WHITE PAPER

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Compaq Deskpro Workstation Key Technologies White Paper

The purpose of this paper is to provide an overview of the Key Technologies incorporated into the new Compaq Deskpro Workstation models with the new Intel 820 chipset and the benefits of these features.

NOTICE

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Introduction

Compaq Deskpro Workstations are high performance workstations that provide workstation performance at an exceptional price for business, technical and creative professional customers. Customer market segments include:

- Financial trading or analysis
- Computer aided design (CAD)
- Computer-aided engineering (CAE)
- Digital content creation (DCC)
- Electronic design automation (EDA)
- Software development
- Geographical information systems (GIS)

Compaq Deskpro Workstations offer customers the latest in technological innovation to meet their needs today and in the challenging workstation environments of tomorrow, with models designed for a variety of customers. This paper describes the key technologies for new Compaq Deskpro Workstation models with the Intel 820 chipset.

Intel 820 Chipset

The 820 chipset is targeted for the upper-mainstream and price/performance workstation segments. Replacing the 440BX chipset as the price/performance workstation chipset, the 820 enables the latest technologies such as AGP 4X, RDRAM, Ultra ATA/66, and 133-MHz Front Side Bus (FSB).

Summary of New Technologies

- 133-MHz FSB provides a faster bus for higher processor throughput
- 4X AGP (266-MHz AGP speed) enables faster 3D graphics and video processing
- RDRAM memory interface provides up to 1.6 GB of memory bandwidth for improved overall system performance
- Ultra ATA/66 supports high performance hard drive data transfer
- Enhanced manageability with support for Alert on LAN (AoL) technology
- Embedded AC '97 digital controller to enable low cost implementation of audio and modem technology
- Enhanced baseline security architecture will initially include Random Number Generator (RNG) for enabling security feature implementations
- New Hub-Link architecture enables future accelerated I/O expansions (multiple USB, 1394 I/Os) without saturating system bandwidth
- ACPI Power Management for PCI and USB

Customer Benefits

- *Performance and stable platform for late-1999 through 2000* – For customers requiring a platform that offers the most current technology, stability, and protection against obsolescence, the 820 with its inherent architecture provides features that will enable the latest technologies with sufficient capability to accommodate technologies through 2000.
- *Flexibility and capability to grow* – The new Hub-Link architecture ensures the ability to accommodate higher speed I/Os (USB, 1394, etc.) as the platform evolves over time.
- *Highest graphics and multimedia performance* – AGP 4X performance takes advantage of the highest performance 3D, video and visualization applications.
- *Highest system performance* – By enabling AGP 4X, 133MHz FSB, RDRAM and UATA/66, the 820-based system will allow the highest overall system performance (data throughput) for the most demanding 3D graphics and multimedia, audio and video, and visual content-based applications.

Pentium III Processors

Intel has enhanced the Pentium III processor to take advantage of the new Intel 820 chipset. These processors feature 0.18 micron technology and key attributes of the P6 microarchitecture, such as Dynamic Execution, a multi-transactional system bus, Intel MMX media enhancements, and Streaming SIMD Extensions.

New Processor Features

- Support for faster processor speeds: 600EB MHz and 733 MHz
- Advanced transfer cache – full-speed 256K Level 2, 8-way set associative, 256-bit data bus to the Level 2 cache, reduced latency interface to the cache data, and 11.7 GB/s maximum bandwidth on Level 2 cache transfers up to 733 MHz core frequency
- Advanced system buffering – six fill buffers providing a 50% increase in concurrent nonblocking data cache operations, eight bus queue entries allow more outstanding memory/bus operations, and four writeback buffers that reduce blocking during cache replacement operations and faster de-allocation times for multiple fill buffer
- Support for 133-MHz Front Side Bus (FSB) with a peak bandwidth of 1.07 GB/s
- Supports larger memory bandwidth – 1.6 GB/s per memory channel

Customer Benefits

- *Higher core clock frequency* (MHz) performance with 133-MHz FSB and 256-KB full speed L2 cache provide the power needed to simultaneously run user applications and background IT services that help reduce network bandwidth requirements and protect corporate data.
- *Streaming SIMD Extensions* provide network bandwidth improvements, from enhanced TCP/IP performance and compression/decompression, as well as an enhanced 3D and multimedia processing hardware platform. Delivers expanded support for rich data types and emerging applications and interfaces, such as speech recognition, video and audio.
- *Improved overall system performance* by enhancing the speed at which data is transferred between the processor and other parts of the system.
- *Delivers the latest technology* with a platform that provides performance headroom and longevity into the year 2000.

Rambus Technology

Developed by Rambus, Inc. in conjunction with Intel Corporation, Rambus DRAM (RDRAM) is a new memory technology designed to keep pace with the latest high-speed microprocessors and graphics controllers. Workstation users demand the ability to quickly and easily navigate tremendous amounts of information, including complex graphics and multimedia content. The Rambus solution achieves a ten-fold increase in component throughput, while utilizing fewer ICs and assuring a modular/scalable solution. A single RDRAM is capable of delivering 1.6 GB/s per channel. It is 2 bytes wide running at 400 MHz clock with 95% efficient memory sub-system and protocol. Data is transferred twice in each cycle – on both the rising and falling edge of the clock. The 800-MHz description in memory modules is referring to both the rising and falling edge of the clock. 2 Bytes * 400M Transfers/s * 2 = 1.6 GB/s.

Customer Benefits

- *Improves memory bandwidth* to increase performance in memory-intensive applications.
- *Provides headroom* to accommodate the fast memory requests of increasingly powerful processors.

Hard Drives

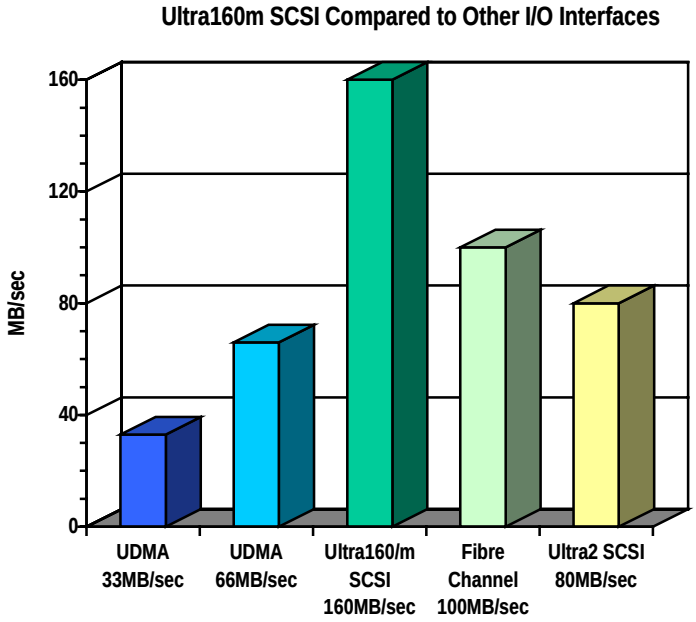
There are two primary interfaces (between the drive and the workstation system bus) available for drives today, Ultra ATA and SCSI. Compaq offers the highest-performance hard drives available and the choice of Ultra3 SCSI and Ultra ATA/66.

Ultra3 SCSI Hard Drives

Ultra3 SCSI is the newest generation of SCSI technology utilizing LVD (low voltage differential) signaling and an 80-MHz clock rate to allow maximum burst rates on the Ultra3 SCSI bus of 160 MB/s, which doubles the maximum burst rate of Wide Ultra2 SCSI. This higher data burst throughput rate provides superior performance in large data transfers, such as streaming video, loading large CAD models, and especially in configurations with several high-speed disks on a single controller. The Ultra3 controller offers more bandwidth headroom for these demanding applications than is available on the Wide Ultra2 SCSI controller and older 40 MB/s Wide-Ultra SCSI devices and is therefore more impervious to performance degradation due to saturation of the SCSI bus. LVD also uses differential signaling technology, which has lower voltage swings and is less susceptible to noise than Ultra SCSI technology.

Some models of the Compaq Deskpro Workstation come standard with a one-inch 9.1-GB Ultra3 SCSI 10,000 rpm hard drive, as well as an integrated Adaptec Ultra3 SCSI controller. Ultra3 SCSI is backward-compatible with all previous versions of SCSI. When an Ultra3 drive is installed on a previous-version (Ultra2 or Wide-Ultra, for example) SCSI bus, performance defaults to the specifications of that bus.

Note: Ultra3 may also be referred to as Ultra160M in the industry. Some vendors have chosen the Ultra160M to identify the next generation of SCSI technology. Compaq has chosen to refer to it as Ultra3.



Customer Benefits

- *Maximum burst rate is doubled*. Ultra3 SCSI features a 160 MB per second burst rate, compared to Wide Ultra2 SCSI's 80 MB per second. This saves time through faster performance in some applications where the SCSI bus is the bottleneck. In multiple disk configurations, significant gains are evident where large blocks of data are sequentially accessed.
- *Domain validation* to verify system configuration (it ensures end-to-end cable configurations operate correctly) and confirm the systems ability to run at negotiated speed. This reduces Total Cost of Ownership (TCO) by minimizing emergency support calls involving improperly designed or configured systems.
- *Enhanced data integrity*

Ultra ATA/66 Hard Drives

The Ultra ATA interface was developed by Intel and Quantum and is commonly referred to as UDMA, Ultra ATA, UATA, or simply ATA. Using "ATA" to refer to Ultra ATA can be confusing. ATA was an earlier protocol with a burst data transfer rate of 16.5 megabytes per second (MB/s). The first version of Ultra ATA, Ultra ATA/33, doubled the burst data transfer rate to 33 MB/s without the need for other hardware changes and is, therefore, fully backward compatible to ATA. Now there is Ultra ATA/66, which doubles the burst transfer rate again to 66 MB/s, and is still backward compatible to ATA. Ultra ATA/66 models implement legacy data transfer protocols that allow them to work in legacy ATA PCs (at legacy ATA functionality). Additionally, Ultra ATA controllers can support up to two devices. The Ultra ATA technology also delivers improved data integrity through improved timing margins and Cyclical Redundancy Check (CRC) data protection verification.

A significant benefit of an ATA hard drive from Compaq is the Drive Protection System (DPS), a hard drive self-test, embedded in the hard drive firmware. Compaq initiated the concept of a resident self-test to reduce the unnecessary replacement of hard drives. DPS offers customers an advanced diagnostic tool designed to identify physical hard drive defects that could result in the loss of data. DPS is unlike current system-level diagnostic tools, which have to be generic to cover multiple suppliers' hard drives; DPS is a design-specific, drive-level test. Current diagnostic tools are dependent on other system components (operating system, cables, CPU) to operate successfully. DPS was derived from the existing SMART protocol and is now an accepted industry standard. Upon execution, information obtained through DPS testing is permanently recorded on the drive. This logging capability assists in troubleshooting system level problems that might result in unwarranted hard drive replacement

The technological advances that allow Ultra ATA/66 drives to perform more efficiently are:

- *Decreased command turnaround overhead*. Ultra ATA/66 minimizes the periods during which the bus remains idle while waiting on the host PC to issue commands to the hard drive. Because the effective data transfer rate equals the burst transfer rate *minus* the command turnaround time, improvements in command turnaround overhead will increase overall performance.
- *Minimized slipped revolutions*. Slipped revolutions, or "slipped revs," occur when the drive must rotate a second time to allow the host PC to drain a buffer. The Ultra ATA/66 higher data rate minimizes slipped revs. As a result, the buffer does not accumulate data and no revs are slipped.
- *Improved timing margins*. Ultra ATA/66 improves timing margins by eliminating propagation and data turnaround delays.

Hard Drive Sizes and Speeds for Ultra ATA

Ultra ATA/66 hard drives will be available in a wide range of sizes throughout 1999. Most drives will be 10GB and larger, with some drives exceeding 20GB.

Ultra ATA hard drives are transitioning from 5400 rpm to 7200 rpm speeds. Just how suddenly this transition occurs depends on how quickly 7200 rpm drive costs reach 5400 rpm costs. Compaq recommends business users invest the extra dollars in converting to 7200 rpm drives in 1999. The combination of faster spin speed and other advantages of 7200 rpm class drives will generally improve overall drive performance by 20%. Additionally, customers who choose to standardize on longer lasting technology will want to invest in 7200 rpm drives considering 5400 rpm drives will phase out more quickly.

Customer Benefits

- *Faster and larger* hard drives with continued improvement in hard drive and controller technologies.
- *Wide range of fixed storage technologies* now available allows customers to select a system that best meets their needs.
- *High speed and economy* with readily available Ultra ATA/66 controllers.

Cyclical Redundancy Check (CRC)

Ultra3 SCSI and Ultra ATA/66 drives implement a significant feature called Cyclical Redundancy Check (CRC), which provides data transfer verification. CRC is calculated on a per-burst basis by both the host and the drive and is stored in the respective CRC registers. At the termination of each burst, the host sends the contents of its CRC register to the drive, which compares the burst data against the register contents to ensure integrity. For even greater integrity, the protocol can be used at speeds slower than its maximum 66 MB/s. The slower the drive's transfer speeds, the greater the integrity margins.

CRC is used by Compaq Intelligent Manageability solutions to provide Integrity Monitoring functions, yielding proactive notification of hard drive data transmission problems and recommendations for enhancing system performance.

Intel PRO/100+ Management Adapter

Increasingly, personal computer (PC) manufacturers are equipping PCs with the capability to generate remote system alerts. Components within these PCs or, in some cases, the PCs themselves feature the intelligence required to identify local problems proactively and issue alerts that report these problems to a centralized management console. Alerting technologies reduce the cost of ownership not only by centralizing routine management functions but also by allowing network administrators to respond to events such as boot failure, overheating, tampering, or theft proactively before significant PC damage or loss can occur.

The Network Interface Controller (NIC) is playing an increasingly significant role in the delivery of alerting capabilities. New, NIC-specific alerting technologies allow the NIC to receive event information from the PC, identify a particular event, and transmit a specific alert packet proactively to the management console.

Intel has integrated Alert on LAN (AoL) technologies into the 82559 Fast Ethernet controller available with the new Intel PRO/100+ Management Adapter. Compaq supports both Intel's Alert on LAN and 3Com's Remote System Alert alerting technologies on new Deskpro Workstation models.

Supported Alerts

The Alert on LAN solution supports the alerts listed in Table 1.

Table 1. Alerts supported by the Intel PRO/100+ Management Adapter

Alert	Description	Benefits
BIOS Hang	The NIC issues a BIOS hang alert if the PC determines that the system BIOS has hung up during POST.	Enables a proactive response to failed automated processes.
OS Hang	The NIC issues an OS hang alert if the PC determines that the OS has failed to load.	Enables a proactive response to failed automated processes.
Missing Processor	The missing processor alert occurs if the chipset does not detect the processor during the initial boot.	Enables a quick response to theft, intrusion, improper processor seating, or a defective processor; minimizes costly losses and downtime.
Thermal	The NIC issues a thermal alert if the PC's Thermal and Fan Control (TAFI) integrated circuit detects an over-temperature condition.	Enables a proactive response to specific thermal problems; minimizes damage and downtime caused by overheating.
Chassis Intrusion	The NIC issues a chassis intrusion alert if someone removes the PC's cover (hood) and activates the hood sensor switch. **NOTE**: Even if disconnected from utility power, the PC can store a chassis intrusion event. When power is restored, the NIC issues the appropriate alert.	Enables a quick response to theft or intrusion.
Heartbeat	This real-time monitor checks for the presence of the PC on the LAN and issues an alert if the PC is not present.	Enables a quick response if the PC has been disconnected from the network for any reason.

The high-level process for reporting a NIC alert (for example, a chassis intrusion alert) using the Intel PRO/100+ Management Adapter on a Compaq Deskpro Workstation is:

1. The PC's hood is removed.
2. This activates the hood sensor switch, which sends a Hood Sense signal to the PC's input/output controller hub (ICH).
3. The ICH passes information about this event to the NIC via the NIC's PCI connector.
4. The NIC decodes the information from the ICH, identifies the event, and transmits the appropriate alert packet over the network to the management console.

Implementation Requirements

Table 2 summarizes the requirements for implementing Intel's Alert on LAN on a Compaq Deskpro Workstation.

Table 2. Implementation Requirements

Requirement	Description
Hardware	Compaq Deskpro Workstation with Intel 820 or future chipset.
	Intel PRO/100+ Management Adapter.
NIC drivers	Intel PRO/100+ Management Adapter driver 3.14 or later (included in the pre-install image of any Compaq Deskpro Workstation featuring an Intel 820 or future chipset, and an Intel PRO/100+ Management Adapter). Alternatively, the latest Intel PRO/100+ Management Adapter driver is available on the Compaq website at: http://www.compaq.com/support/files/desktops/us/software/1375.html
Alert on LAN utilities	The client-side software utility (agent) required by the Alert on LAN solution is not included with the Intel PRO/100+ Management Adapter driver 3.1x. The user should download the agent on the Compaq website at http://www.compaq.com/support/files/desktops/us/software/1375.html
	The user should download the server-side software utility (proxy) from the Compaq website at http://www.compaq.com/support/files/desktops/us/1375.html
Management console	Support for NIC-based alerts is restricted to a few applications such as HP OpenView Network Node Manager 6.x and Intel LANDesk Client Manager 6.x and the future release of Compaq Insight Manager.

AGP

Introduced by Intel in late 1997, AGP has become an industry standard as Intel has placed significant technical and marketing efforts behind this technology. Many vendors began to deliver this technology when Intel introduced the enabling technology with its 440LX AGPset designed for Pentium II processors; however, the benefits of AGP were not realized immediately as some of the underlying infrastructure and support were not available. As time has progressed, AGP technology has come to the forefront and the underlying infrastructure is available.

Core logic chipset support and AGP slots are required in a system to support an AGP graphics accelerator. AGP boards currently come in two form factors NLX and ATX. The NLX form factor is shorter than the ATX form factor; however, many times an extender bracket can be added to an NLX board so that it can fit in an ATX slot. With the introduction of the Intel 840 chipset, a third form factor is available called AGP Pro. To utilize the AGP protocol, several software components are required. Without these software components, a graphics accelerator can reside in the AGP slot, but is restricted to using PCI 66 protocol. Software support is required from the operating system, the graphics driver, and the GART miniport driver. The GART miniport driver is a mechanism that enables graphics applications to access main system memory for texture mapping functions. While the graphics driver and the GART miniport driver are developed by Compaq and/or its strategic graphics partners, operating system support is provided by Microsoft. Microsoft provides AGP support in Microsoft Windows 95 (Intel AGPset only), Windows 98, and Windows NT 4.0 Service Pack 4.

In an AGP architecture, the 2D or 3D graphics accelerator is placed on its own bus and given direct access to system memory. The real features of AGP allow for highly pipelined data transfers between the graphics accelerator and system memory; providing much higher sustained bandwidths in comparison to the PCI bus. The performance advantages of AGP are particularly apparent when 3D applications utilize larger and more detailed textures and command lists, or when vertex data is being communicated. 2D graphics accelerators can also take advantage of the AGP architecture because of the increased bandwidth noted above. Since the graphics accelerator has direct access to system memory, a cost savings is also possible as the graphics accelerator may not require as much on-board memory. Another advantage of AGP is the fact that the graphics accelerator is the only device resident on the AGP bus, therefore, it alone is the bus master. Since this means reduced bus arbitration latency, the graphics accelerator can immediately initiate a transaction when needed. Finally, the removal of the graphics accelerator from the PCI bus increases the bandwidth for other devices on the PCI bus, increasing overall system performance.

AGP Modes

Currently, there are three data transfer rates supported by AGP (all AGP modes support a 32-bit wide bus with a 66 MHz bus clock). (These data transfer rates are theoretical maximums).

- AGP 1X Mode, which yields 264 MB/second throughput
- AGP 2X Mode, which yields 532 MB/second throughput
- AGP 4X Mode, which yields 1 GB/second throughput

To put the above throughput numbers in perspective, the typical PCI bus supports a bus width of 32 bits, clocked at 33 MHz yielding a maximum rate of 132 MB/second throughput. The above throughput numbers make it quite clear that AGP is significantly more efficient than PCI.

There are also four AGP data transfer modes that can be utilized to pass data to and from the AGP controller:

- CPU-GC (Frame Mode only)
- GC-MMF (AGP Frame Mode)
- GC-MMS (AGP Sideband Addressing Mode)
- GC-MMP (AGP Pipelining Mode)

Mode costs, performance and functionality are taken into account by engineering designers when determining the best modes to implement in an AGP controller. Intel continues to encourage AGP controller designers to move from Frame Mode to Pipelining and to Sideband Addressing in their new design to achieve maximum performance.

AGP Pro

The latest extension to the AGP specification is AGP Pro. The AGP Pro specification defines an extended interface connection that was designed to deliver additional electrical power to workstation class graphics accelerators; this is accomplished by adding more power pins on both ends of the standard AGP connector, as well as a corresponding AGP Pro slot in the system. In addition, the AGP Pro specification requires a compliant system to have compatible thermal handling characteristics and two PCI slots adjacent to the AGP Pro connector. These PCI slots can then be used by the AGP Pro graphics accelerator for additional electrical or mechanical purposes. This would provide a compelling benefit in the instance where a graphics solution is made up of two or more boards. AGP Pro does not increase performance over and above the AGP modes mentioned previously; however, it does allow more flexibility in the design of higher performance graphics accelerators by providing more power. Only the AGP ATX form factor is defined in the AGP Pro specification, NLX is not defined. One additional point of note is that an AGP graphics accelerator can be supported in an AGP Pro slot; however, an AGP Pro graphics accelerator cannot be supported in an AGP slot.

Workstation Software Platform

Interoperability

Customers who have already made the move to Windows NT, or are planning to, can be assured that Compaq's Interoperability Program provides seamless integration with applications and information on existing networks. Compaq has partnered with the best integration ISVs in the industry to deliver a broad range of high-performance interoperability solutions for Windows NT, UNIX, and Macintosh. Compaq and its partners perform joint testing to ensure ease and compatibility for a wide variety of operations, such as application access, resource access and sharing, distributed application execution, systems administration, porting and migration, internetworking, and mail. Once the right set of tools have been selected from Compaq's Interoperability ISVs, the ability to access networked information from the Windows NT desktop includes the following application examples: UNIX applications, UNIX OpenGL 3D applications, IBM applications, and files resident on UNIX network File System (NFS). The Compaq Interoperability Program provides the right set of solutions for a heterogeneous enterprise environment.

Intelligent Manageability

Intelligent Manageability is Compaq's industry-leading, award-winning client management solution that helps lower the total cost of ownership by making personal computers more manageable from a single point on the network. It is available on all commercial products from Compaq including desktops, portables, and workstations. Intelligent Manageability supports a variety of the leading third-party management solutions, such as Unicenter TNG, HP OpenView, Microsoft SMS, Novell ManageWise, and BMC Patrol.

Initial Configuration and Deployment Features

- Remote ROM Flash - secure, fail-safe flashing of ROMs over the network
- Remote Wakeup and Shutdown - allows a system administrator to power on/power off a computer from a remote location; enables distribution of software or management of inventories at any time
- Compaq Restore CD - allows you to restore the factory image in the event the original configuration becomes damaged, or in the event of a hard drive failure
- Wired for Management - Intel-led industry initiative to make Intel architecture-based systems universally manageable and universally managed; includes asset management, network boot, power management

Fault Notification and Recovery Features

- ECC Memory - check and corrects 1 bit errors
- Pre-failure Warranty - alerts user before component fails; covers processors, hard drives and memory
- SMART hard drives - (Self Monitoring Analysis and Reporting Technology) drives constantly monitor their activity and predict failures before they occur
- Thermal Sensor - monitors temperature within the chassis
- Surge Tolerant Power Supply - withstands power surges up to 2000V

Asset Tracking and Security Features

- AssetControl - provides the capability to track items such as: serial number, model, manufacturer for system, hard drives and monitors; ROM versions
- Remote Security Management - allows the ability to control security settings over the network
- DMI 2.0 compliant - industry standard for managing computer components, when used with DMI complaint management apps, components can be managed over the network

Software Updating and Management Features

- Support Software CD - contains the latest drivers, flashable ROM images, and utilities
- Website updates - easy access to the latest drivers and ROMPAQs

System Software Manager

A single tool for unattended installation of Compaq Deskpro Workstation system software is available with the System Software Manager (SSM). It allows for easy distribution from a centralized *File Store with no software distribution infrastructure required. *File Store is a directory used to hold the SoftPaq deliverables and working files of System Software Manager. The *File Store can contain custom deliverables that can be installed silently by SSM. The directory can be located on the local system, the network, or on a CD. Multiple file stores can be created to manage different work groups.

System Software Manager optimizes workstation performance with system software during initial deployment and throughout the product lifecycle. The robust feature set includes:

- Detection and upgrade or installation of drivers, system agents, and system ROM on multiple clients simultaneously
- Installing and upgrading drivers for PCI and Plug and Play (PnP) boards and system ROMs in a post Operating System installation environment
- Integration with a variety of software delivery mechanisms. The mechanisms can include the execution via a logon script, software distribution application, email, or local execution from a CD

Unattended Network Installation Toolkit (UNIT)

Compaq provides an open, customizable, free toolkit called UNIT that allows customers to distribute unique software solutions across hundreds of systems in as little as an hour. UNIT simplifies and automates deployment of applications, drivers, upgrades, etc., over the network to help save time and money for customers and resellers. Designed to work with System Software Manager, which comes standard with all Compaq Deskpro Workstations, UNIT is available for free download from the Compaq Web site at http://www.compaq.com/products/workstations/software-platform/unattend.html.

Insight Manager Lite Console Client

Lite Console is an entry-level, web-based desktop management tool that allows the user to view system information, receive alerts, run diagnostics, update system software, and change security settings. It is the industry's first integrated tool for easily managing work groups of PCs and workstations. It allows for Web-based management of a domain, work group, range of clients, or one client at a time. You can view asset and configuration data, change security settings and asset tag information, receive fault and security alerts and run diagnostic tests. Lite Console allows for software management with a ROM flash to change BIOS and the updating of hardware device drivers.