture maps. Bilinear texture filtering averages the four adjacent texels (texture map element) or interpolates, thus creating a newtexel.

Mip-mapping: a texture map is stored at several levels of detail in a structure called a mip-map. Tri-linear mip-mapping uses a more complex interpolation technique than bi-linear filtering - resulting in a more realistic rendering used for landscapes and motion.

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- 33 million texture mapped pixels per second – nearest neighbor ~~bi~~-linear interpolation including full per-pixel perspective correction, depth buffered
- 16.5M texture mapped pixels/sec –trilinear mip-mapped including full per-pixel perspective correction, depth buffered

Table 6: ELSA GLoria-XL Technical Specifications

3D/2D Controller	3Dlabs GLINT Delta + MX
VGA Controller	S3 Trio64V2
Bus Type	PCI
RAMDAC	IBM RGB640 250 MHz
Memory Type	VRAM & DRAM
Frame Buffer Memory Amount	16 MB VRAM
Z-Buffer and Texture Mapping Memory Amount	24 MB DRAM (GLINT) upgradeable to 40 MB. 1 MB DRAM (S3)
Memory Speed	60 ns VRAM, 50 ns DRAM (GLINT) 70 ns DRAM (S3)
Data Path	64-bit (GLINT) 32-bit (S3)
Controller Clock Speed	55 MHz (GLINT MX) 40 MHz (GLINT Delta) 50 MHz (S3)
Max Vertical Refresh Rate	230 Hz
Max Pixel clock	250 MHz
Hardware Accelerated 3D:	
32-bit Z-buffering	Yes
Gouraud shading	Yes
Stencils	Yes
Texture mapping	Yes
Operating Systems	Windows 95 Windows NT 3.51 Windows NT 4.0

Diamond Fire GL 4000

Select models of the Compaq Professional Workstation 5100 include the Diamond Fire GL 4000 graphics controller which delivers high performance 3D graphics capabilities for users working in demanding, true color environments such as 3D animation, visualization, simulation, and mechanical CAD.

The Fire GL 4000 uses the Mitsubishi 3DPro chipset based on the REALimage rendering technology from Evans & Sutherland to deliver a very high level of 3D performance. It provides hardware acceleration for OpenGL 1.0 (NT 3.51 only), OpenGL 1.1 (NT 4.0 only), and HEIDI (NT 3.51 and 4.0). Support for Direct3D and HEIDI under Windows 95 will be available at a later date.

The Fire GL 4000 delivers industry leading 3D graphics performance by combining a comprehensive set of hardware acceleration features including rasterization, texture mapping and triangle set-up with the new 3D-RAM and CDRAM memory architectures.

3D-RAM is a new technology used for the Frame buffer and Z-buffer memory on the Fire GL. This design includes a small arithmetic logic unit in the DRAM that performs a number of the calculations locally. This improves performance by reducing traffic to and from memory.

The Fire GL uses CDRAM (Cache DRAM) for the texture memory. This technology provides a small SRAM cache built into the DRAM. This high-speed cache provides a buffer for texture between the controller and the DRAM memory, which reduces data access times and ultimately, increase graphics performance.

With all of the Fire GL's high performance features, it can deliver performance exceeding the throughput capabilities of the PCI bus. One component of the Highly Parallel System Architecture in the Compaq Professional Workstation 6000 and 8000 is dual peer-PCI buses, which eliminates the potential PCI bus bottleneck to provide improved throughput and overall system performance when compared to single bus implementations.

The Fire GL 4000 comes standard with 15 MB of 3D-RAM for frame buffer and Z-buffer memory, 16MB of CDRAM for texture memory, and 1 MB DRAM Frame Buffer memory for the CIRRUS Logic 5446 VGA controller. The maximum resolutions, colors, and refresh rates are outlined in the chart below; other resolutions are selectable:

Table 7: Fire GL 4000 double buffered resolutions

Double Buffered Capabilities Resolution; Max Colors	<i>Fire GL 4000</i> Max Hz
1280 x 1024; 16M	85
1024 x 768; 16M	100
800 x 600; 16M	120
640 x 480; 16M	120

Fire GL 4000 Features

Features of the Fire GL 4000 graphics controller include:

- Support for major industry 3D APIs, including
- OpenGL -- Open Graphics Library is a software interface to graphics hardware developed by Silicon Graphics Inc. The Fire GL supports OpenGL 1.0 under Windows NT 3.51 only and OpenGL 1.1 under Windows NT 4.0 only.
- Direct3D -- A set of APIs for real-time 3D graphics that are an addition to the Microsoft DirectX interactive media technologies. They provide a comprehensive 3D solution for software developers building interactive media programs and games. Fire GL 4000 support for this API under Windows 95 will be provided at a later date.
- Heidi -- 3D API from Kinetix (an AutoDesk company) that provides an immediate 2D and 3D mode drawing interface for 3D Studio Max. Support for Windows NT 3.51 and 4.0s available immediately. Support for Windows 95 will be provided at a later date.
- BigFocus Display list drivers -- Provide performance acceleration for AutoCAD R13.
- 3D-Win -- 3D viewer software for AutoCAD R13, Windows NT and OpenGL
- On-board VGA support with CIRRUS Logic 5445 VGA chip for full-screen DOS box support on Windows NT Workstation 3.51 and 4.0.
- Hardware accelerated 3D, 24-bit Z-buffering for realistic depth perception and texture mapping.
- Full, 32-bit RGBA double buffering for smooth animation by allowing the next image to be created in off-screen memory while displaying the current image.
- Gouraud shading for smooth surfaces.
- Texture mapping for creating realistic images.

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- Fog for fading effects, atmospheric effects, and depth-queuing.
- Anti-aliasing to provide smooth colors and removes jagged lines for high quality, realistic rendered scenes.
- Alpha-blending for creating transparent effects such as an object behind a window.
- Bilinear and trilinear mip mapping
- 2,000,000 Gouraud shaded, textured polygons per second (25 pixel triangles) with lighting, z-buffering, blending, and fogging enabled.
- 60 million bilinear MIP-mapped pixels per second.
- 30 million trilinear textured pixel per second.

Table 8: Fire GL Technical specifications

3D/2D Controller	3DPro (Mitsubishi/Evans & Sutherland)
VGA Controller	CIRRUS Logic 5446
Bus Type	PCI
RAMDAC	220 MHz Texas Instruments TVP3026
Memory Type	3D-RAM and CDRAM
Frame Buffer and Z-buffer Memory Amount	15MB 3D-RAM
Texture Mapping Memory Amount	16MB CDRAM
Memory throughput	3D-RAM- 10ns CDRAM- 15ns
Data Path	64-bit (3Dpro) 32-bit (CIRRUS)
Controller Clock Speed	70MHz
Max Vertical Refresh Rate	120Hz
Max Pixel clock	220MHz
Hardware Accelerated 3D:	
32-bit Z-buffering	Yes
Gouraud shading	Yes
Stencils	Yes
Texture mapping	Yes
Trilinear mip mapping	Yes
Operating Systems	Windows NT 3.51/4.0 Windows 95*

* Available at a later date.

3D Performance Comparison

The ELSA GLoria-XL supports high resolutions up to 1920 x 1200 for professional 3D applications. To distinguish the ELSA Gloria-XL from the ELSA Gloria-L and Diamond Fire GL 4000 graphics options, the table below highlights the main feature differences:

Table 9: GLoria-XL and Fire GL features

	ELSA GLoria-XL	Diamond Fire GL 4000
Maximum Resolution	1920 x 1200 @ 32 K colors	1280 x 1024 @ 16.7 M, double buffered
Multiple Monitor Support	Yes	No
Display Memory	16 MB VRAM	15 MB 3D-RAM for display and z-buffer memory
Texture Memory	24 MB DRAM z-buffer and texture memory, upgradeable to 40 MB	16 MB CDRAM
Maximum True Color, Double Buffered Resolutions	1920 x 1080 @ 24bpp	1280 x 1024 @ 24bpp
Performance 25 pixel triangles ¹	1 M/sec	2 M/sec
Pixel Fill Rate Bi-linear MIP mapping Trilinear MIP mapping ²	30 M/sec 15 M/sec	60 M/sec 30 M/sec

¹25-pixel triangles per second using 32-bit color, 32-bit z-buffering, dithering, stenciling, clipping, and fogging enabled

²Perspective correct, bilinear / trilinear Mip mapped, depth buffered pixels/sec

Monitors

The recommended monitors for Professional Workstations are the Compaq P75, 17", P110, 21", and P1610, 24" and the Compaq TFT500 and TFT450 Flat Panel Monitors.

The Compaq P75 monitor:

- On-Screen Display
- Digital Dynamic Convergence
- Clarifies corner-to-corner focus.
- Graphic Picture Enhancement
- Automatically optimizes screen adjustments for text, presentation or full-motion video through the on-screen controls.
- AssetControl
- Space-saving design
- New reduced-depth Trinitron tube and concealed cables saves four inches of desk space.
- Plug and Play and Microsoft PC97 Compliant
- Macintosh Compatibility
- TCO95 Compliant

The Compaq P110 monitor

- Trinitron Technology
- 21" Screen (19.8" diagonal viewable image)
- Flatter, bigger screen minimizes distortion and external light reflection.

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- Ambient light sensor
- Universal Serial Bus (USB) Hub
- .25 - .27 mm variable aperture grille pitch
- Offers 85Hz refresh rates at resolutions up to 1600 x 1200.
- TCO 95 certified
- Plug and Play and Microsoft PC97 Compliant

The Compaq P1610 monitor

- 16:10 aspect ratio
- 24" screen (22.5" viewable image size)
- Delivers maximum image area to increase productivity for intensive applications like CAD/CAM, 3D design, prepress, animation, and financial modeling.
- Trinitron Technology
- .25 - .28 mm variable aperture grille pitch
- Supports 1920 x 1200 resolution at a refresh rate of 76 Hz.
- Expert user controls - Allows high-end users to control advanced geometry and color adjustments, so they can get the best performance from their monitors.
- Plug and Play and Microsoft PC97 Compliant
- TCO 95 certified

The Compaq TFT500 Flat Panel Monitor provides an unprecedented combination of size and performance for the flat panel revolution.

- 15.1" (38.3 cm) viewable Active Matrix Display
- Wide viewing angle: 120 degrees horizontal and 80 degrees vertical
- 1024 x 768 resolution
- USB Hub with 3 downstream ports for connecting USB peripherals
- TCO-95 compliant
- low power requirements (<40 watts)
- Light weight (20 lbs.)
- detachable base
- Optional Desk Arm Mount
- Wall mountable.

The Compaq TFT450

- Space-Saving and Lightweight Weighs 13.5 pounds (with base) with a 2.8" thick panel.
- Thin Film Transistor (TFT) active matrix screen.
- Brightness of 185 nits offers a brighter picture than a standard CRT monitor.
- Wide Angle Viewing
- Arm Mount: frees up to 100% of desk space while increasing mobility. Wall Mount: hangs on a wall like a painting. Standard Mount: offers small footprint and compatibility with Compaq's Multimedia Sound System.
- DisplayAssistant
- TCO 92 Compliant
- AssetControl
- Fault Management
- Plug and Play and Microsoft PC97 certified

Wide-Ultra SCSI Controller

The Compaq Professional Workstation 5100 includes a Symbios Wide-Ultra SCSI host adapter (embedded on the system board) to provide a powerful and expandable multitasking, bus-

mastering interface between the PCI bus and SCSI devices. Wide-Ultra SCSI is the latest SCSI technology, replacing previous Fast-SCSI-2 and Narrow-Ultra SCSI versions. Wide-Ultra SCSI provides a 16-bit bus master interface capable of data transfer rates up to 40 MB per second. A total of seven SCSI devices can be connected to the internal or external SCSI connector. Examples of SCSI devices include harddrives, CD-ROM drives, scanners, tape backups, and removable media drives. The driver for this controller is the same one that is used with the Compaq Professional Workstation family and Compaq server products. SmartStart for Workstations installs this driver for the customer during set-up.

Table 10: Wide-Ultra SCSI boosts bus speed by doubling Fast-Wide SCSI transfer rates

	Data Path	Transfer Rate
Fast-Wide SCSI	16-bit	20 MB/s
Wide-Ultra SCSI	16-bit	40 MB/s

Hard Drives

The Compaq Professional Workstation 5100feature either a 2.1 GB, 4.3 GB, or optional 9.1 GB Wide-Ultra SCSI, Self-Monitoring Analysis and Reporting Technology (SMART) hard drive. The SMART functionality providesprefailure alerting designed to notify the user and network administrator before a hard drive failure occurs.

Below is an overview of the features and performance levels of the hard drives used on the entire Compaq Professional Workstation 5100 product line:

2.1 GB Wide-Ultra SCSI Hard Drive

Capacity	2.1 GB
RPM	7200 rpm
Seek time average	10.0 ms
Latency average	4.17 ms
Transfer rate	
Sustained avg.	7.3 – 11.4 MB/s
Interface	Up to 40 MB/s

4.3 GB Wide-Ultra SCSI Hard Drive

Capacity	4.3 GB
RPM	7200 rpm
Seek time average	9.5 ms
Latency average	4.17 ms
Transfer rate	
Sustained avg.	7.3 – 11.4 MB/s
Interface	Up to 40 MB/s

9.1 GB Wide-Ultra SCSI Hard Drive (Optional)

Capacity	9.1 GB
RPM	7200 rpm
Seek time average	8.5 ms
Latency average	4.17 ms
Transfer rate	
Sustained avg.	10.2 - 15.4 MB/s
Interface	Up to 40 MB/s

10/100 Autosense: automatically configures to the speed of the network (10 or 100 Mbit)

Magic Packet : Network packet that contains unique data field to generate a wake-up signal, causing the PC to power on from a remote location - useful for software distribution, service and support. (Magic Packet is a trademark of Advanced Micro Devices).

Compaq Netelligent 10/100 TX Embedded UTP/Coax Controller

The Compaq Professional Workstation 5100 comes standard with the autosensing Netelligent 10/100 TX Embedded UTP/Coax controller with Magic Packet support. The Netelligent Controller is a dual-speed, 32-bit bus-mastering controller, designed to take full advantage of the Peripheral Component Interconnect (PCI) bus architecture. It delivers excellent network throughput and low CPU utilization for both client and server connections. This controller automatically senses the network speeds and configures itself to operate in either 10Base-2, 10Base-T, or 100Base-TX networks.

Special features of the Netelligent Controller are:

- Fully complies with IEEE 802.3 and 802.3u specifications to ensure compatibility with all industry-standard 10Base-2, 10Base-T, and 100Base-TX devices.
- 32-bit bus-mastering data transfer provides the highest level data transfer method between network and workstation. Bus-mastering relieves the CPU of managing the controller for high throughput and low CPU utilization.
- PCI Plug-and-Play compliance allows the 10/100 TX Embedded UTP/Coax Controller to automatically configure interrupt and memory addresses to conflict-free settings.
- Operates over 10Base-T or 100Base-TX so customers can maintain their investment in current 10 Mb/s Ethernet networking, while also allowing easy migration to high-speed networks as the need arises.
- Auto-negotiation support lets the 10/100-TX Embedded UTP/Coax Controller to automatically determine the proper network speed.
- Full duplex capable for increased bandwidth up to 20 or 200 Mb/s.
- Diagnostic LEDs indicate network speed, link integrity, and network activity for “at-a-glance” troubleshooting.

Remote Wakeup

The Netelligent network controller supports industry standard MagicPacket™ technology to achieve Remote Wakeup functionality. Magic Packet, sometimes called Wake-On-LAN, is used to wake up a sleeping or powered-off Compaq Professional Workstation 5100 remotely over the network. This is accomplished by sending a specific packet of information, called a Magic Packet frame, to a node on the network.

The Magic Packet frame contains a unique data field not normally expected in typical traffic on a local area network (LAN). When a Remote Wakeup-enabled NIC on a turned off workstation decodes this data field, Magic Packet signal is generated. This Magic Packet signal causes the PC to power on. The key to the Magic Packet frame is the Media Access Control (MAC) address of the target workstation, which is repeated 16 times. This pattern of 16 addresses in the data field is not expected to occur in any normal LAN frame other than the specific Magic Packet frame.

Remote Wakeup is possible because a sleeping or powered off Compaq Professional Workstation 5100 maintains a very low power supply to the NIC. A wire supplies 5 volts of power from the workstation's power supply to the NIC; power that is maintained at all times while the Compaq Professional Workstation 5100 is plugged into the wall socket. The NIC uses this power to turn on the workstation when it detects a Magic Packet frame on the network. For more information about Remote Wakeup, refer to *Configuration Management* under the Intelligent Manageability section.

24X Maximum IDE CD-ROM

All models of the Compaq Professional Workstation 5100 include a 5.25", half-height auto-slot load 24X Maximum CD-ROM Drive using the new Constant Angular Velocity (CAV) technology. This CD-ROM uses a slot load mechanism, similar to car stereos, where the CD slides directly into the slot in the CD-ROM. Additionally, previous CD-ROM technology used Constant Linear Velocity (CLV) technology which allowed the disc to rotate at a faster rate while reading the inner tracks and a slower rate when reading the outer tracks. Conversely, CAV technology spins the disc at a fixed rate and the data transfer rate increases as it moves toward the outer tracks. This is the same technology that is used for hard drives where it has demonstrated excellent performance in high data transfer and fast access times. Using this technology enables reliable CD-ROM speeds above 8X. The 24X CAV CD-ROM dramatically increases the access time performance of the CD-ROM in the Compaq Professional Workstation 5100.

Technical Specifications

Access Time	Average = <80 MS
Transfer Rate	3600 KB/second MAX

PremierSound[®] Audio

The Compaq Professional Workstation 5100 includes Compaq's PremierSound[®] audio solution. The PremierSound[®] audio design incorporates a high performance custom designed loudspeaker, a ported (bass reflex) enclosure for extended low frequency output, a low distortion amplifier (less than 0.3 % at the rated power of 3W_{rms}), and 5 bands of fixed equalization. Combined with the ESS Audio 16-bit controller, the design provides a complete, optimized audio solution.

The high performance loudspeaker and the ported enclosure are designed in conjunction with the equalization to provide crisp, clean, wide bandwidth audio from a small integrated mono solution. The low frequency capability of the enclosure and speaker are dramatically better than typical business audio solutions.

The five stages of fixed equalization are used to "tune" the audio system to the acoustic environment, lower distortion and smooth the response of the speaker. The tuning allows us to shape the frequency response to provide exceptionally clear, natural, voice quality, whether on your desk or in the vertical stand.

The result is a well-balanced audio system capable of delivering clean, undistorted output at a level needed to support an office environment. To use the audio capabilities, line in/out and microphone connections are provided on the back of the chassis.

This driver is part of the standard workstation software platform that is used for all Compaq Professional Workstations. SmartStart automatically installs this audio solution for the customer during set-up.

Universal Serial Bus (USB)

The Compaq Professional Workstation 5100 includes two Universal Serial Bus (USB) hubs. USB is a peripheral bus standard developed by a group of PC and telecom industry leaders, used to connect computer peripherals outside of the workstation. This eliminates the need to install cards in expansion slots and then having to reconfigure the system. Workstations equipped with USB will allow peripheral devices to be automatically configured as soon as they are physically attached, without the need to reboot or run setup. USB also allows up to 127 devices to run

simultaneously, with peripherals such as monitors and keyboards acting as additional plug-in sites or hubs.

USB peripherals can include telephones, modems, keyboards, mice, CD-ROM drives, joysticks, tape and floppy drives, scanners, and printers. USB has a 12Mbps/sec data rate, compared to 115.2Kbits/sec for serial ports and 2Mbps/sec for enhanced parallel ports. This speed can accommodate a new generation of peripherals, including MPEG-2 (compressed data) video based products and digitizers.

Drawing its intelligence from the host workstation, USB can detect when devices are added and removed. USB automatically determines what host resource each peripheral requires, including driver software and bus bandwidth, and makes those resources available without user intervention.

Currently, there are different ways to implement USB. The Compaq Professional Workstation 5100 implements the OpenHCI USB interface. OpenHCI reduces CPU overhead for USB devices compared to other implementations and is fully compatible with UniversalHCI.

Currently, Microsoft NT Workstation 4.0 does not support USB, but future versions are expected to include USB drivers that will allow the workstation to recognize USB peripherals.

The Workstation Software Platform

The workstation software platform is consistent across all workstation products including the Professional Workstation 5100, the Compaq Professional Workstation 6000, and the Compaq Professional Workstation 8000. As a result, customers can rely on a single software platform to deploy any Compaq workstation product.

The table below highlights the enhancements to the workstation software platform that were made since the introduction of the Professional Workstations 5000. For a complete overview of the software platform, please refer to the Compaq Professional Workstation Software Platform White Paper.

Table 11: Compaq Professional Workstations Software Comparison Chart

Software Features	CPW 5100	CPW 6000	CPW 8000
Operating System			
Microsoft Windows NT Workstation 4.0	✓	✓	✓
Microsoft Windows 95	✓	✓	✓
Microsoft Windows NT Workstation 3.51	✓	✓	✓
SunSoft Solaris 2.5	✓	✓	✓
UNIX / NT Interoperability			
NFS Client	✓	✓	✓
PC-X Server	✓	✓	✓
PC-X Server OpenGL 3D	✓	✓	✓

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Software Features	CPW 5100	CPW 6000	CPW 8000
Management			
Configuration Management			
Remote ROM Flash	✓		
Remote Security Management	✓		
Remote Wakeup	✓		
Remote Shutdown	✓		
Fail-safe Boot Block ROM	✓		
Compaq Support Setup for Windows NT 4.0 • Remote driver install or update • Remote cold/warm reboot • Remote version control	✓	✓	✓
Net PC Technologies: • Remote System Installation	✓		
ACPI Ready Hardware	✓		
Enhanced Support Software CD & WWW Site	✓	✓	✓
Asset Management			
Memory serial number, manufacturer, speed, etc.	✓	✓	✓
Asset Tag; component serial #s, models; board, BIOS rev.	✓	✓	✓
Fault Management			
ECC Memory, ECC Fault Prediction & Prefailure Warranty	✓	✓	✓
Threshold Alerts, Alpha Page Alerts	✓	✓	✓
Processor Fault Prediction and Prefailure Warranty	✓	✓	✓
SMART II Drives, Proactive Backup, & Prefailure Warranty	✓	✓	✓
Thermal Sensor	✓	✓	✓
Surge Tolerant Power Supply	✓	✓	✓
Performance Management			
Security Management			
Smart Cover Sensor	✓		
Setup password	✓	✓	✓
Enable/disable ports, media write/boot, QuickBoot, etc.	✓	✓	✓
Boot control, power-on password, QuickLock/QuickBlank	✓	✓	✓

Software Features	CPW 5100	CPW 6000	CPW 8000
Compaq Applications			
Compaq Insight Manager	✓	✓	✓
Compaq Diagnostics for Windows NT	✓	✓	✓
Compaq Support Software Diskette for Windows NT (NT SSD): • Compaq Support Setup for Windows NT 4.0	✓	✓	✓
Compaq SmartStart for Workstations	✓	✓	✓
Compaq Insight Manager for OpenView & TME 10NetView	✓	✓	✓
Info Messenger	✓	✓	✓
Compaq Systems Management Toolkit	✓	✓	✓
Compaq Utilities	✓	✓	✓

Microsoft Windows NT Workstation 4.0

Microsoft Windows NT Workstation has become a strong alternative to UNIX workstations because of its superior performance, lower total cost of ownership (TCO), two-in-one solution, leading workstation market share, application availability, and support for improved inter-departmental communication.

- Total Cost of Ownership Study conducted by the independent consulting firm Deloitte and Touche Consulting Group reports a 39 percent cost savings for technical workstations running on Windows NT Workstation when compared with those running on UNIX.
- Customers do not need to switch between a technical workstation and a PC to do regular office productivity tasks such as email, word processing, and project management. Thousands of 32-bit applications for Windows run natively on Compaq Professional Workstations using Intel Pentium Pro and Pentium II processors and the Windows NT Workstation operating system today.
- Microsoft Windows NT based workstations outsold traditional UNIX based workstations in 1996 according to the leading market research firm, International Data Corporation (IDC). Based on the IDC report, growth of the traditional UNIX workstation market was flat in 1996 while workstation volume based on Windows NT Workstation grew by 45.8 percent.
- Because Microsoft Windows NT Workstation is now the number one platform for technical environments, application vendors are optimizing their applications and developing innovative applications for the Windows NT platform. With Windows NT Workstation, application vendors minimize the need to optimize their applications for multiple RISC architectures and UNIX variants.
- Many new and innovative applications are being written for Windows® only (e.g. Solidworks). Software vendors want to take advantage of the huge volumes and price/performance available on technical workstations based on the Windows NT Workstation operating system. In many cases, Windows NT Workstation-based versions of applications provide features not available on UNIX-based platforms.
- Use of Windows NT Workstation facilitates communication and improves productivity by linking engineering departments with manufacturing, marketing, purchasing and other company functions with one operating system.

All Compaq workstations ship standard with Microsoft Windows NT Workstation 4.0.

Compaq Support Software

Compaq Support Software for Microsoft Windows NT 4.0

The Compaq SSD for Windows NT contains device drivers and utilities that enable you to take advantage of specific capabilities offered on Compaq products. These drivers are provided for use with Compaq hardware only. Compaq support for Windows NT contains a new architecture design known as Compaq Support Setup for Windows NT to improve the distribution and maintenance of workstation drivers and utilities. Design enhancements and features include:

Remote Capability: Allows the ability to install, remove, update, and configure components remotely via machine name. Supports distributed computing environment (DCE) perspectives.

Improved Graphical User Interface: A new, more straightforward GUI interface has been provided for increased flexibility and improved functionality.

New Copy / Installation Engine: A new copy engine has been provided to allow more flexibility in support of software that is installed from various media types. For example, hardware abstraction layer support can be installed from the Windows NT CD, SmartStart[™] network, and Service Packs, all with the same transparency.

Silent Setup Command Line Interface: Allows most of the functionality of the GUI interface with execution output to a log file. Desired for Microsoft Systems Management Server configurations.

Transition of Windows NT 3.51 Device Drivers to the Compaq Web Site

SmartStart for Workstations handles the hardware preparation and automatic driver installation for Windows NT 4.0. For installation of Windows NT 3.51, device drivers are only available from the Compaq Web site. Once downloaded, customers can automatically install device drivers using the Compaq SSD for Windows NT setup program. This program will detect the hardware and automatically install the right drivers. Detailed Windows NT 3.51 installation instructions are included on the Compaq Web site.

Windows NT / UNIX/ Macintosh Interoperability

Compaq has partnered with the best ISVs in the industry to deliver high-performance interoperability solutions for integrated UNIX, Windows NT, and Apple Macintosh environments. Compaq and its solutions partners provide:

- A broad range of tested solutions for applications access, resource access and sharing, distributed application execution, system administration; as well as migration tools and internetwork integration products.
- The right set of tools and experience to make it easy for customers to phase in their move to the Windows NT / X86 platform.
- Software that is fully tested and certified where appropriate on Compaq Professional Workstations, both by the partner ISV and by Compaq.
- Continued enhancement of the partnership program, offering cutting-edge solutions as they become available.

Compaq's Interoperability Program Partners include Datafocus, Equilibrium, Hummingbird Communications Ltd., Intergraph, Mortice-Kern Systems, and Softway Systems. Compaq and its'

partners together provide robust, reliable solutions to address the primary concerns for interoperability including:

- Applications access
- Resource access and sharing
- Distributed applications
- Internetwork integration
- Software tools
- Administration

For more information, refer to the UNIX, Macintosh, and Windows NT Interoperability and Migration whitepaper.

Intelligent Management Features

The Professional Workstation provides configuration, information, asset, fault, performance, security, and support software management features. This section describes enhanced management functionality.

Configuration Management *NEW*

Configuration Management features include:

- Remote Wakeup and Remote Shutdown
- Remote Security Management
- Remote ROM Flash
- Fail-safe Boot Block ROM
- Advanced Configuration and Power Interface (ACPI)–ready hardware
- Remote install or update of Compaq Windows NT 4.0 Support Drivers

Remote Wakeup and Remote Shutdown:

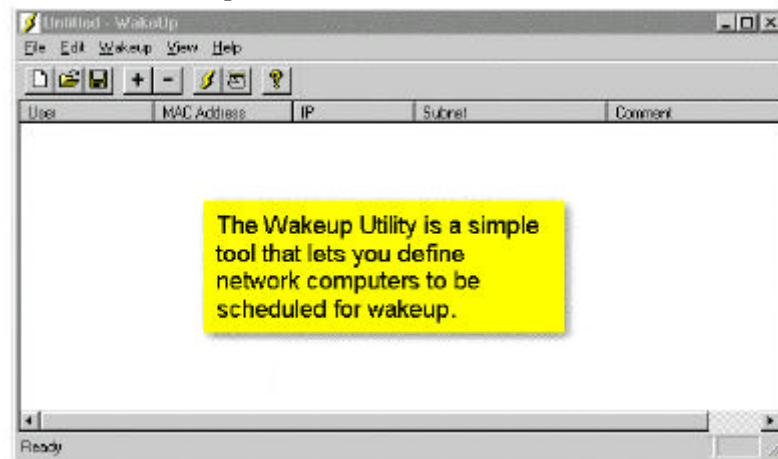
Remote Wakeup and Remote Shutdown allow a system administrator to power on, restart, and power off a client computer from a remote location with a Compaq provided software application or supporting PC LAN management tools. This enables cost-effective power consumption when the administrator needs to distribute software, perform security management, or update the ROM.

Note: Third-party software tools may be required to remotely distribute software. Integral to Remote Wakeup is industry standard MagicPacket™ technology. For more information on Magic Packet, refer to the Network Interface Controller section.

Compaq provides a *Remote Management Setup* application (available by download from www.compaq.com). The Wakeup Utility allows you to define target machines and turn them on with a remote wakeup-call.

Diagram 5: Remote Wakeup Screen

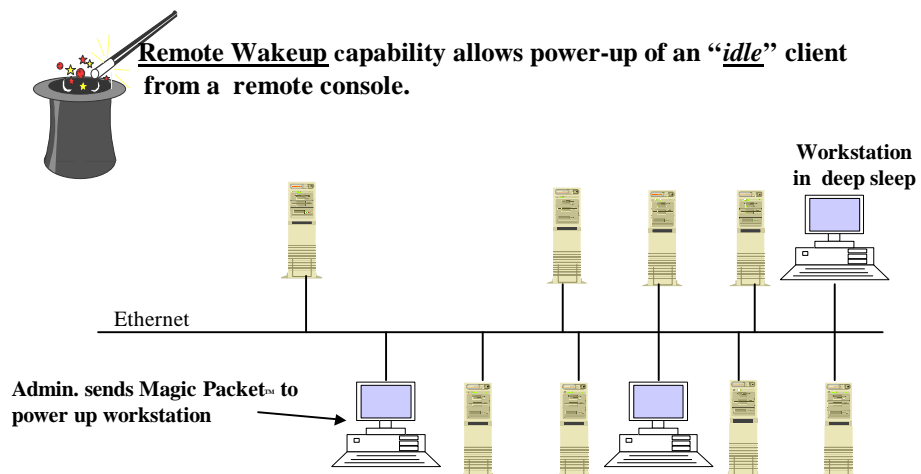
How Remote Wakeup works



The following sequence of events occurs when Remote Wakeup turns on a PC:

1. From the Wakeup Utility the systems administrator defines the target network computers and schedules the time for wakeup. At the scheduled time, the Wakeup utility sends a Magic Packet™ to the remote machine. Note: Supporting third-party PC LAN management applications may also be used to send a Magic Packet frame to the PC.
2. The Remote Wakeup-enabled NIC in the workstation receives the wake-up frame and analyzes it to determine if the frame contains the workstation's media access control (MAC) address.
3. If the frame contains the workstation's MAC address and if the capability is enabled in CMOS, the workstation boots itself, just as if it were turned on by using the On/Off switch.

Diagram 6: Remote Wakeup Illustration



Remote Security Management

Remote Security Management allows the system administrator to safely set or modify security features on remote Compaq Workstations, directly from the centralized network management console. Enabling the system administrator to perform these tasks remotely, on multiple workstations, results in consistent deployment of and greater control over Workstation security

parameters over the network. It also results in greater productivity and lower total cost of ownership. Note: Use of Remote Security Management requires an established setup password.

Remote Security Management is performed in two stages:

- System administrator uses the Remote Management Setup software on a centralized management console to define the security parameters.
- System administrator uses a PC LAN management product to distribute the settings over the network to remote Compaq Workstation personal workstations.

For more information on enabling Remote Security Management, refer to the online *Remote Management Administrators Guide* as found in the Remote Management Setup Application

Using the Remote Management Setup utility and PC LAN management software for network distribution, the systems administrator can manage the following features remotely:

- Wakeup and Shutdown
- QuickLock and QuickBlank
- Serial and Parallel Interfaces
- Administrator Password
- Smart Cover Sensor
- Asset Tag
- QuickLock on Suspend
- Network Server Mode

Diskette Boot and Diskette Write

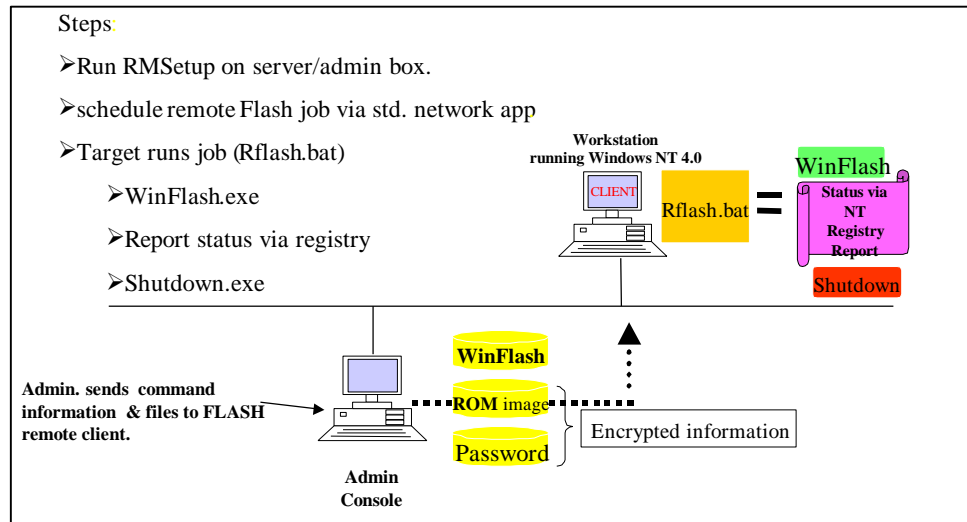
Remote ROM Flash

Flashing the Compaq Professional Workstation ROM remotely provides secure, Fail-safe ROM image management from a central network console. Remote ROM Flashing is performed in two stages:

- System administrator uses the Compaq Remote Management Setup software on a centralized management console to prepare a Compaq Professional Workstation 5100 ROMPaq file.
- System administrator uses a PC LAN management product, such as Microsoft SMS, or Intel LANdesk Manager to distribute and execute the file to remote Compaq Professional Workstation 5100 system(s) over the network.

Compaq designed the Remote ROM Flash capability to be secure and fail-safe. ROMPaq ROM images from Compaq are digitally signed to ensure authenticity. Also, the ROM Flash matches the ROM version against the machine type before flashing to ensure that the correct ROM is flashed on the proper machine. The ROM firmware includes a Boot Block that is protected during the flash process and allows the Compaq Professional Workstation 5100 to be restarted, in the unlikely event of an unsuccessful ROM flash.

Diagram 7: Remote ROM Flash Flow



Fail-safe Boot Block ROM:




The Fail-safe Boot Block ROM allows for system recovery in the unlikely event of a ROM flash failure; for example, if a power failure occurs during a ROM upgrade. The Boot Block is a flash-protected section of the ROM that checks to validate the system ROM each time power to the system is turned on.

- If the system ROM is valid, the system starts normally.
- If the system ROM fails the validation check, the Fail-safe Boot Block ROM provides enough support to start the system from aROMPaq diskette, which can program the system ROM with a valid image.

As there is no video or hard drive support from the Boot Block ROM, the keyboard lights are used to communicate information. When the Boot Block detects an invalid system ROM, the system sounds a series of beeps (one long and three short) and flashes the three keyboard lights. The following table lists the various keyboard light combinations, as well as the meaning and action associated with each combination.

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Table 12 : Keyboard Light Combinations

Num Lock 	Caps Lock 	Scroll Lock 	Meaning and Required Action
OFF	ON	OFF	System requires setup password. Enter the setup password. The light remains on until a valid setup password is entered.
ON	OFF	OFF	System could not start from diskette because the ROMPaq diskette is not present, is bad, or the drive is not ready. Insert a valid ROMPaq diskette, turn the power off, then turn the power on.
OFF	OFF	ON	ROM upgrade failed. Try another ROMPaq diskette. If the light remains turned on, contact Compaq customer support.
ON	ON	ON	ROM upgrade successfully completed. Turn power off and back on to resume normal system operation.

Advanced Configuration and Power Interface (ACPI) -Ready Hardware:

ACPI-Ready Hardware means that the Compaq Professional Workstation 5100 hardware is designed for ACPI power management features available in future Microsoft operating systems (Memphis and NT 5.0). To enable the ACPI feature a new ROM BIOS, driver, and operating system upgrade will be required.

ACPI (Advanced Configuration and Power Interfaces) defines a hardware interface that allows standard way to integrate power management features throughout a workstation, including hardware, operating system and application software. This enables the PC to automatically turn on and off peripherals such as CD-ROMs, network cards, hard disk drives and printers. With the ACPI technology, peripherals will also be able to activate the workstation. For example, inserting a CD-ROM into a CD slot can turn on the workstation, which will then activate a monitor.

ACPI will also allow system manufacturers to deliver operating systems-directed power management, such as the OnNow initiative, for instantly available workstations.

The key benefit of ACPI-ready hardware is that when future ACPI-based Microsoft operating systems are available, the Compaq Professional Workstation 5100 hardware will already be able to utilize these features.

Remote install or update of Compaq Windows NT 4.0 Support Drivers:

The Compaq SSD for Windows NT contains the capability to remotely install or update drivers on remote workstations. Refer to the *Compaq Support Software* section for more details.

APPENDIX

QUESTIONS AND ANSWERS

System Design

Q. What is Compaq Highly Parallel Systems Architecture?

- A.** Compaq's Workstation engineers did extensive application profiling to understand the nature of the bottlenecks inherent when running complex, resource intensive applications such as those found in CAD/CAE, EDA, and financial trading environments. To provide a truly balanced, high performance system, we realized there was a need to offer not only multiprocessing capabilities, but also dual memory controllers so memory requests can be processed in parallel. In addition, dual-peer PCI buses were implemented so I/O requests can also be processed in parallel.

The Compaq Professional Workstation 5100 has been designed with the Highly Parallel Systems Architecture to maximize system bandwidth, which improves overall system performance. No other Intel based Windows NT system on the market today provides this optimized architecture. Designed using industry standard components to deliver the uncompromising performance that workstation users require, Compaq Highly Parallel System Architecture consists of the following:

- Dual memory architecture: provides exceptional performance in resource-intensive applications by providing 1.07GB/sec memory bandwidth: two to four times faster than other Windows NT / X86 systems
- Dual-peer PCI buses: provides I/O bandwidth of 267MB/sec – twice that of single bus implementations – and allow for better balanced I/O system performance
- Optimized multiprocessing support: 1-2 Pentium II processors; 266MHz/512KB, 300MHz/512KB, or 333MHz/512KB

Typical workstation designs include dual processing capabilities with a single memory controller and a single PCI bus. Under this design the processors must compete for access to the critical subsystems such as memory and hard drives. By providing dual memory controllers with dual peer PCI buses, data from the multiple processors has double the access to critical subsystems, which significantly improves overall system performance for the demanding applications in the target segments.

Q. Will the new Highly Parallel System Design provide improved system performance for all applications?

- A.** This new design does provide improved performance for most applications when both sets of DIMM sockets on the system board are populated with memory. This allows for concurrent access to the dual memory controllers and dual PCI buses, which improves overall system throughput and ultimately overall system performance. This is especially true for customers using large data sets in the CAD/CAE and DCC segments.

Q. Is this new design a proprietary Compaq design?

- A.** The Compaq Highly Parallel System Architecture design is based on industry standard components. Thus, if customers need to upgrade components such as memory or hard drives, they are not limited to Compaq-specific solutions.

Processors

Q. What is the expected upgrade path for the Compaq Professional Workstation 5100?

A. The Compaq Professional Workstation 5100 can be upgraded to dual Pentium II 266MHz, 300MHz, or 333MHz processors with 512K cache. Intel is currently indicating that future versions of the Pentium II processor will have faster clock speeds along with larger cacheable address spaces.

Multiprocessing

Q. What, if any, initiatives are underway to ensure applications are able to take advantage of the multiprocessing capabilities of these workstations?

A. Compaq is currently working with Intel and several major ISVs to help the ISV develop multiprocessing capabilities into their applications.

Q. Can the Compaq Professional Workstation 5100 be deployed as a server?

A. Although several features of the Compaq Professional Workstation 5100 have been leveraged from server technologies, this workstation is not supported as a server. Among the major differences between a server and this workstation are:

- Compaq servers support multiple network operating systems while the Compaq Professional Workstation 5100 primarily supports Microsoft Windows NT Workstation (with some support for Windows 95 and Solaris).
- Servers provide redundant features for high availability. These features are not included with the Compaq Professional Workstations since they are not particularly useful in the targeted applications.
- The workstation provides capabilities, such as 3D graphics, which are not available or required for the server products.
- These workstations are tested and certified to run specific power user applications such as CAD and 3D animation. Servers are designed for deployment into environments such as file and print, database and application servers.

System Board

Q. What core logic chipset does the Compaq Professional Workstation 5100 use?

A. The Compaq Professional Workstations 5100 use an industry standard solution from Reliance Computer Corporation (RCC). This solution is available to other OEMs and is fully x86 compatible. It is implemented on the Compaq Professional Workstation 5100 to provide the highly parallel design.

Q. Will Compaq continue to support the RCC chipset in future workstation products?

A. Compaq will continue to evaluate new technologies as they become available. As always, those technologies that provide the best performance using the target segment applications will be incorporated in future workstation products.

Q. When will other Compaq Professional Workstations support Magic Packet™ capability?

A. Currently, the Compaq Professional Workstation 5100 is the first product in the Compaq Professional Workstation family to support Magic Packet capability. It is expected that future Compaq Professional Workstations will support this feature.

Memory

Q. Is the Compaq Professional Workstation 5100 memory interchangeable with the memory on the Compaq Professional Workstation 5000?

A. No. However, the Compaq Professional Workstation 5100 uses the same memory as the Compaq Professional Workstations 6000 and 8000 as well as the ProLiant 2500.

Q. Does the Compaq Professional Workstation 5100 support Synchronous DRAM (SDRAM)?

A. No. By interleaving EDO memory, the Compaq Professional Workstation 5100 achieves the same transfer rate of SDRAM while maintaining customer investment in EDO memory.

Bus Technology

Q. Does the Compaq Professional Workstation 5100 provide support for infrared?

A. Infrared is included in the design of the Compaq Professional Workstation 5100. Currently, infrared is supported with Windows 95 and is expected to be supported in future versions of Windows NT. In addition to operating system support, customers will need to purchase a transceiver that plugs into the IR port.

Graphics

Q. Does the Compaq Professional Workstation 5100 support Intel's Advanced Graphics Port (AGP)?

A. No. AGP provides a mechanism by which main memory can be used as texture memory. The ELSA GLoria-XL card supports up to 40MB of texture memory on the graphics controller card itself, providing a fast, local source of memory for high performance applications requirements. The Diamond Fire GL 4000 has local texture memory providing a very tightly coupled high bandwidth path between texture memory and the frame buffer. AGP technology has been implemented on mainstream and high end desktop PCs to provide a low cost of texture memory for entry level 3D applications.

In addition, Microsoft will not fully support AGP in Windows NT until revision 5.0. The current Compaq Professional Workstation products, therefore, will not support AGP. As newer implementations of AGP become available and as support for this emerging technology is built into Windows NT, Compaq will incorporate AGP into its future workstation designs.

Operating Systems

Q. What level of support will Compaq provide for operating systems?

A. The matrix below provides our operating system support plan:

Table 13: Operating Systems Support

Operating System	Perform Testing	Certification	Install, Config & Setup	Usage	Available Management Support	License Exchange
Microsoft Windows NT Workstation 4.0 and 3.51	Compaq	Microsoft	Compaq	Compaq	Full from Compaq	No
Microsoft Windows 95	Compaq	Microsoft	Compaq	Compaq	POST Compaq Utilities	No

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<i>SunSoft Solaris Intel Edition</i>	SunSoft	SunSoft	SunSoft	SunSoft	None	No
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ISVs

Q. Who are our ISV partners?

A. The following is a current list of our workstation ISV partners.

Segment	ISV Partner
CAD	Autodesk, Bentley, EDS/Unigraphics, Intergraph Software Solutions, PTC, SDRC, Solidworks
CAE	ANSYS, Fluent, MacNeal-Schwendler Corp., Mechanical Dynamics, MARC Analysis
DCC	Adobe, Kinetix, Macromedia, Softimage
Finance	Applix, C*ATS, Infinity, MarketNet Group, NeoVision Hypersystems, Summit Systems
EDA	Mentor Graphics, Viewlogic, VeriBest, Cadence, Quickturn, Synopsys
Technical	Oxford Molecular, Mechanical Dynamics, Platform Computing, Visual Numerics, Inc.
Interoperability	DataFocus Inc, Equilibrium, Hummingbird Communications, Ltd., Intergraph Corporation/ISS Division, Mortice Kern Systems, Inc. (MKS), Softway Systems, Inc.