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# HP 3000 Corporate Business Systems CS 990, CS 992/100, CS 992/200, CS 992/300, CS 992/400

## Technical Data

### HP 3000 Computer Systems

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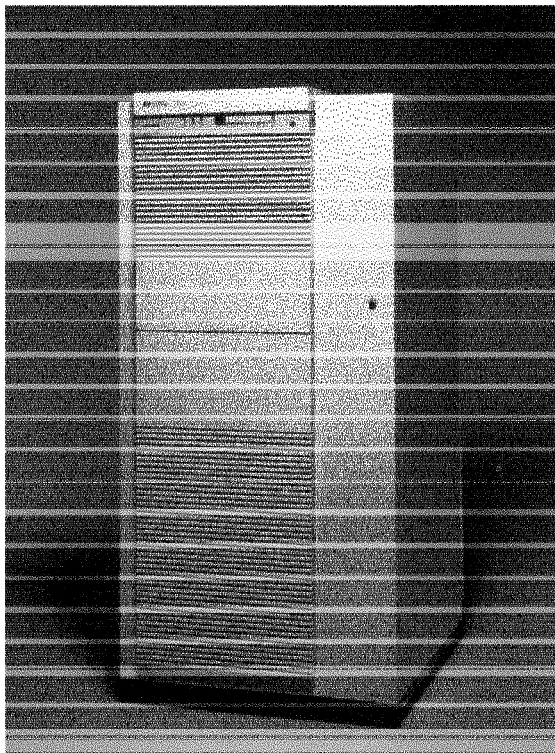
The HP 3000 Corporate Business Systems are highly expandable, high performance computers offering superior value and ease of use for their performance class. They deliver mainframe performance, data center management functionality, and high

availability, at a significantly lower cost of ownership than traditional mainframe systems.

These systems combine the advantages of HP's leading-edge Precision Architecture RISC (PA-RISC) technology and

symmetrical multiprocessing together with mainframe-class memory and I/O bus architectures to deliver leading edge performance today, and expansion for performance upgrades in the future. Powerful hardware is driven by a robust operating system, MPE/iX, designed to handle a variety of business critical data processing applications. MPE/iX offers powerful system management utilities, high availability options, tools for performance measurement and monitoring and built-in features to ensure data integrity.

All HP 3000 systems are complemented by a full range of high quality HP peripherals, industry standard networking, a rich set of application development facilities, several high performance database management solutions, and advanced PC integration products. Since the HP 3000 Corporate Business System is compatible with other HP 3000 systems, a multitude of business solutions are available which meet a wide range of business needs.



## Features

- 16.7 ns system clock cycle and five-stage instruction pipelining for fast instruction execution with virtually every clock cycle
- Large high-speed instruction and data caches (2 Mbytes each) for optimized hardware performance
- High-performance floating point co-processor standard for increased performance in compute-intensive applications
- Single chip VLSI CPU on single-board processors provides high reliability
- Symmetrical multiprocessing for convenient, modular growth
- Enhanced, high-speed bus structure and memory mapped file system optimized for I/O intensive relational database and IMAGE database management applications (Processor Memory Bus - 1 GB/sec peak bandwidth)
- Optional windows-based OpenView PC console for customizable, exception-based systems management through highlighted icons.
- Optional high availability, systems management and PC-based performance analysis and capacity planning software.
- Corporate Business System DX packages provide standard PC-based performance tools, factory pre-installation of the OpenView PC console, and selected high availability software with optional pre-installation.
- Air-cooled design for low power and cooling requirements.

**Table 1. Specifications**

	990	992/100	992/200	992/300	992/400
Relative Performance	1	1.25	2.1	2.9	3.5
CPU clock cycle (ns)	21	16.7	16.7	16.7	16.7
Maximum users	2300	2300	2300	2300	2300
Standard/Maximum					
Memory (Mbytes)	192/2 Gbytes	192/2 Gbytes	256/2 Gbytes	256/2 Gbytes	256/2 Gbytes
Cache Size (l plus D)	4 Mbytes	4 Mbytes	2 x 4 Mbytes	3 x 4 Mbytes	4 x 4 Mbytes
Maximum Disk	690 Gbytes	690 Gbytes	690 Gbytes	690 Gbytes	690 Gbytes

- Compact system cabinet and external cabinets for rackmounted I/O bays and peripherals minimize floorspace requirements.
- 192 Mbyte - 2 Gbyte Error Correcting Code memory expandable in 64, 128 or 256 Mbyte increments for balanced system I/O and application performance
- Maximum of 690 Gbytes of disk storage for very large database support
- Standard battery backup, powerfail recovery to prevent data loss after a power failure
- Support for a wide offering of high quality, high-speed HP disk arrays, tapes, printers and other peripheral devices connected by HP SCSI, fiber-link, and HP-IB (IEEE 488)
- Support for thousands of applications to meet your business needs

## Powerful, Low Cost Hardware Design

### HP Precision Architecture-RISC

The HP 3000 CS 99X business computers use HP's Precision Architecture RISC (PA-RISC) technology to provide high performance and reliability at a low cost.

PA-RISC is built upon Reduced Instruction Set Computing (RISC) principles, a design approach that delivers greatly simplified computers that are optimized to provide the highest performance for a given integrated circuit technology. The inherent simplicity of PA-RISC implies that computer systems can be implemented with fewer components to achieve vastly superior reliability when compared to older Complex Instruction Set Computer (CISC) systems.

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At the core of PA-RISC is an instruction set containing 140 carefully selected, fixed format instructions. Because the instruction set is simplified, instructions can be hard-wired directly into the CPU. Hard-wiring eliminates microcode and the necessity to decode complex instructions. This allows the processor to operate at maximum performance.

PA-RISC utilizes a load/store design and register-to-register operations to reduce the number of memory accesses. To further enhance performance, optimizing compilers schedule instructions and manage the instruction pipeline. With hard-wired control, a load/store design, and optimizing compilers, instructions can be executed on virtually every clock cycle. Single cycle instruction accounts for much of the superior performance of PA-RISC.

As one of the first major vendors to deliver a RISC-based system, Hewlett-Packard is one of the leading manufacturers of RISC-based computers today.

### **VLSI Technology Leadership**

PA-RISC was designed to provide user benefits independent of the particular semiconductor technology implementation. HP's use of submicron CMOS Very Large Scale Integration (VLSI) technology allows the entire CPU to be integrated onto a single chip. The entire processor including the cache, Translation Lookaside Buffer (TLB) and floating point coprocessor are implemented on a single printed circuit board. Reduced complexity allows fewer components and higher reliability, and a resulting lower cost base.

### **Low Cost of Ownership / Small Footprint**

Traditionally, business computers of this power have made use of liquid cooling. Mainframe vendors supplying older technology, CISC-based systems use hundreds of chips and components so closely packed that they are at risk of overheating unless liquid cooling is used. The HP 3000 Corporate Business System's advanced RISC-based VLSI allows use of CPU technologies that provide very high performance without the complexity that creates the need for liquid pumps and exorbitant tubing. This results in a system that has 1/12 the footprint of traditional mainframes, requires much less complex site preparation and maintenance, and is significantly less expensive to produce, own and operate.

### **Designed For Growth**

The Corporate Business Systems were designed from inception to allow for future scalability and expandability. For example, the Corporate Business System 99X has a virtual address capability with an addressing range of 256 terabytes, allowing for substantial expandability to meet growing software requirements. In addition, the hardware architecture is designed to handle higher degrees of multiprocessing, including 8- and 16-way, and to capitalize on emerging technologies such as processor redundancy and fault tolerance.

### **Symmetric Multiprocessing**

The HP 3000 Corporate Business System currently supports tightly coupled, symmetrical multiprocessing of up to four processors. Multiprocessing (MP) allows for economical, modular growth of processing power as system performance requirements increase, and performance capabilities will be augmented in the future with the introduction of higher degrees of multiprocessing in the CS 99X package. Multiprocessing in the MPE/iX software environment is entirely trans-

parent to the application, end users and system administrators. This means that existing applications can benefit from the increased MP system performance without having to execute any rewrites or modifications. In addition, MP provides increased system availability. If one CPU fails, MPE/iX notes the failure upon reboot, deconfigures the failed processor, and continues normal boot and operation.

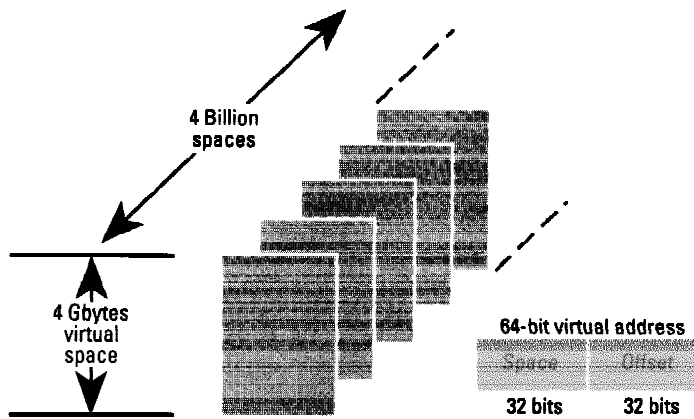
### In-Cabinet Processor Upgrades

Simple processor board replacements and additions allow you to grow your CS 99X system from one performance level to another. Through an easy processor addition today and/or a future processor upgrade tomorrow, you can increase your system performance, protecting your initial investment in the HP 3000 Corporate Business System.

### Virtual memory

Virtual addresses are 64 bits in length, ensuring ample expandability to meet your growing software needs. Virtual memory is divided into 65,535 spaces with each space 4 Gb in length. Spaces are further divided into fixed-length 2-Kbyte pages, with a page holding either code or data. A single data structure can be up to 1 Gbyte in length and the virtual memory scheme can accommodate memory of more than 260,000 Gbytes.

Figure 1. Virtual Address Space



Virtual-to-physical address translation is done by the Transaction Lookaside Buffers (TLB) that cache recently accessed virtual page translations and convert the 64-bit virtual address into a 32-bit physical address. For example, the CS 99X TLB holds translations for 8192 virtual pages (enough room to map 16 Gbytes of system memory). The memory for the virtual pages is split into two parts, half for an instruction TLB and half for a data TLB. This split allows parallel translation of instruction and data addresses.

All HP 3000 high-end systems provide page-level access protection, and the TLB hardware supports protection mechanisms to ensure that the currently-executing process has sufficient authorization to perform the requested data, code, or I/O access. The TLB also uses parity checking which signals the CPU when errors are detected.

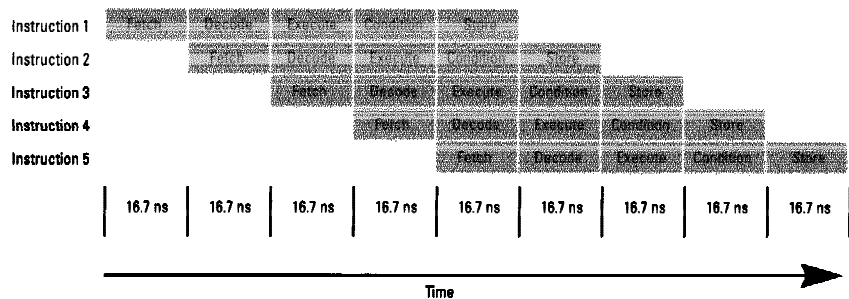
## Advanced Processor Technology

### Cache

The use of cache memory enhances system performance by minimizing CPU requests for instructions or data stored in memory. By storing frequently used instructions and data in a high-speed cache memory instead of relying on system memory, the CPU can execute instructions or process data without overloading the Processor Memory Bus. This is particularly important for multiprocessor systems.

The HP CS 99X processor board uses a 2 Mbyte instruction cache and a 2 Mbyte data cache. This cache operates in a write-back mode. Write-back means that the cache writes modified data to system memory only when the processor needs the cache location for other data, when the operating system flushes the cache location due to a direct memory access operation, or upon power failure. This efficient cache operation provides maximum system throughput. Parity checking protects the cache and a parity error triggers a recovery algorithm that resolves cache failures.

Figure 2. Instruction Pipelining



### Instruction Pipelining

Instruction pipelining is a technique that overlaps instruction processing so that one instruction can begin to execute before the previous one has finished. The net effect is that one instruction completes with essentially every instruction clock cycle. The efficient use of pipelining greatly increases system performance. The HP 3000 CS 99X systems utilize five-stage pipelines with fast 16.7 nanosecond cycle times.

### Floating Point Coprocessor

Single and double precision floating point calculations are performed by the floating point coprocessor (FPC), which comes standard with every system. The coprocessor significantly decreases the time required to perform floating point calculations. The FPC unit allows floating point operations to overlap with CPU operations, as long as there is no interlocking data. This ability to operate in parallel allows for increased performance in applications which are compute-intensive.

## System Organization

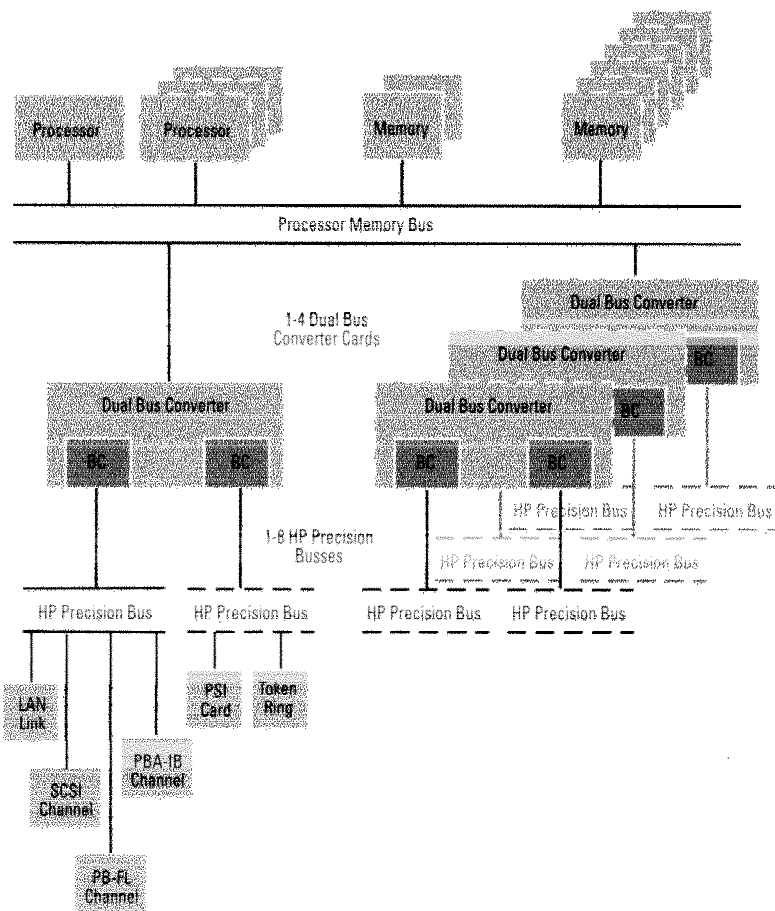
### Memory and I/O subsystems

The HP 3000 Corporate Business System uses 4 Mbit dynamic RAMs and is expandable in 64, 128 and 256 Mbyte increments. Up to 2 Gbytes of main memory are supported. Refer to the Table of Specifications for specific memory sizes.

The HP 3000 CS 99X has a mainframe-class bus structure which provides high system throughput to handle very heavy processing and I/O demands. This bus structure is two-tiered to provide an optimum balance between processor and I/O requirements. An important augmentation to system hardware performance is MPE/iX's ability to reduce disk I/O significantly when compared to traditional mainframes. MPE/iX employs an improved disk

caching capability referred to as "mapped files", which enables the system to take advantage of large memory sizes to increase performance in I/O intensive applications by using main memory as a buffer for disk. This ability to minimize disk I/O is a crucial factor in providing responsive systems for critical application processing, and provides our customers with a competitive advantage by improving system performance without costly peripherals or complex system administration.

Figure 3. System Organization



### High speed Processor Memory Bus

Central Processing Units access main memory over a 1 Gbyte/second (peak) high-speed Processor Memory Bus (PMB). Its separate address and data paths have been designed to maximize speed and throughput of memory bound transactions. Additionally, the PMB was designed to minimize bus contention for high-performance multiprocessing applications by having special hardware to ensure processor cache coherency. The bus speed and cache coherency hardware allow for efficient performance scaling for multiprocessing applications such as OLTP.

### HP-Precision Bus

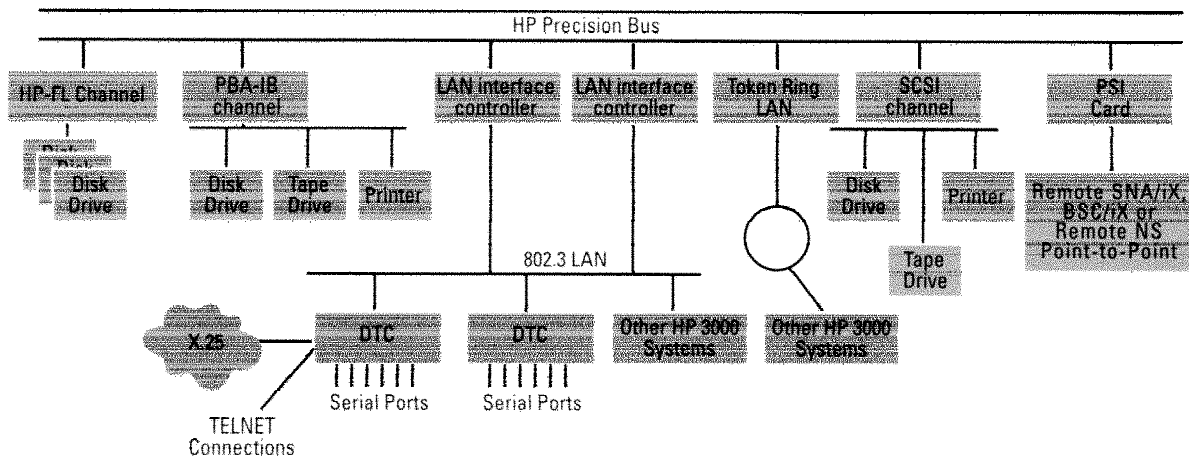
The HP-Precision Bus supports I/O expansion cards for interfacing to peripheral devices and providing data communications functions. The PMB supports up to 8 HP Precision Busses (HP-PB) through separate dual bus converters. One dual bus converter connects to two HP-PBs. The Precision Bus provides a 32-bit data path and can support a peak data transfer rate of 32 Mbytes/sec. In the maximum Precision Bus configuration, aggregate I/O throughput is 256 Mbytes/sec.

### Peripheral connections

Disks are connected via Precision Bus Fiber Optic Link interfaces (PB-FL), which support up to eight disk drives each. Disks, tapes and system printers are connected either via an industry standard SCSI channel card or a Precision Bus Adapter Interface Bus (PBA-IB) channel card which supports the 8 bit wide, IEEE-488 standard Hewlett-Packard Interface Bus (HP-IB). One SCSI channel card is integrated into the system and provides connection for up to seven peripheral devices. One PB-FL is integrated into the system for support of up to eight disk drives, and one PBA-IB is included for support of up to 6 peripheral devices. In addition to peripheral interface cards, the

HP-PB card cage supports Programmable Serial Interface (PSI) cards, allowing HP 3000 900 Series systems to be linked to other computers in a distributed computing environment, and an 802.3 Local Area Network Interface Channel (LANIC) for system-to-system datacommunications. A Corporate Business System with a full complement of card cages supports a maximum of 40 PB-FL cards, 40 SCSI cards, 16 PBA-IB cards or 8 PSIs.

Figure 4. Peripheral Connections



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### **Workstation and serial printer connection**

Connections for workstations, serial printers and other serial devices are provided via Datacommunications and Terminal Controllers (DTCs) that are distributed over an IEEE 802.3 standard Local Area Network (LAN). This flexible connection scheme allows DTCs to be situated in the department that they serve, saving the cost and effort of running cables from the system processing unit to each workstation. The DTC 48 can support up to 48 directly connected ports or 36 modem ports. A LAN/Console card is integrated into the system for connection to the DTC LAN, connection to the system console and system-to-system datacommunications, if desired.

PCs can also be connected to the HP 3000 through HP LAN Manager and Novell Netware LANs. Physical connections can be via HP EtherTwist which is a local area networking scheme using unshielded twisted pair (or phonewire). Both workstations that are connected via a DTC, and PCs that are connected via a LAN can communicate with HP 3000 systems and servers sharing the same LAN.

### **Systems Management**

The HP 3000 Corporate Business Systems have robust functionality for managing large data center environments. Available from Hewlett-Packard and its third party partners is a wide variety of systems management solutions in the areas of performance management, system accounting and configuration, security, availability, operations control and storage management.

#### **HP OpenView Systems and Network Management**

HP OpenView System Manager provides a flexible, integrated approach to systems and network management and a consistent management framework for an organization's entire network of information and computing resources. Through exception-based system management, operators are notified of system events graphically and automatically by the HP OpenView network map. Operators can define which events to report, providing flexibility and eliminating unwanted notifications. The HP OpenView console is a version of HP OpenView System Manager that provides the benefits of OpenView for a single HP 3000 system. Task-based filtering of events lets the operator focus on specific categories of messages all at once, e.g. all tape messages or all printer messages, and an automatic response feature brings the system one step closer to being self-managing. The HP OpenView console is standard on the DX version of the Corporate Business System.

### **High Availability**

The HP 3000 Corporate Business System meets the high availability requirements of mission critical applications through a variety of software and hardware elements. This system features error correction for the system bus and main memory, a battery backup capability, and redundant I/O channels. In the event of a power loss, the powerfail battery backup protects the system. If AC power is lost, the state of the processor is secured in memory for at least 15 minutes. Maximum storage time depends on the amount of memory in the system. If power is restored within this limit, the system restores itself and resumes processing with no loss of data.

Hardware redundancy also extends to on-line storage as available disk arrays provide RAID-3 level data protection. Software provides capabilities for transparent disk mirroring through Mirrored Disk/iX. SPU Switchover/iX detects systems failures and allows for switchover from a primary to a secondary processor in the event of a processor failure. Unplanned downtime is further minimized by AutoRestart/iX which automatically and immediately saves the system state after a software failure, and system availability is further improved by TurboSTORE/iX II, which provides high speed, unattended, on-line backup. TurboSTORE/iX II and AutoRestart/iX are standard on the DX version of the Corporate Business System.



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### **Performance Management**

HP GlancePlus, a performance monitoring and diagnostic software tool for the HP 3000, provides information on current system resource usage and process activity to help system managers and operators quickly isolate and resolve performance bottlenecks when they occur.

HP LaserRX software provides the comprehensive system activity information needed to manage your HP 3000 system for optimal performance, helping to contain costs, streamline data processing operations, and efficiently deliver defined levels of service. RXForecast works with LaserRX to support ongoing capacity planning and to allow you to perform regular system resource forecasting. All three of these performance management tools are standard on the DX version HP 3000 Corporate Business System.

### **Security**

Operating system security is an essential component of systems management. To protect your system from unauthorized access and data corruption, the HP 3000 provides robust system security. The operating system is designed so that the user capabilities, the account structure, the file system, and system security are integrated. All MPE/iX systems provide Department of Defense (DoD) C2 functionality when combined with a user interface package. Every file and device can optionally have an access control definition (ACD), which specifies which users have access to that file or device. An ACD can

restrict read, write, and append access, and can restrict printing access to a particular device to a specific user or set of users. System security is further augmented with multi-level logon access security and auditing.

### **Open Systems Functionality**

All HP 3000 900 systems provide OLTP performance and functionality while also supporting industry and de facto standards. The HP 3000 provides interoperable networking (ARPA, OSI and IBM SNA services) and application portability through standard application programming interfaces (POSIX, industry and defacto standard languages and relational database management systems).

### **Industry Standard Networking**

HP networking solutions are based on defacto and industry standards. These standards include: Open Systems Interconnect (OSI); Transmission Control Protocol / Internet Protocol (TCP/IP); Systems Network Architecture (SNA), and the Open Software Foundation's Distributed Computing Environment (OSF/DCE). A networking solution based on standards enables effective communication between a variety of computer systems. In addition, it protects your current computer equipment investment and gives you the flexibility to choose the best technologies and applications for your future needs.

### **System-to-System**

For system-to-system communications, the HP 3000 has a complete offering of local and wide-area networking services. ARPA Services, NFS, and NCS allow for transparent file access, file transfer, and sharing of resources in a TCP/IP environment. In OSI networks, FTAM allows users to transfer files between different vendor computers. In addition, the HP 3000's X.400 product, based on the industry standard OSI model, lets users send and receive electronic mail messages across a multivendor environment. For HP 3000 to HP 3000 communication, HP Network services provides virtual terminal and file transfer capabilities.

### **PC Integration**

The HP 3000's family of PC Networking products (Novell Netware and LAN Manager) enable PC users to access enterprise-wide information and computing resources. This provides users with the best of both worlds: access to PC applications plus access to the power and resources of the HP 3000.

HP 3000 Networking Services and PC Networking products are supported over industry standard links: Ethernet/802.3, and Token Ring for local-area communication and X.25 for wide-area connection. NS Point-to-Point is also supported for a direct connection between HP 3000 systems.

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### **IBM Coexistence**

For seamless integration into an IBM computing environment, the HP 3000 offers a complete array of SNA and BSC connectivity products, including: interactive communication products SNA IMF for 3270 emulation and SNA DHCF for IBM 3270 access to the HP 3000; batch communication products SNA/RJE and BSC RJE; LU 6.2 PU 2.1 API for program-to program communications; and electronic mail communications through either SNADs or X.400. SNA/SDLC Link, BSC Link and SNA/X.25 provide the link for HP-to-IBM communication in SNA and Bisync environments.

### **Information management**

The HP 3000 has several database management products for information storage. HP ALL-BASE/SQL is HP's strategic relational database management system (RDMS) for HP 3000 900 Series systems. This database is based on the industry standard, SQL. In addition, leading third party relational database management solutions are also supported. HP TurboIMAGE is a networked database management system that provides the best DBMS performance on HP 3000 systems. Software developers are provided with a rich selection of programming languages and CASE tools that support these databases. Reporting and presentation tools are available to allow access to the stored data without programming.

### **Support services**

A wide range of hardware and software support services are available worldwide for all HP 3000 products. Available specifically for the HP 3000 Corporate Business System, is HP Premier Account Support, which is designed to meet your complete support needs for your HP 3000 CS 99X system. Included is complete hardware and software support, personalized HP Response Center service, network support, consulting and training. Contact your HP sales representative for details on this and other available support services.

### **System software and supported peripherals**

For a complete list of supported system software and peripherals, refer to the "900 Series HP 3000 Supported Products Listing".

## Ordering Information

The HP 3000 Corporate Business System is available preconfigured with HP TurboIMAGE DBMS, ALLBASE/SQL RDMS, and MPE/iX Fundamental Operating Software, and standard memory as outlined in Table 1. The HP 3000 Corporate Business System DX includes all of the above plus the HP OpenView console, HP TurboSTORE/iX II, HP AutoRestart/iX, HP Glance-Plus, HP LaserRX/MPE, HP RXForecast, and HP Thin-LAN 3000/iX.

All software above, excluding LaserRX and RXForecast, is available factory pre-loaded. Return credits are available when upgrading from other HP 3000 systems to these systems.

Table 2. HP 3000 CS 99X Technical Specifications

<b>Electrical specifications</b>	
<b>AC power input</b>	200-220 VAC 50/60Hz 200-240 VAC (L-N), 348-415 VAC (L-L) 50 Hz
<b>Maximum current</b>	7.5 amps @ 400 VAC 13.1 amps @ 208 VAC
<b>Maximum heat dissipation</b>	4260 Watts
<b>Environmental Characteristics</b>	
<b>Temperature</b>	
Operating	+5 to +40C
Recommended	+20 to +25C
Non-operating	-40 to +70C
<b>Humidity</b>	
Operating (non-condensing)	15% to 80% at 40C
Recommended	40% to 60%
<b>Maximum Altitude</b>	
Operating	3,045m (10,000 ft)
Non-operating	4,572m (15,000 ft)
<b>Regulatory Compliance</b>	
<b>Electromagnetic Interference</b>	Complies with FCC, Part 15, Subpart B as Class A computing device Complies with C1SPR22/EN 55022Class A VCCI Class 1 Registered
<b>Electromagnetic Immunity</b>	Complies with PR EN 55024-2 (ESD) Complies with PR EN 55024-3 (Radiated Immunity)
<b>Safety</b>	UL Listed, CSA Certified Complies with IEC 950, EN 60950 Contact local HP sales representative for European Datacom license numbers.
<b>Acoustics</b>	7.5 Bels (A) Sound Power at ambient temperature less than 30~C
<b>Ventilation</b>	Forced air cooling (two-speed fans); air flows from top to bottom
<b>Physical Characteristics</b>	
<b>Dimensions</b>	
Height	1620mm
Width	750mm
Depth	905mm

For more information, call your local HP sales office listed in your telephone directory or an HP regional office listed below for the location of your nearest sales office.

**United States:**

Hewlett-Packard Company  
4 Choke Cherry Road  
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