HEWLETT PACKARD

General Information Manual

HP 3000 Computer Systems

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HP 3000
Computer Systems

General Information Manual

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- "Networking with X.25" (5957-4635)
- "The Hewlett-Packard NewWave Environment -- Your Window to the Future" (5952-3755)

To obtain any of these primers, contact your local HP Sales Office. Or call HP's Direct Marketing Division at (800) 538-8787; from California, Alaska, or Hawaii, call (408) 738-4133.

Data Sheets

For more in-depth information about HP 3000 systems and related topics, a variety of detailed data sheets are available from your HP Sales Representative, including:

- "MPE XL Operating System Data Sheet"
- "Migration to 900 Series HP 3000 Systems Data Sheet"
- "Migration Planning Guide"
- "Migration Checklist"
- "Fast Start Participant List"
- "Migration Toolset Data Sheet"
- "Information Management Specifications Guide," a compilation of data sheets for the HP 3000 information management software products
- "HP Precision Architecture Data Sheet"
- "MICRO 3000LX Data Sheet"
- "MICRO 3000GX Data Sheet"
- "MICRO 3000XE Data Sheet"
- "Series 70 Data Sheet"
- "Series 925LX Data Sheet"
- "Series 925 Data Sheet"
- "Series 935 Data Sheet"
- "Series 950 Data Sheet"
- "Series 955 Data Sheet"
- "HP 3000 Data Communications Products Specifications Guide"
- "HP Computer Systems Support Services Planning Guide"
- "Performance Consulting Services Data Sheet"
- "Customer Education Planning Guide"

Configuration Guide

The "HP 3000 System Configuration Guide" (5954-9354) provides detailed hardware configuration information for the family of HP 3000 systems. It can be obtained from HP Sales offices or from HP's Direct Marketing Division.

Table of Contents

Chapter 1 Introduction

Chapter 2 The MPE Operating System

Chapter 3 Information Management

Chapter 4 HP Precision Architecture

Chapter 5 HP 3000 Hardware Overview

Chapter 6 Networks

Chapter 8 Commitment to Your Success

Index

1

Introduction

Management Overview

HP 3000 computers provide a compatible family of multipurpose, business data processing systems. Well known for reliability and ease of use, HP 3000 systems are ideally suited for on-line, transaction-oriented applications and distributed data processing. Batch processing and IBM mainframe communication are also well supported by the HP 3000.

With an installed base of over 30,000 systems, HP 3000s are used in highly diverse settings: offices, factories, government and educational organizations, financial institutions, hospitals and many more. Office and manufacturing environments have especially benefited from the HP 3000.

HP provides comprehensive networking capabilities, high-quality peripheral devices and workstations, personal computers, and a wide range of ready-to-run software to complement the HP 3000 family. And because the HP 3000 has been well-established for more than a decade, there are numerous solutions available from value-added businesses.

Recent enhancements to the entire HP 3000 product family have greatly extended its performance range on both the low end and the high end. The low entry-level cost made possible by the new low-end HP 3000 systems provide customers an opportunity to economically automate areas of their businesses that may not have been feasible in the past.

On the other end of the spectrum is HP Precision Architecture (HPPA), a new architecture that is at the forefront of computer technology. By using HPPA, the HP 3000 Series 925, 935, 950, and 955 are able to deliver outstanding performance at industry-leading prices while maintaining compatibility with the rest of the HP 3000 family.

HP 3000 Strategy

The strategy for the HP 3000 family is built upon the following key elements:

1. *Broad compatible product line.* The concept of a broad family of processors based on a common operating system – MPE (Multiprogramming Executive) -- is the cornerstone of the HP 3000 strategy. By offering a family of compatible processors, HP allows you to select a computer system that is the appropriate size for your application. Once the purchase decision has been made, you are assured of a clear and simple growth path. Growing within the HP 3000 family is particularly easy with the upgrade credits offered by Hewlett-Packard. Software compatibility combined with low cost hardware upgrades give your hardware and software investment a level of protection unique in the industry.

2. *Commercial systems leadership.* From the beginning, the HP 3000 was designed with the commercial marketplace in mind. Commercial data process-

ing relies heavily on database applications involving extensive on-line, transaction processing. The HP 3000 MPE operating environment with its tightly integrated database management system is tailored for transaction management. In addition to a finely tuned operating system, the HP 3000 boasts a large body of vertical-market application software and solutions by HP and numerous software suppliers. Rounding out HP's commitment to commercial systems leadership is a support organization that has been rated number one in the industry for five years running.

3. *Productivity.* The decision to purchase a computer is really a decision to increase productivity. HP provides system management tools that allow very large computing centers to be managed by very small staffs. HP also provides program development environments that allow companies to get the most out of their valuable programming staff. Most important, HP is the acknowledged leader in the field of PC integration. The integration of PCs and HP 3000s provides a unique computing environment that simplifies information distribution and access and integrates data processing and personal computing applications. The result is more timely access to data, more effective use of resources, and improved decision making.

4. *Comprehensive networking.* In today's world of distributed data processing among multivendor installations, the ability to network systems together is key. HP has recently been recognized by leading industry analysts as a dominant player in the networking arena. Beside offering scalable and flexible networking solutions, HP's AdvanceNet products are based on industry and de facto standards. This commitment to standards ensures compatibility with existing networks.

Foundation for the Future

The 900 Series systems are HP 3000 systems that are based on HPPA.

HPPA is the foundation for HP's computer development efforts through the rest of this century. This new architecture gives significant advantages in price and performance today and provides a platform for higher performance in the future.

A Commitment to Your Success

Superior software and hardware are not enough. HP provides comprehensive support services for the HP 3000 systems that are second to none in the industry. A variety of support services tailored to meet your needs are available. In addition, HP provides a full range of documentation, training and consulting programs to ensure that you have the assistance your organization needs to be successful. Chapter Eight of this manual describes the support services, training and documentation for HP 3000 systems.

The HP 3000 Systems

MICRO 3000LX/GX/XE

HP's MICRO 3000LX, 3000GX, and 3000XE computers are complete, entry-level business systems that deliver exceptional performance for departmental, distributed branch office, and small business applications. With the MPE V operating environment, they bring the power of transaction processing, text and graphics processing, data communication, and data management to the office in a small, unobtrusive package.

The MICRO 3000LX is a low-cost system for up to 8 users, while the MICRO 3000GX supports up to 16 users with extended data storage and I/O options. The MICRO 3000XE supports up to 56 users and has greater memory and data communication support, making it the right choice for expanding distributed-processing networks and for growing branch offices and small to medium businesses.

Series 70

The HP 3000 Series 70 is the highest-performance MPE V-based system. It provides processing power and capabilities to handle a full range of EDP and distributed data processing applications. The Series 70 is ideally suited for large departments, manufacturing plants, and regional headquarters.

The Series 70 can support up to 400 users.

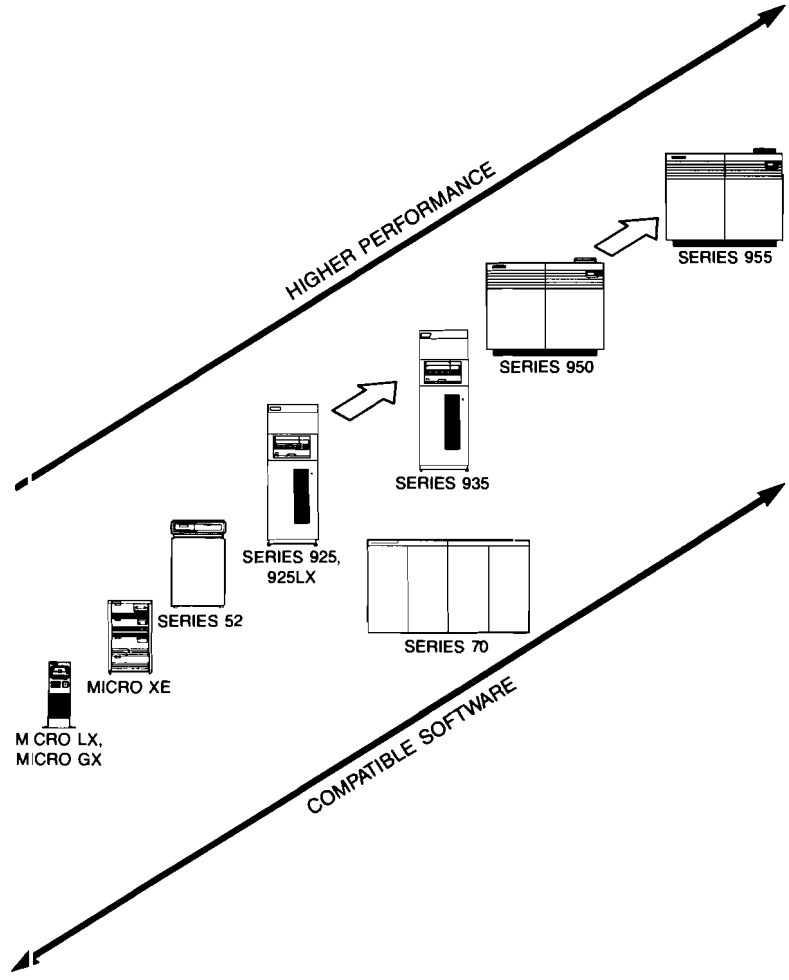


Figure 1-1. HP 3000 Systems: A Broad, Compatible Family

Series 925 and 935

The HP 3000 Series 925 and 935 are midrange members of the HP 3000 family of business computers. The Series 925LX is a low-cost entry-level version of the Series 925.

The Series 925 and 935 are available in a compact, attractive cabinet with the capacity to rack mount an entire entry-level system. They can also be easily expanded to handle larger terminal and disc configurations. The Series 925LX has the same packaging and performance as the Series 925, but supports fewer users.

The Series 925LX supports up to 40 users; the 925 supports up to 152 users; and the 935 supports a maximum of 240 users.

Series 950 and 955

The Series 950 and 955 are the highest-performance members of the broad family of HP 3000 business computers. By incorporating the latest in VLSI technology with HPPA, the Series 950 delivers 7 MIPS of CPU performance on a single processor board to provide a highly reliable, cost-effective solution to high-end data processing needs.

At 11 MIPS, the Series 955 is the highest-performance member of the HP 3000 family. The Series 955 incorporates a very high performance VLSI CPU and large cache memory to provide a significant performance boost over the Series 950. A Series 950 can be upgraded in the field to a Series 955.

The reduced complexity of HPPA allows the high-performance Series 950 and 955 to fit in a meter-high, dual-bay package, which is smaller and has significantly lower cooling and power requirements than typical systems in its performance class.

The Series 950 supports connections for 400 users. The Series 955 will support 400 users and beyond.

HP Precision Architecture

The new HP Precision Architecture, which forms the basis of the 900 Series systems, offers major price and performance advantages over more complex architectures and provides the flexibility to meet user requirements through the end of this century. HPPA represents a fundamental change in computer design. This new architecture is based on RISC (Reduced Instruction Set Computing) concepts with extensions for a complete system.

RISC is the result of the discovery that computer performance can be increased by reducing and simplifying the computer instruction set. This allows computer instructions to be implemented directly in hardware, eliminating the system overhead associated with the microcode of conventional computers.

Pipelining, which provides higher performance by overlapping the execution of multiple instructions, is enhanced through the uniformity of the HPPA instructions.

The architecture can be implemented in a number of technologies and is ideal for VLSI design. By eliminating the chip space required for microcode, highly integrated VLSI designs can be achieved.

Improved performance also results from the memory hierarchy design of the new architecture and its use of optimizing compilers. Frequently used instructions and data are stored in a large number of CPU registers, thereby minimizing memory accesses. Additionally, a large amount of CPU cache provides high-speed buffering for code and data, further minimizing the time that the processor must wait while memory accesses are performed.

Optimizing compilers generate very efficient object code, allocate registers and schedule instruction sequences to maintain an efficient pipeline operation.

HPPA transparently supports a 48-bit or 64-bit virtual memory address space. The 48-bit space is more than 65,000 times larger than that of a conventional 32-bit system, and the 64-bit space is more than four billion times larger. The 48-bit virtual addressing capability of the 900 Series systems allows users to expand their program sizes substantially without being limited by addressing capacity.

The new architecture has the capability to support multiprocessing and provision for a variety of coprocessors to meet specific computing requirements (such as floating-point coprocessors).

The architecture provides significant benefits in design and development time, reliability, and reduced manufacturing costs. It allows simplified system designs that require substantially fewer system components than complex computer architectures.

HPPA is on the leading edge in computer design. It is the "wave of the future" in computer design, and represents a significant contribution to the computer industry.

The MPE Operating System

MPE (Multiprogramming Executive) is the operating system for the HP 3000 family. A disc-based operating system, MPE manages all system resources and coordinates the execution of all programs running on the system.

Starting with the original version of MPE, HP has added new functions and capabilities to MPE's performance, ease of use, and reliability, yet maintained compatibility and interface consistency.

There are now two versions of MPE supported on the HP 3000. MPE V is supported on all MICRO 3000s and the Series 70. MPE XL (MPE with Extended Large Addressing) is the operating system for the 900 Series systems. MPE XL is upwardly compatible with MPE V.

MPE XL is a major new version of MPE, designed specifically to take full advantage of HPPA. MPE XL is object-code and source-code compatible with MPE V. MPE XL has two run-time environments, which are transparent to the user:

- Compatibility Mode: For object-code compatibility with MPE V-based applications
- Native Mode: Provides source-code compatibility. Provides the full performance benefits and advanced capabilities of HP Precision Architecture

Other major features of MPE XL include:

- Multiprogramming: Concurrent transaction processing, data communication, on-line program development, and batch processing
- Extended large addressing: 48-bit virtual addressing
- Demand-paged virtual memory transparently manages virtual memory and eliminates the need for program segmentation
- Mapped files: an extension of disc caching without the need for file system buffering; increase system performance for I/O intensive applications
- File system with file backup, user logging, security and interprocess communication
- Comprehensive access security and complete accounting resources
- Concurrent multilingual capability: seven programming languages, including HP-extended versions of COBOL, RPG, FORTRAN, BASIC, and Pascal
- Powerful command language including user-defined commands, command files, conditional job control, extensive on-line HELP facility, and meaningful error messages
- Device and file independence simplify application development and maintenance
- Spooling of input and output tape label facility
- Complete, automatic terminal management for local and remote terminals
- Power fail/automatic restart

Information Management

Hewlett-Packard offers a wide range of information management products to help you deliver more capable solutions in less time, for less money, and with improved quality. These products form HP's Information Management Framework.

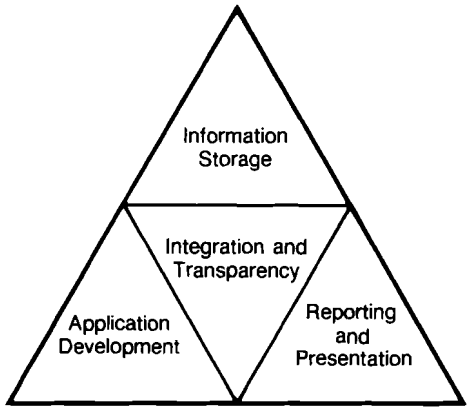


Figure 1-2. HP's Information Management Framework

The HP 3000 has two complementary database management products: an industry-standard relational Database Management System (DMBS) and our award-winning network DBMS. Programmers need a rich selection of programming languages and tools. Reporting and presentation tools are available to allow access to information without programming. And a common data dictionary provides the integration necessary to tie the system into a unified whole.

ALLBASE/XL is HPs database management offering for the HP 3000 900 Series. It comprises both a relational DBMS, HP SQL, and a network DBMS, TurboIMAGE. ALLBASE/XL is optimized for HPPA.

HP SQL/V and the HP SQL module of ALLBASE/XL are based on the industry-standard SQL. HP SQL/V is available on all MPE V systems. Applications developed for HP SQL/V are upwardly compatible with the HP SQL module of ALLBASE/XL.

TurboIMAGE, a general-purpose, two-level network structure DBMS with owner/member data set relationships, is included with the Fundamental Operating Software. QUERY/V, a database support tool included with TurboIMAGE, makes it possible to locate, update, and report on data items within a TurboIMAGE database. KSAM/V (Keyed Sequential Access Method) allows you to create and maintain disc files whose records are accessed by the value of the key fields within the data records.

Silhouette enables users to duplicate databases, allowing two systems to mirror the databases of each other. This product allows for increased system availability.

HP System Dictionary provides a central information resource for documenting data, applications, programs, files, users, input forms, and network configurations for HP 3000 systems.

The VIRTUOSO Code Generator is a programmer's productivity tool that makes it easier to develop and maintain large business data processing applications by structuring and standardizing the manner in which applications are developed. Transact, a procedural language, provides the functionality of a third-generation language combined with a comprehensive set of powerful, high-level constructs that can perform several functions within a single statement.

Cooperative Services, a sophisticated development tool, facilitates development of cooperative processing applications where processing is shared between the PC and the HP 3000.

HP also offers a full range of programming languages, including COBOL, FORTRAN, Pascal, C, BASIC, RPG, and SPL/V.

Toolset provides a set of tools for coding, symbolic debugging, and version management of COBOL II and Pascal applications. Toolset/XL extends symbolic debugging to FORTRAN 77.

HP Symbolic Debugger/XL is the symbolic debugger for HP C/XL, HP FORTRAN 77/XL, and HP Pascal/XL

HP's Screen Management Facility includes FORMSPEC/V and VPLUS/V for the creation of forms and terminal I/O portions of applications.

Business Report Writer, a high-performance report writing system for data processing professionals, can access TurboIMAGE and IMAGE/V databases, MPE files, and KSAM/V files.

Inform/V is an interactive inquiry and report generation facility that enables end users to access data and generate reports in a fraction of the time needed by traditional methods.

Information Access is an information management tool that provides authorized PC users with secured access to departmental and corporate information.

HP Visor, an easy-to-use, terminal-based interface to HP SQL/V and the HP SQL module of ALLBASE/XL, enables end-users to perform queries and generate their own reports without involving a programmer.

Office Information Products

HP's Personal Productivity Center (PPC) combines the strengths of personal computing, office applications, networking, and distributed data processing. Tasks are performed in the most efficient environment -- MPE for transaction processing and MS-DOS for individual analysis.

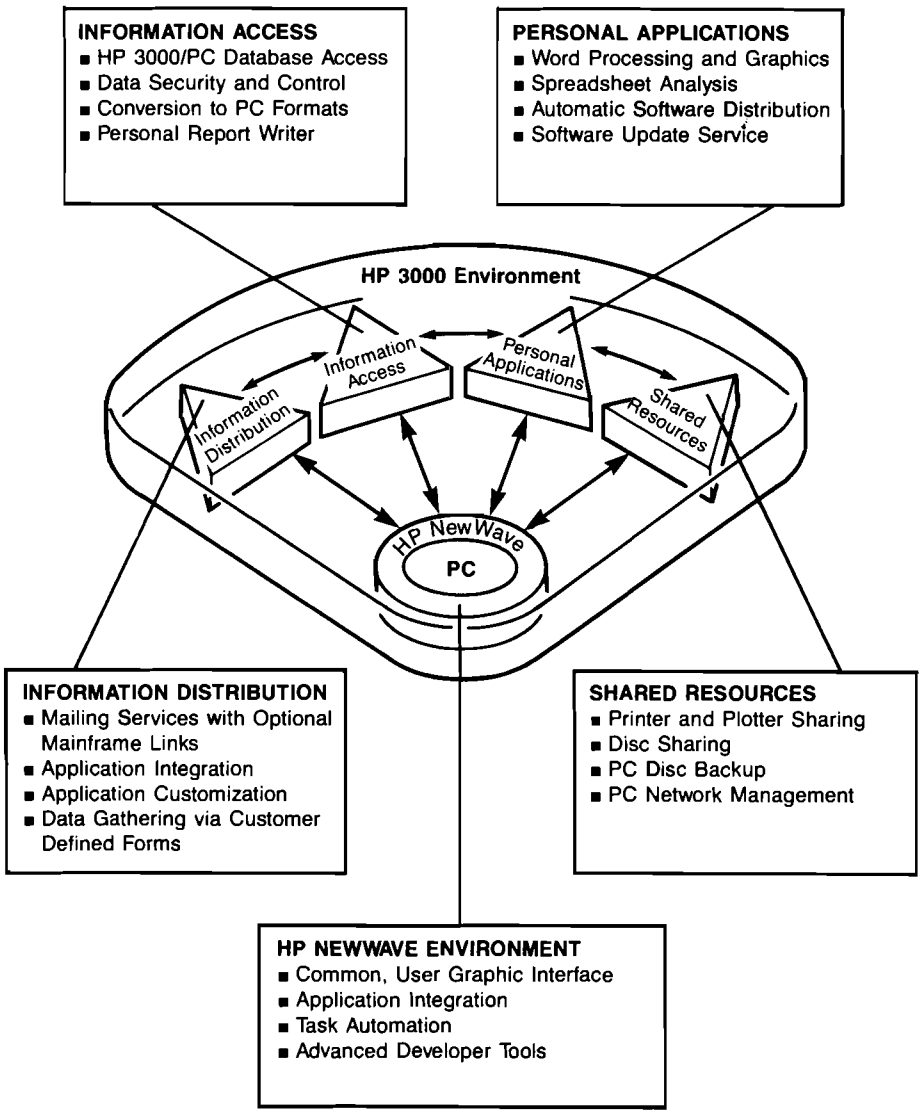


Figure 1-3. HP's Office Framework

At the core of PPC, HP Business System Plus integrates PCs and HP 3000s into a tightly knit business system, providing versatile electronic mail services, data access, shared peripherals, and personal applications. With its easy-to-use, graphic workstation interface and advanced application integration capabili-

ties, the HP NewWave environment enhances developer and end-user productivity. The HP NewWave developer's kit is currently available, and HP NewWave end-user applications will be available later this year.

Compatibility and Migration

Compatibility is the most important element in the HP 3000 strategy. HP has made a very large investment to ensure that the 900 Series systems are compatible with the rest of the HP 3000 family. The result is the smoothest path to next-generation systems ever offered in the industry.

You can upgrade to the 900 Series as easily as you upgraded to previous HP 3000 systems. In addition, HP has provided tools so that migrating to the 900 Series can be performed in stages as your schedule permits without interruption of operations.

- *Object Code Compatibility.* You can move MPE V applications and data to the 900 Series systems by a simple backup procedure. Just store the applications and data on a tape and restore them on the 900 Series system without modifications. The applications will run on the 900 Series system in Compatibility Mode.
- *Source Code Compatibility.* To achieve the maximum performance for applications, applications can be recompiled with HP's optimizing compilers to run in Native Mode.
- *Migration Flexibility.* You have ample flexibility in upgrading to the 900 Series systems because Native Mode applications can access Compatibility Mode and vice versa. And programs can communicate with one another regardless of the mode in which they are running.
- *Operational Compatibility.* MPE XL is a functional superset of MPE V. The two versions are nearly identical in terms of user interface, system management, accounting and security. Your investment in MPE V training is well protected.
- *Peripheral Compatibility.* Because of common I/O mechanisms, the 900 Series systems support many of the same peripherals and workstations as the other HP 3000 systems. This protects your investment in peripheral devices when you upgrade to the 900 Series systems.
- *Cross-System Development.* Compatibility Mode allows you to develop applications on the 900 Series system that will also run on MPE V-based systems.

HP 3000 Naming Conventions

Hewlett-Packard's naming convention for HP 3000 software products is to add either the suffix "/V" or "/XL" to a product name. Software products with the "/V" suffix are designed for use with MPE V and also may run in MPE XL Compatibility Mode. Software products with the "/XL" suffix are specifically designed for use on the 900 Series systems.

Compilers with the suffix "/XL" (such as COBOL II/XL) generate object code that runs in Native Mode on the 900 Series systems. Compilers with the suffix "/V" (such as RPG/V) generate object code that runs under MPE V and in Compatibility Mode under MPE XL.

In this manual, the term "MPE V-based system" refers to those members of the HP 3000 family that operate under the MPE V operating system.

The MPE Operating System

Introduction

The functional heart of the HP 3000 is the Multiprogramming Executive, MPE. This general-purpose, disc-based operating system supervises all processing and maintains all user interface with the HP 3000.

MPE provides a single operating environment across a family of systems, it delivers superior performance in I/O-intensive transaction processing environments, and it is easy to use.

Single Operating Environment

MPE provides a single operating environment for all HP 3000 computer systems. You can move from one HP 3000 system to another without having to do extensive reprogramming or undergo additional training for a new environment.

Two versions of MPE are supported on HP 3000 systems. MPE V is supported on the MICRO 3000 through Series 70. Multiprogramming Executive with Extended Large Addressing (MPE XL) is the operating system for the 900 Series of HP 3000 computers.

MPE XL, a major new version of MPE, is upwardly compatible with MPE V and extends the MPE operating system to HP Precision Architecture (HPPA).

Superior Performance

The MPE operating system has been designed to provide optimum performance in a database-intensive, transaction processing environment. In these environments, I/O performance is a key factor to overall system performance and response time. MPE excels in this area by reducing the number of times it has to access a disc.

Ease of Use

The key to providing a system that is easy to use is its user interface or commands. You use simple commands like "HELLO" to log on, "SHOWTIME" to see what time it is, "SHOWME" to look at your log-on identification, and "BYE" to log off of the system. For all its power and sophistication, MPE XL retains the commitment to ease of use that has been characteristic of every version of MPE.

Another feature that makes MPE easier to use than other systems is the fact that the same commands that are used to access the system interactively from a terminal can be used to create a batch job to be run in the background.

Versatility

Interactive Processing

MPE provides both interactive and batch processing. In interactive processing, you enter commands and data at the terminal and receive immediate response. This is called a session, and is especially useful for data entry and retrieval, program development, text editing, and any other application in which a direct dialogue with the computer is preferred.

Sessions can be used to access:

- Operating system commands and subsystems
- Programming languages and utility programs
- Database management systems
- Data communication facilities
- Application programs
- Office system programs

A session begins when you enter the "HELLO" command from an on-line workstation and MPE connects you to the Command Interpreter. You may then enter commands to use language compilers or other subsystems such as the text editor, to run programs, or to modify your files. The session continues until you enter a "BYE" command or a new "HELLO" command, or until the system operator intervenes to abort the session.

Batch Processing

Batch processing lets you submit to the computer, as a single unit, commands that request various operations such as program compilation and execution, file manipulation, or utility functions. Such a unit is called a job. Jobs contain all necessary instructions to MPE and all references to programs and data required for their execution. Once a job is running, you need to supply no further information.

Batch processing is a logical extension of the interactive functions available through MPE. Any capability, with the exception of BREAK, that is available in one mode is available in the other and employs the same MPE commands. Languages, utilities, and application development software can be run in either batch or interactive mode without changes. The standard input and output devices are automatically redefined.

The only significant difference between a session and a batch job is that during a session you can interactively alter the course of processing, whereas in a job, the command stream is fixed and the job will be executed in its entirety, as predefined in the job control statements, without active intervention.

User-Friendliness

User Interface

The many features and capabilities of the MPE operating system are designed to meet the needs of different kinds of users. Each type of user is associated with a particular set of capabilities and responsibilities, and each has access to MPE features to assist with specific tasks.

There are five categories of users:

- The *end user*, who can range from an order entry clerk to a functional manager, takes advantage of all the capabilities of the operating system through an application program that he or she can run without any knowledge of MPE itself.

- *Programmers* are users who create application programs that run on the system. MPE provides two major areas of system interface for these users: an interactive interface that includes a command language, an on-line HELP facility, and job control facilities, and a programmatic interface that includes programming intrinsics and the MPE file system.
- The *system manager* creates accounts (basic structures for user access), defines resource-use limits, controls scheduling queues, alters the system configuration, and maintains the system library.
- *Account managers* maintain accounts by defining the valid users and file groups for the accounts and specifying resource-use limits for them.
- The *system operator* operates the system console and is responsible for responding to all system requests. MPE provides a range of operational capabilities that help in keeping the system operating as smoothly and efficiently as possible and in performing day-to-day operations such as system start-up, back-up, maintenance and recovery.

Command Language and Interpreter

MPE's command language, which is processed by the Command Interpreter, contains all necessary commands to direct and control the system. The simplicity of MPE's command language greatly enhances the system's usability.

You can enter MPE commands interactively during a session or through a batch job. The commands are the same; MPE does not have a separate control language for batch jobs. MPE commands also can be issued programmatically.

The more than 175 MPE commands collectively provide a powerful tool for using the system. End users like the ease of use of the command language, while experienced users and programmers appreciate the power the MPE commands supply.

Actions you can perform through MPE commands include:

- Initiate and terminate jobs and sessions
- Run system programs and utilities
- Compile, link, run and debug programs
- Create, maintain and delete files
- Display file information
- Display job, session or device status
- Transmit messages
- Establish communication with local and remote computers
- Control and manage system resources

If the Command Interpreter detects an error in command syntax during a session, it informs you with a meaningful error message that specifies the erroneous parameter and prompts you to re-enter the command correctly. If it detects a command error during a job, it lists the error on the output device and halts the job. However, you can specify that the Command Interpreter ignore errors during a job so that the job will be completed.

You can use the command language to create batch files (job streams) that contain control statements and variables. Execution of the commands in the file can be altered at execution time through the use of these control statements.

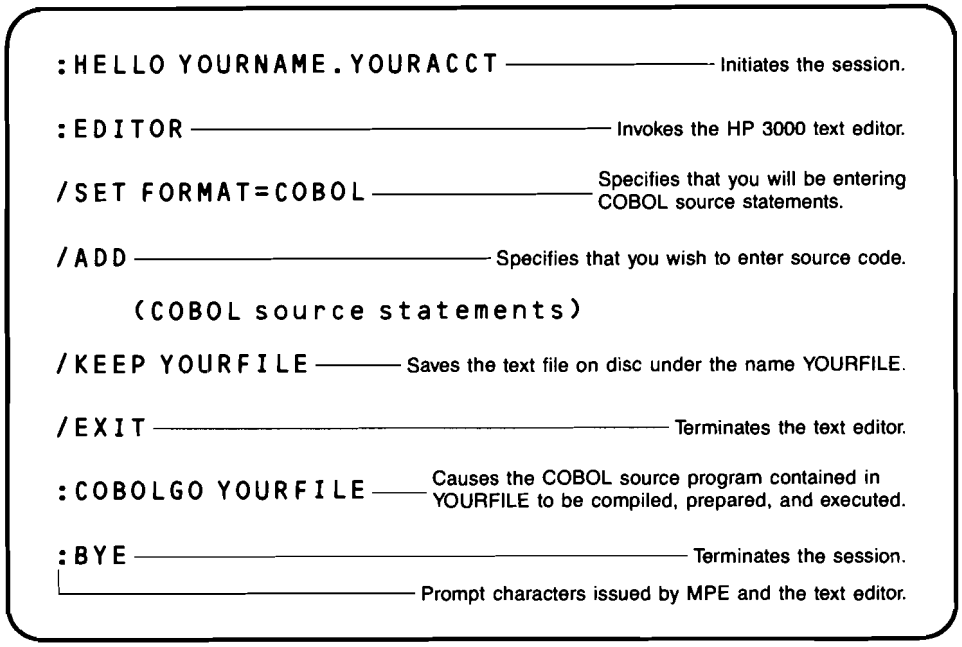


Figure 2-1. Sample Session

The example above is somewhat simplified since it does not include the various informational messages, compilation output, and program output generated by MPE, the text editor, the COBOL compiler, and the program itself. The fact remains, however, that if the source program (entered by way of the editor) contains no errors, the entire session can be performed by entering just eight MPE and text editor commands in addition to the COBOL statements that constitute the program.

MPE XL Enhancements

MPE XL provides a superset of the features of the MPE V Command Interpreter. It includes features that provide greater productivity for all users.

New features include system- and user-created variables that can be accessed directly via commands and programmatically. Over 30 system variables provide information such as the date, time, system serial number, day of week, etc. Other new features include a significantly enhanced REDO facility, search paths, and built-in calculator.

User-Defined Commands and Command Files

MPE allows you to define your own commands by combining several MPE commands into a command procedure and assigning the procedure a name. The name can then be used as a command. Thus, it is possible to enter a single command name that you have defined and cause several commands to be executed. These user-defined command sets can be created by individual users and can be made available to entire accounts and all accounts system-wide. It is also possible to redefine existing MPE commands and messages to suit your particular situation.

MPE XL gives you additional flexibility by allowing you to create command files. A command file is simply a list of commands (which can be user-defined commands) and parameters in a file. You just use the name of the file to execute the commands.

Spooling Facility

MPE provides a flexible spooling facility for output devices and batch job input. (SPOOL is an acronym for Simultaneous Peripheral Operations On-Line.)

The MPE Spooling Facility permits the concurrent use of output devices that would otherwise be nonshareable, such as tape drives and line printers. For instance, if several users send output to a line printer at approximately the same time, their output is directed to spoolfiles on disc and printed on a priority basis as the printer becomes available. In this way, each user can immediately proceed with other processing activities without having to wait for the printer. Spoolfile priorities can be changed by the system operator.

Job Control Facilities

MPE contains Job Control Words (JCWs) and conditional execution functions that permit you to design job streams whose execution can be altered based on the results of previous job steps.

You can use both system-defined JCWs and your own JCWs to store job status information and to pass such information between programs and between a program and the MPE Command Interpreter. JCWs are defined and accessed by commands from the Command Interpreter and by intrinsics from your programs.

You can also use JCWs in conjunction with conditional execution function statements. These statements specify a logical expression (TRUE or FALSE), and are evaluated during program execution. If the value found is TRUE, the remaining statements related to that condition are executed. If the value is FALSE, any existing alternative statements are executed instead.

On-line Help Facility

Whenever you need assistance with command syntax, or even the name of a command, you can invoke the on-line HELP facility.

The HELP facility provides encyclopedic information on all MPE commands. There are two ways to use the HELP facility. One way is to ask for help regarding a specific command. For instance:

```
:HELP REDO EXAMPLE
```

In response to the above request, the HELP subsystem will display an annotated example of the REDO command. You can also request information on the operation and parameters of each command.

The other way to use HELP is to enter the HELP subsystem, where you can access information by topic areas and tasks. This enables you to learn how to perform specific tasks without prior knowledge of which commands are required.

```
:HELP ———————————— Example of HELP being used in "subsystem" mode.

Information is available on the following classes of commands:
Running Sessions
Running Jobs
Managing Files
Running Subsystems and Programs
System Management, Status, and Accounting
Operator Control
Spooler Control
Utility Functions

For more information, enter a KEYWORD. You can also enter any
command name as a Keyword. Enter "help' for information on help.
Enter "exit' to leave help.
KEYWORDS: SESSIONS, JOBS, PROGRAMS, FILES, MANAGE, OPERATOR,
          SPOOLER, UTILITY
>
Running Sessions. Following are the commands used:
COMMAND ( ) LOG ON
ABORT
BYE
DSLINE
EOD
EOF
HELLO
HELP
REMOTE
REMOTE HELLO
RESUME

You can use any command as a keyword.
>EXIT———————————————————————— You EXIT the HELP Subsystem

:———————————————————————————— MPE Prompt
```

Figure 2-2. Using MPE's On-line HELP Facility

System Utilities

MPE includes a database management system, subsystems, and other utilities that are not included with most operating systems. The following utility subsystems are supplied with MPE:

- TurboIMAGE network database management system
- EDIT, a text editor
- FCOPY, a program for general purpose file copying FCOPY also allows movement of files between groups and accounts or from one peripheral type to another.
- SORT-MERGE, a utility for sorting records in a file and merging sorted files This utility can sort any character sequence using any data type.
- V-Plus interactive screen management system

Special-purpose utilities are provided for system administration tasks. For instance, the MPE Tape Labeling Facility allows labels to be placed on magnetic tapes for identification and protection purposes. In addition, utilities are provided to facilitate migration of applications and databases to the 900 Series systems.

Native Language Support

MPE includes utilities and intrinsics that facilitate the development of applications for users in different countries and cultures. Native-language support includes such features as currency symbol handling and character translation.

An Application Message Facility offers programs fast, efficient access to message catalogs, which can be customized for each country's language. The contents of the catalogs (an application's set of messages to its users) can be changed to fit each country's language without having to recode or recompile the application.

Designed for Performance

MPE is optimized for interactive, I/O-intensive, transaction processing. It balances interactive and batch processing in a way that guarantees efficient, user-controllable scheduling of processes. (A process is a single execution of a program, whether interactive or batch.)

Scheduling

Automatic Scheduling

The MPE job/session scheduler schedules jobs and sessions according to their assigned priorities. When the execution of one process is interrupted for any reason, such as I/O, an internal interrupt, or an interrupt from the scheduler itself, control is passed to the process with the next highest priority that is awaiting CPU resources. When two or more programs have the same priority, the oldest process is selected first.

Jobs and sessions are scheduled by means of a master queue that is ordered by priority. This master queue is divided into areas called priority classes. Each area is bounded by two priority numbers established by the system manager.

MPE automatically reassigns priority classes to each process executing on the system. You may, however, specify priority classes by selecting a general category of process dispatching priority for the program. This is done by including the PRI parameter in your JOB or HELLO command. The five process dispatching priority types (queues) are:

- AS -- system processing only
- BS -- very high priority
- CS -- interactive
- DS -- batch
- ES -- very low priority (background)

MPE actually translates priority types into numerical ranges that are ordered in a master queue. The numerical range of each priority type can be changed at any time to ensure that an optimal balance of services is maintained among the processes on the system.

Process Execution

As a process runs, it may require more code or data. If the code or data is not present in main memory, the memory manager is instructed to retrieve it before the process is allowed to continue executing. While the process waits for the needed code or data to be transferred, MPE transfers control to the next process ready to be executed.

The objective of the process dispatcher and the memory manager is to provide for optimum efficiency in the use of system resources while satisfying the requirements of executing processes. This is done automatically by MPE without assistance from the system users.

Virtual Memory Management

By swapping portions of code and data that are on disc into and out of main memory, MPE virtual memory management allows programmers to create programs and access data files that are too large to be kept in main memory. This capability makes programming easier, since the programmer need not be concerned with segmenting and swapping code and data. Virtual memory management is also the basis for MPE disc caching.

MPE XL Demand-Paged Virtual Memory

The "XL" in MPE XL stands for "extended large addressing," one of the operating system's most important features. MPE XL provides one of the largest address spaces in the industry, the benefits of which include:

- Applications can be written that are much larger than available main or secondary memory. Further, very large applications can execute concurrently without virtual memory constraints.
- Programmer productivity improves because programmers do not have to segment their programs or use extra data segments.
- System performance is enhanced because the CPU does not have the overhead caused by program or data segmentation.
- The virtual addressing capabilities of MPE XL can meet addressing requirements throughout the rest of this century.

The term "virtual memory" refers to the fact that the available memory space appears to be many times larger than the actual amount of main or even disc memory. MPE XL provides this capability to an extraordinary degree by taking advantage of HPPA's extremely large addressing potential.

MPE XL provides a virtual address space that consists of 65,000 individual spaces, each 4 billion bytes in size. This is 65,000 times larger than the virtual address space of typical 32-bit systems.

All open files on the system are encompassed in MPE XL's virtual address space. This space is managed by MPE XL transparently to the programmer.

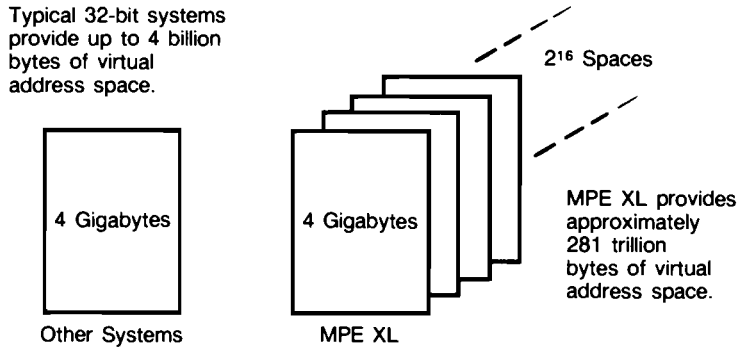


Figure 2-3. MPE XL's Extremely Large Virtual Address Space

Every virtual space is subdivided into fixed-size blocks called pages. MPE XL ensures that a page can hold either code or data, but not a combination of both. Since active code pages are nonmodifiable, multiple users are able to share a single copy of a program's code.

Code and data pages are automatically fetched from disc to main memory as required by the process (on demand). While pages needed for one process are being obtained from disc, execution of other processes continues.

MPE XL typically fetches pages from disc in groups so that not only the specific page required is obtained, but also those around it. This reduces the number of disc accesses because the processor is most likely to require pages that are located close to one another. Frequently used pages remain in memory for fast access, while rarely used pages remain on disc until needed.

MPE XL allows a program's pre-declared data structures to be up to 1 Gb in size. Access to multiple 4-Gb data areas is provided through mapped files.

Disc Caching

Disc speeds are not improving as rapidly as memory and CPU speeds, and memory costs are moving down constantly. Therefore, increasing memory size and using main memory as a buffer for disc is an important way to increase performance for I/O-intensive applications. MPE reduces physical I/Os to disc by performing logical I/Os to portions of disc that are buffered in main memory.

MPE V Disc Caching places those frequently accessed portions of files and directories in available portions of main memory, where they can be read repeatedly by an executing program. Thus, instead of going immediately to the disc to get requested information, disc caching first checks to see if the information is already in memory, i.e., in the disc cache.

When the information is located in the disc cache, I/O performance is improved in two principal ways. First, several time-consuming disc accesses are eliminated. Second, since information can be accessed in main memory 10 to 100 times faster than it can be accessed from disc, disc caching greatly reduces the time required to complete an I/O operation. This dual improvement means better response and higher throughput for I/O-intensive applications.

Disc caching is most effective in applications that have a high hit rate. The disc cache hit rate is the frequency with which the desired information is found in main memory, and an access to disc eliminated. The hit rate is particularly high and the performance improvement from disc caching is greatest with applications where multiple users share the same information.

Programs that share IMAGE databases, for example, benefit greatly. Disc caching not only reduces the contention for these databases, it also reduces the lock service times of the database control blocks. Because I/O requests can be serviced more quickly with disc caching, the locking delays are reduced, and the throughput is increased.

The MPE memory manager controls the operation of disc caching and handles file information in the cache dynamically. As a result, special areas of main memory need not be dedicated for the disc cache. However, if you wish to gain significant performance benefits from disc caching, you must configure an ade-

quate amount of main memory on your system. Your local system engineer or performance specialist can help you decide how much, if any, additional memory will be required.

MPE XL Mapped Files

MPE XL employs a very sophisticated technique for performing file access. This technique, referred to as "mapped files," is an improved version of the disc caching capability of MPE V.

The mapped files technique significantly improves I/O performance without imposing additional CPU overhead or sacrificing data integrity and protection. This technique also eliminates file system buffering and optimizes the global memory management of the system.

Mapped files are based on MPE XL's demand-paged virtual memory and are made possible by the extremely large amount of virtual space on the system. When a file is opened, it is logically "mapped" into the virtual space. In other words, all files on the system and their contents are referenced by virtual addresses. Every byte of each opened file has a unique virtual address.

File access performance is significantly improved when the code and data portions of files required for processing can be found in memory most of the time. This enhances file access performance because accessing memory is much faster than performing physical disc I/O operations. It also enhances performance over MPE V disc caching since both reads and writes are cached.

Traditional disc caching schemes impose a CPU overhead penalty. MPE XL takes advantage of the system architecture and hardware so that you can obtain the benefits of increased I/O performance without incurring this penalty.

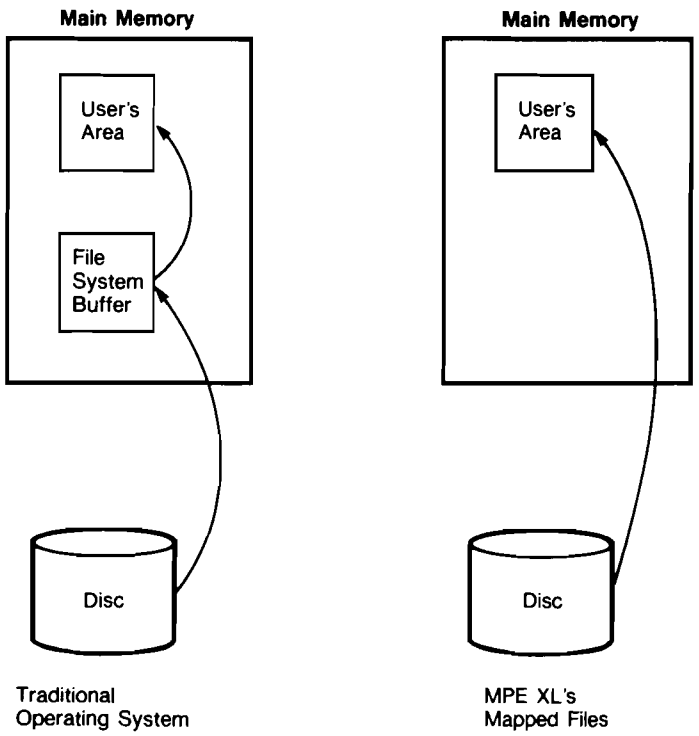


Figure 2-4. MPE XL's Mapped Files

The virtual-to-physical address translations to locate portions of the mapped-in files are performed by the system hardware, so that CPU overhead is virtually eliminated for this function.

In addition, the mapped file technique eliminates file system buffering. In traditional operating systems, data is copied from disc into a file system buffer

in memory, from where the data is moved into the user's area in memory. Since MPE XL's Memory Manager fetches data directly into the user's area, the need for file system buffering is eliminated. The benefits of this are two-fold: System performance is increased by the elimination of unnecessary data movement within memory, and the use of memory space is optimized.

Transaction Management

In most commercial computing environments, different file system access methods, databases, and applications manage transactions and recovery differently. The result is a complex solution that requires duplication of effort, high administrative and support overhead, and compromised performance. MPE XL's Transaction Management consolidates all of these functions into a single efficient and consistent module that is common to all disc access methods. Performance and efficiency gains are also realized over implementations at higher levels of the system by tight coupling with memory management, I/O, and HPPA protection hardware.

MPE XL s Transaction Management is a high-performance means of ensuring the integrity of data. It provides smoother performance, because all writes and updates relative to a transaction can be buffered in main memory until the entire transaction is complete, thus providing logical database integrity while reducing the number of physical I/Os.

Protecting Your Investment

Within the HP 3000 family, simple upgrade paths are provided to higher-performing systems. Return credits on older systems mean that upgrades are cost effective. A simple backup and restore procedure with object code compatibility means your applications run without changes or recompilation and no disruption of your business.

Native Mode and Compatibility Mode

HP ensures compatibility and provides a smooth migration path when moving from MPE V-based HP 3000s to HPPA systems. MPE XL is a compatible superset of MPE V/E. (MPE V/E is an extension to MPE V).

Native Mode

Native Mode, the native run-time environment of MPE XL, offers the highest performance on HPPA. In accordance with Hewlett-Packard's design objectives, Native Mode on an HPPA system provides *source code compatibility* with MPE V-based systems where appropriate. A program written on an MPE V system can simply be recompiled using an MPE XL compiler to get the performance benefits of HPPA.

Native Mode is the preferred environment because it makes full use of the high performance of the 900 Series systems. Native Mode provides all the benefits of MPE XL described in this chapter, such as demand-paged virtual memory, large address space, and mapped files.

Compatibility Mode

Compatibility Mode provides *object code compatibility* between MPE V-based systems and the 900 Series. It does this by emulating in software the MPE V HP 3000 environment on an MPE XL system. Compatibility Mode allows current HP 3000 customers to move their applications and data to the 900 Series systems without changes or recompilation.

Compatibility Mode provides a working MPE V/E environment, including MPE V/E code and stack structures and callable MPE V/E system intrinsics. As a result, Compatibility Mode also allows cross development of MPE V applications on MPE XL systems.

Flexibility and Phased Migration

Compatibility Mode and HP's assortment of migration utilities provide for smooth, flexible migration to 900 Series systems.

Because of the high degree of object code compatibility, you can simply store an MPE V program, restore it on a 900 Series system, and run it in Compatibility Mode without modification or recompilation. This applies to applications written in any language supported by MPE V. You can move your databases to the 900 Series in the same way.

For improved Compatibility Mode performance of MPE V object code, MPE XL provides an MPE V Object Code Translator that translates MPE V object code into the native instructions of the 900 Series. Translation of the MPE V object code reduces the overhead incurred while running a program in Compatibility Mode.

To take full advantage of the 900 Series performance and the benefits of MPE XL, you can recompile your applications using Native Mode compilers for the 900 Series. These compilers provide source code compatibility with the rest of the HP 3000 family. Typically, little or no code modification is required.

Applications can run partly in Native Mode and partly in Compatibility Mode. MPE XL switches between modes transparently. This transparency in operation is made possible by MPE XL's Switch Subsystem, which determines whether code is in Native Mode or Compatibility Mode and automatically switches between modes as needed while an application is running.

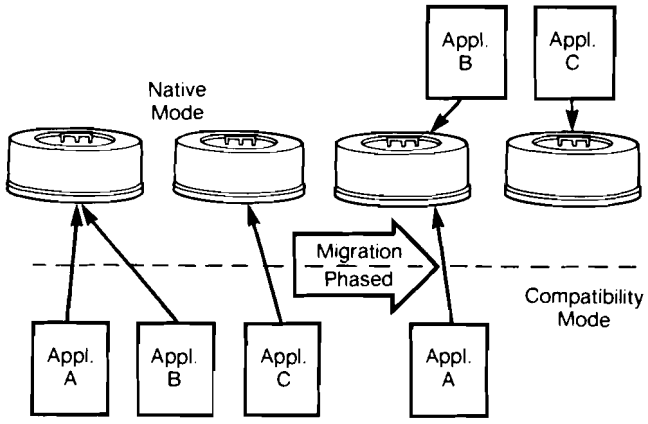


Figure 2-5. Migration Flexibility

At the first release of MPE XL, four Native Mode compilers are available: COBOL II/XL, HP Pascal/XL, HP C/XL and HP FORTRAN 77/XL. Native Mode compilers for other languages will be available in the future.

The figure below illustrates the flexibility of migrating to the 900 Series. You can move some applications to Native Mode while leaving others in Compatibility Mode. As illustrated, the same database can be accessed by programs in Compatibility Mode or Native Mode.

The total effect is that you can immediately move your applications to Compatibility Mode and migrate your programs to Native Mode when and if it fits your schedule.

In addition, if an application written in a high-level language calls SPL/V procedures, it can be recompiled to Native Mode and call SPL/V procedures in Compatibility Mode via a user-supplied mode-switching procedure.

Exceptions. Naturally, there are some minor restrictions in migrating MPE V-based applications to the 900 Series. For example, applications that use undocumented intrinsics, execute in Privileged Mode, or use privileged machine instructions may need to be modified in order to run on a 900 Series system.

For information regarding other, less frequently encountered exceptions, please contact your HP Sales Representative.

Cross-Development (MPE V and XL)

You can develop applications on a 900 Series system for use on other HP 3000 systems, allowing a 900 Series system to be used for centralized application development.

The same source code for programs written in COBOL II/XL, HP FORTRAN 77/XL, and HP Pascal/XL can be compiled to run in Native Mode on a 900 Series system and on MPE V-based systems.

The same source code written in COBOL II/V, HP FORTRAN 77/V, Pascal/V, FORTRAN 66/V, BASIC/V, HP Business BASIC/V, RPG/V, and SPL/V can be compiled to run in Compatibility Mode on the 900 Series or on MPE V-based systems. The MPE V Segmenter is supplied with MPE XL to facilitate cross-family development in these languages.

System Management and Security

MPE is designed for optimum ease of use and can be tailored to meet your specific system security requirements. It has security features that prevent unauthorized access and maximum data integrity.

Ease of Management

The system management commands and utilities provided by MPE simplify system maintenance operations. Compared to other computers of similar power, the HP 3000 requires significantly less time and effort for system administration and operation.

A complete set of operator commands and utilities simplify operational tasks such as system configuration, startup, modification, backup and recovery. Operator commands and utilities also simplify spooling and tape labeling.

System Startup

MPE allows the system manager to specify a series of commands to be executed automatically each time the system is started. These commands eliminate the need for operator intervention when the system is started.

Automatic Creation of Sessions

Automatic creation of sessions allows terminals to log on automatically into application environments. You can begin working without having to log on or interact with the operating system. This feature helps to make the system easy for inexperienced users to use and provides an additional level of security.

Automatic Scheduling of Jobs

Job scheduling allows you to specify a particular time and date when your jobs will run. For instance, if a job will impact system response time, it can be scheduled to run when fewer users are logged onto the system. The job will be executed automatically without requiring operator intervention. Automatic job scheduling can be used to automate many daily operation routines such as backup.

Self-Adjusting System Tables

In MPE XL, most system tables are self-adjusting to the system requirements, thus eliminating the need for a system shutdown to adjust these tables. This feature provides increased system availability as well as simplifying system operations.

Diagnostics

A comprehensive set of on-line diagnostics can be used by HP Customer Engineers (CEs) to diagnose system hardware and peripheral problems. These tests can be executed while the system is in operation. HP also provides a system self-test that takes 30 seconds to execute and is highly effective in isolating hardware failures. The self-test is designed for ease of use so that you can run it prior to requesting service from HP.

All the diagnostic functions are available remotely. A remote support modem is included with the system when the you purchase a support contract. By connecting a remote terminal to the system console via the modem, a remote console can operate in parallel with the system console. This allows HP CEs to diagnose hardware and run software troubleshooting tools from a remote site. On-line diagnostics and remote support result in less system downtime and reduced maintenance costs.

System Account Structure

The MPE accounting facility provides a flexible and powerful means of coordinating access to the system and disc file usage. To coordinate system access, system administrators can devise a structure of accounts and users that reflects the functional organization of the people who use the system. The accounting facility maintains running totals on the amounts of system resources that each account consumes, including disc space used, cumulative CPU time consumed, and cumulative terminal connect time for sessions. The current totals can be displayed at any time and can be used for billing purposes.

Users are individuals who access the HP 3000. Each user is assigned a unique name and optional password and is assigned to a specific account. Each user

may have a specified home group of files and may access any other file groups in the account. A maximum job priority may be assigned to each user.

Groups are used to partition the file domain of an account. Files must be assigned to a group, and each group has a unique name (within the account) and optional password. Limits may be established on the permanent disc space, CPU time, and connect time used by a group. MPE maintains running counts of resource usage for each group and the sum of these group counts always equals that of the account in total.

Accounts are collections of users and groups. Each account has a unique name and an optional password assigned to it when the system manager creates the account. Each account also has its own file domain or unique set of files. The system manager may define resource-use limits for an account. MPE maintains a running count of each resource that the account uses. MPE also stores a list of user names and group names recognized by the account, the maximum job priority at which jobs in the account may be scheduled, and limits established on the account's usage of disc file space, CPU time, and connect time.

To illustrate how accounts, groups, and users interrelate, consider the following example. Figure 2-6 represents a system that includes interactive terminals dispersed throughout a company. The system manager has assigned three accounts: Marketing, Engineering, and Finance. The marketing account manager has defined two users who can access the system: Bill and Dave. Each user has his private group (assigned as his home group) where he stores his private programs and files. Bill and Dave can also access programs and files stored in the other groups in the account.

A group named PROJ1 was created to contain programs and data files relating to current projects. An administrative group was created to contain administrative work such as schedules and budgets. The public group, to which no password was assigned, contains general purpose utility programs for use by all.

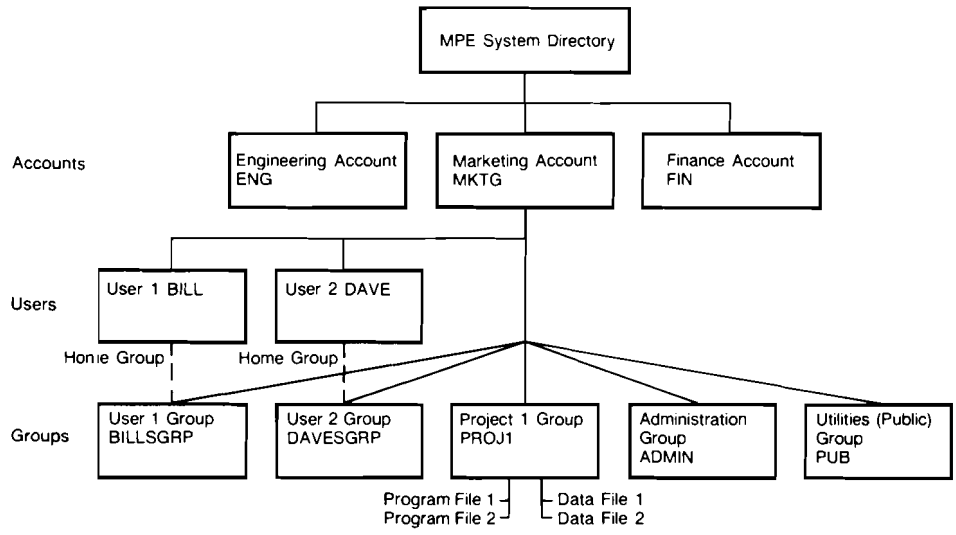
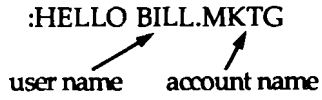


Figure 2-6. MPE XL System Account Structure

Bill can log on to the HP 3000 from a terminal with the command:



By default, Bill now has access to all programs and data files in his home group: BILLSGRP. Bill can gain access to a file in the PROJ1 group by using the fully qualified file name that specifies both the account and group under which the file was created. The file Bill wants is called "Forecast," so he enters:

Alternatively, Bill could have logged on to the HP 3000 and requested access to all programs and files in the PROJ1 group by appending the group name to his log on request, as follows:

Bill now has access to all files in the PROJ1 group.

To summarize, you can log on the system using only your assigned user and account names, in which case you are automatically given access to your home group. Or, you can log on specifying your user name, account name, and a group name, which gives you access to the group you specify whether or not it is your home group.

As you can see, the account structure provides both control and security over file use. Access to the system is granted only to individuals with a valid log-on identification consisting of account, group, and user names, each of which may require a password. Figure 2-7 illustrates both an unsuccessful and successful log-on procedure where passwords are required.

System Security

To protect your system from tampering and interference, MPE provides ample system security. MPE is designed so that the user capabilities, the account structure, and system security measures are intertwined.

Restricting User Access

Passwords can be assigned for each account and for each group within an account. Further, passwords can be assigned to each user name. Thus, to log onto the system, you can be required to provide up to three passwords.

To illustrate, suppose you know the password for your user name and account. You would be able to log onto the system and access files in your home group, but you would be unable to access other groups in the account whose passwords are unknown to you.

Once you are logged onto the system, what you are able to do can be restricted in a number of ways. For example, you can be restricted from saving files or using

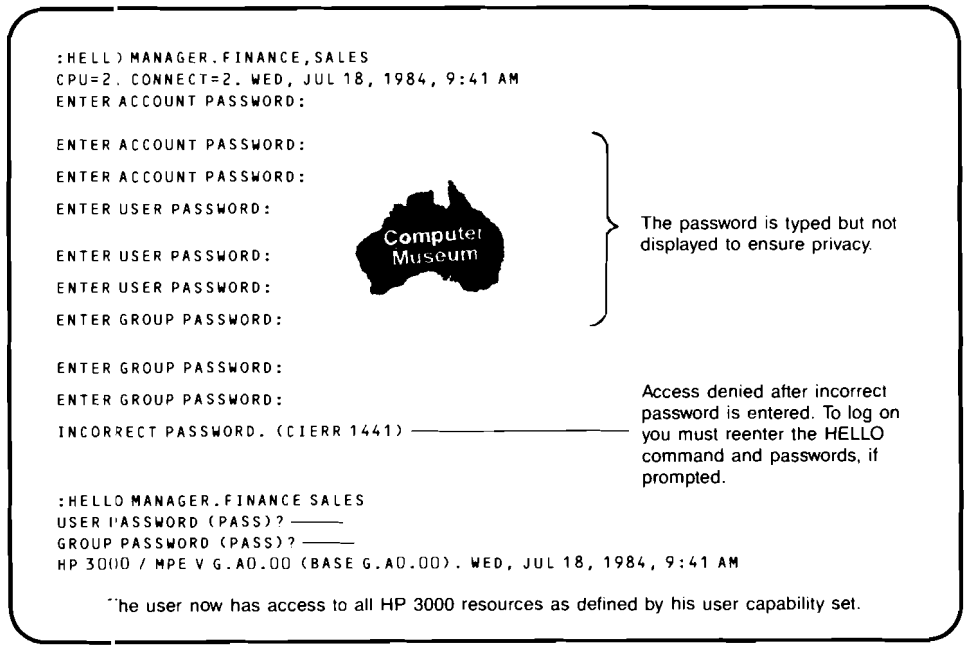


Figure 2-7. MPE System Access Security

nonshareable devices such as tape drives or line printers. You can be limited regarding the amount of CPU time and disc space you may consume. Also, you can be restricted from accessing system tables, utilizing system resources such as process management and logging, and using data communication subsystems. You can even be restricted to either interactive or batch access, although normally both are allowed.

File Security

File lockwords, similar in effect to passwords, can be assigned to files. When a file is protected by a lockword, you must supply the lockword in order to access the file.

It may be beneficial to allow users to access given files, but control what they may do with the files. On an account, group, and file basis, you can be restricted from any or all of the following: reading, locking, appending, writing and saving files, and executing program files. In addition, you cannot access files that are not in your account (except for files in PUB.SYS meant for general usage) unless the file has been released.

Security Monitor/V

HP Security Monitor/V (illustrated in Figure 2-8) can be ordered as a separate product when greater security is needed. It is a fully integrated system security program that protects both system resources and sensitive data from unauthorized access. Building on the strong security of the HP 3000 systems, it allows improved password protection, stricter audit trails, and tighter terminal security. Some of its key features are:

- Password encryption and aging
- Terminal passwords
- Terminate idle sessions
- Log selected commands, file opens and closes
- Disable selected commands

Security Monitor/V is available now for MPE V-based systems, and will be available in the future for MPE XL-based systems.

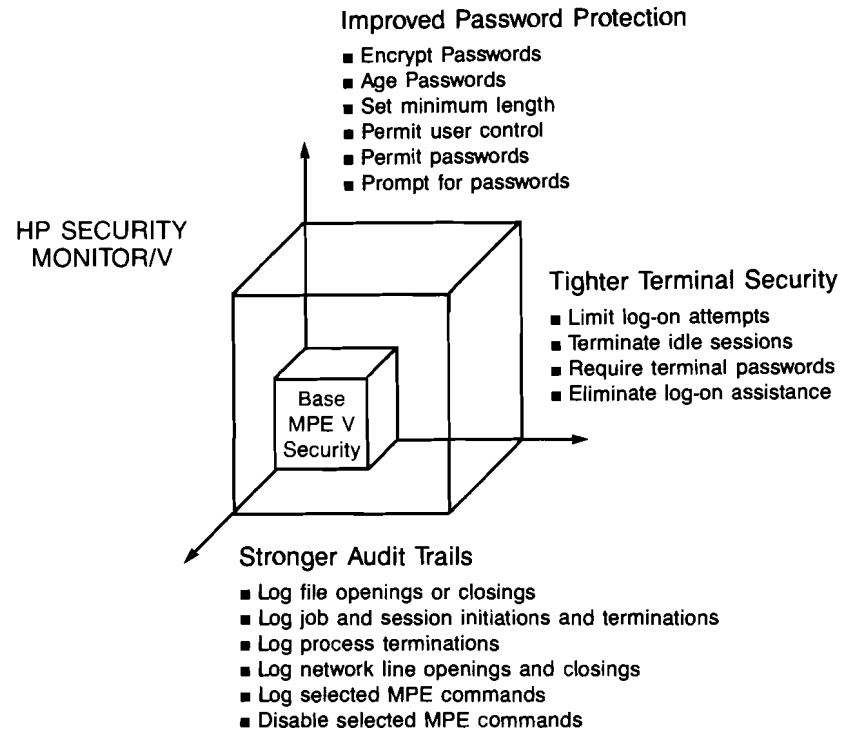


Figure 2-8. HP Security Monitor/V

Private Volumes

MPE provides a private disc volume facility that allows you to create and access files on removable disc volumes. Private volumes consist of removable disc packs that, when mounted on a disc drive, can be accessed by MPE through the file system. Under private volumes, the disc packs mounted on the drives during a cold load are dynamically allocated to the system domain for normal use or to the non-system domain for private use. Non-system-domain packs can be both physically and logically mounted and dismounted during normal system operation.

Failure of a private volume or non-system volume does not disrupt users and applications on other discs. System security is improved since sensitive information can be maintained on a separate disc.

System Backup and Recovery

Periodically, the MPE system and user files should be copied from disc to tape for archival purposes and as protection against hardware failure and accidental or intentional destruction of information.

With MPE, simple backup commands can be executed to initiate system backup. Messages inform the operator of the progress of the backup activities. In some environments, job scheduling may be used with the MPE STORE utility to permit unattended backup. This will allow the system operator to leave or attend to other tasks without having to monitor the backup process.

TurboSTORE/V

For larger HP 3000 systems with increased storage requirements, a separate product called TurboSTORE/V provides better performance. TurboSTORE/V is a full functionality backup program that eliminates bottlenecks associated with system backup. As a result, it provides performance benefits for a wide array of HP 3000 systems, disc drives and tape drives.

TurboSTORE/V supports simultaneous backup to multiple tape drives. This eliminates any bottlenecks created by backup device speed limitations. Up to four tape drives can be used in parallel, cutting backup time substantially.

Logging

Over the last 20 years, computers evolved from batch-oriented systems to systems that are characterized by a large number of users performing on-line transactions. Transaction systems have very stringent requirements for performance, accuracy of data, and the ability to recover from system and hardware failures.

For example, an airline reservation system must maintain data integrity even if several users are performing updates to the same file. It is important that the application ensure that the same seat is not assigned to more than one passenger. This is done by locking common data so that only one user at a time may change it.

Finally, the application must not lose any data in case of a system failure. Users must be able to recover from both "soft" failures, which do not cause any data to be altered on disc, and "hard" failures, such as a disc head crash in which data is destroyed. This is done by "logging," or copying data to a log file.

If a transaction is aborted or a soft failure occurs before the transaction is committed to disc, the file can be restored to its original state by copying the "before" image of the data from the log file back into the data file. This is the same as roll-back recovery in TurboIMAGE.

In the case of a hard failure, transactions from the log file can be applied to a backup and a roll-forward recovery of the transactions performed. This method of recovery just re-applies all the transactions to some checkpoint version of the file.

System Logging. MPE includes a system logging facility that can be enabled and disabled at the system manager's convenience. This facility records details of system resource requests in a series of log files on disc. The system manager or operator can select which system events are to be recorded. For example, log records are provided for job and session initiation and termination, program termination, file closing, file spooling completion, and system shutdown. I/O device failures are recorded in the system log, which can be used to detect problems before they interfere significantly with overall system operation.

Database Logging. The TurboIMAGE database management system also includes a logging facility and Intrinsic Level Recovery (ILR) feature. These features ensure the physical and logical integrity of information maintained in TurboIMAGE databases. You can also choose between roll-forward and roll-back recovery in case of data loss.

User Logging. MPE also includes a user logging facility to provide a means by which applications can maintain integrity of the data upon which they operate. This facility is provided via intrinsics, or system procedures, which allow application transactions to be logged to disc or tape. The application can choose to wait until the transaction is physically posted to the logging device before continuing to the next transaction, or it can continue immediately.

Automatic Power Fail Recovery

Automatic power failure recovery is provided by MPE in conjunction with the HP 3000 hardware. Should a power failure occur, the system initiates a power failure procedure that preserves the operating environment prior to complete loss of power. A battery pack (supplied standard with each HP 3000 model) ensures the validity of main memory for at least 15 minutes. If power is restored within this 15-minute period, the system automatically resumes processing from the point at which the power failure occurred. Jobs and sessions in progress on the system continue where they were interrupted, with programs unaware of the interruption.

Performance Measurement

On-line Performance Tool/V

On-line Performance Tool/V (OPT/V) is an interactive performance measurement software product for MPE V/E that provides information to the system analyst. OPT/V can be used to characterize the current system workload, CPU utilization, memory management activity, I/O traffic, program and process activity, and system table usage to help the user isolate bottlenecks and improve system performance.

Performance data provided by OPT/V is updated at regular intervals and can be presented in charts, graphic displays, or summary reports. Information can be displayed on an HP terminal, and a hard copy of any display can be generated on a line printer with a single keystroke. Although OPT/V is primarily designed for interactive use, it can be executed in batch mode to collect snapshots of system activity over a period of time.

Application Program Sampler

Application Program Sampler/V (APS/V) is a friendly interactive performance measurement software product for tuning application programs on the HP 3000, with the goal of increasing the overall system performance.

APS/V helps the programmer identify CPU bottlenecks in the source code of application programs. APS/V does this by monitoring the execution of application programs using a status sampling technique, and producing histograms showing the relative CPU time spent by various portions of the monitored program. Since an application program frequently calls for the services of the operating system, such as intrinsics and library calls, APS/V reports the CPU time spent in system services as well as the CPU time spent directly in the user code. APS/V can monitor the single execution of a program or the multiple execution of shared programs.

APS/V can be used either during program development or on existing programs. In a typical application, the user monitors a particular program, studies APS/V's histograms and optimizes the code that consumes the most CPU time. This process is repeated until the programmer believes that the software performance is acceptable. APS/V can thus simulate the judgment of an experi-

enced programmer in identifying CPU software bottlenecks, resulting in increased programmer productivity. Although APS/V is intended primarily for interactive use, it can also be executed in batch mode. The histograms can be displayed on any HP terminal, and a hard copy of the display can be generated on a line printer for future study.

MPE XL Tools

Products with functionality similar to that of OPT/V and APS/V will be available in the future on MPE XL-based systems.

System Performance Consulting Services

HP offers two consulting services for HP 3000 system performance: HP SNAPSHOT and HP CAPLAN.

HP SNAPSHOT is a performance consulting service for customers who have specific system performance concerns and require consulting assistance on an individual request basis. HP Performance Specialists provide this service, which includes identifying specific problem areas and making tuning recommendations.

HP CAPLAN is a capacity planning service performed by HP Performance Specialists. This service answers your "what if" questions by providing information on how system performance will be affected by capacity increases (such as the addition of more memory, peripherals, or on-line terminals), and how to best plan for capacity increases. HP CAPLAN services can also provide performance projections for the migration of MPE V-based applications to Compatibility Mode and Native Mode operation on a 900 Series system.

3

Information Management

Hewlett-Packard offers a wide range of information management products to assist you in all phases of the software life cycle. They will allow you to deliver solutions in less time, for less money, and with improved quality.

The MPE Operating System

The MPE operating system provides a productive and efficient environment for the application developer. MPE programming features include:

- Consistent command language interface to all programming tools
- Procedure libraries for external references
- A device-independent file system
- Flexible file security
- Subroutines callable across languages
- Access to all system intrinsics
- Native language support

The MPE operating system is friendly and easy to learn. Programmers can create their own commands. A single command can be created to perform multiple tasks, thereby improving the productivity of the application developer.

Software Life Cycle

The development of an information system can best be thought of as a process. It begins with analysis and design of the new system, proceeds through development and testing, and finally reaches fruition when the system is installed. Maintenance starts the moment the system is installed and continues over the life of the system.

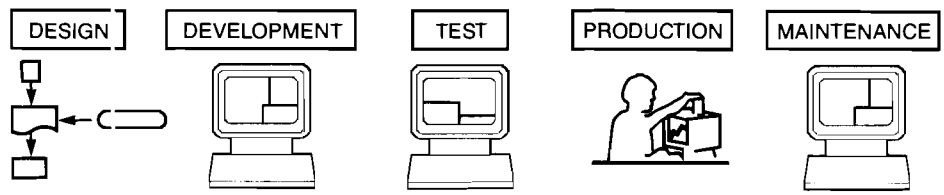


Figure 3-1. Software Life Cycle

Analysis and Design

One of the first steps in the development of a new project is to define the required data flows within the system. HP's System Dictionary allows you to document the attributes of the data required by the system. HP System Dictionary becomes the central repository of the data that drives your organization. Because of the integration between HP System Dictionary and the other HP information management products, you can ensure that data is being defined and used consistently.

Once the data requirements of the system have been defined, design of the database can begin. HP provides a complete family of network and relational database management systems for the HP 3000 family.

The Screen Management Facility makes it easy to define application screens. The end users will be able to see what the application looks like early in the design phase so they can provide valuable input before coding begins.

Development

You have a broad choice of languages for creating applications. HP supports all major third-generation languages. On HP Precision Architecture (HPPA) machines, the compilers will allow you to create program files that will run on both MPE V and MPE XL systems. There is also a choice of powerful fourth-generation languages supplied by HP and by value-added businesses.

A new technology that provides impressive productivity improvements is code generation. HP's VIRTUOSO Code Generator offers state-of-the-art code generation capabilities plus the ability to customize the code libraries. It provides an effective method for implementing code re-use within your development organization.

One of the most time consuming and tedious portions of the development phase is the coding required for producing the reports that the application requires. Business Report Writer (BRW) is HP's answer to your reporting problems. BRW allows you to design your reports on the screen and actually see what the report is going to look like while you are developing it. BRW makes it easy to develop complex reports in a short time.

Testing

Testing is a critical but often neglected part of the application development process. HP's products provide sophisticated debugging capabilities that make it easy to isolate and correct problems. In addition, many of the fourth-generation languages provide their own integrated test facilities.

Production

The HP 3000 computer family -- including software tools and database management systems -- has been optimized for transaction processing. The systems support both interactive and batch execution. Performance tools allow you to monitor the status of the system and tune your applications for peak performance.

HP offers a variety of products to augment your applications. Powerful end-user reporting tools allow users to access information themselves. The Information Access product moves information from the HP 3000 down to a PC for further analysis using a variety of popular PC-based products. By integrating PCs into the environment, end users get the data they need and the HP 3000 is free to concentrate on transaction processing functions.

Maintenance

If your organization is like most, a substantial portion of your resources are being spent maintaining existing applications. Hewlett-Packard's integrated information management products can help you reduce the time and energy required to maintain applications. The HP System Dictionary, serving as a central repository for system information, allows you to easily identify the impact of changes to your applications. The integration between the dictionary and the development and reporting tools minimizes the difficulty of making system changes and allows you to react quickly to changing business conditions.

To be successful in developing applications, you need tools to assist you in all phases of the software life cycle. Hewlett-Packard's integrated information management products provide a comprehensive environment for developing applications.

Information Management Framework

To help convey its broad family of Information Management products, HP uses the framework illustrated in Figure 3-2. Those basic four functions are explored in detail in the following pages.

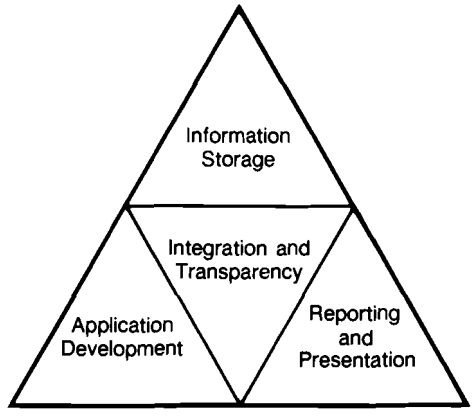


Figure 3-2. HP's Information Management Framework

This chapter summarizes the offerings available on the HP 3000 systems in each of the four basic information management areas. For more detailed information, ask your HP sales representative for HP's "Information Management Specification Guide," part number 5954-9343.

Product Name Suffixes

The names of the products mentioned in this chapter end with either "/XL" or "/V." Products with an "/XL" suffix have been designed specifically for use on the 900 Series systems. Products with a "/V" suffix have been designed for MPE V-based systems. (Some of the "/V" products referenced in this chapter also run in Compatibility Mode on the 900 Series systems.)

Often, one product will have both "/XL" and "/V" versions, with identical or nearly identical features. In those cases, to avoid repetition, both versions are combined in a single description, and neither suffix is used.

Information Storage

Hewlett-Packard offers compatible relational and network databases across the entire HP 3000 family:

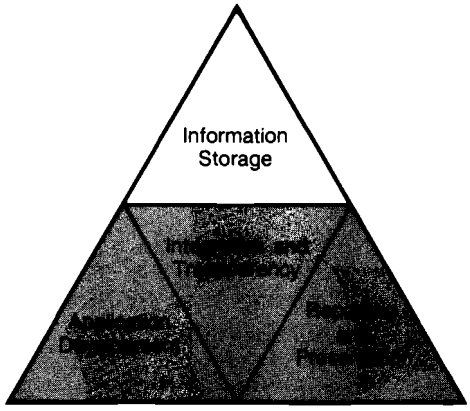


Figure 3-3. Information Storage

- TurboIMAGE -- a fully compatible network database. The TurboIMAGE module of ALLBASE/XL runs on MPE XL-based systems, while TurboIMAGE/V runs on MPE V-based systems.
- TurboIMAGE DBchange/V and TurboIMAGE Profiler/V -- utilities for use with TurboIMAGE/V
- KSAM/V -- keyed file management system
- Silhouette -- a tool to provide higher system availability in network environments
- HP SQL -- the relational database based upon the industry-standard SQL. The HP SQL module of ALLBASE/XL runs on MPE XL-based systems, while HP SQL/V runs on MPE V-based systems.
- ALLBASE/XL -- HP's DBMS offering for the HP 3000 900 Series. ALLBASE/XL consists of both HP SQL and TurboIMAGE and has been optimized for HPPA.

ALLBASE/XL

ALLBASE/XL is Hewlett-Packard's DBMS offering on the HP 3000 900 Series. It contains both the award-winning network DBMS, TurboIMAGE, and the industry-standard SQL-based relational DBMS, HP SQL. Both the TurboIMAGE and HP SQL modules of ALLBASE/XL have been optimized to achieve full native-mode performance. This provides application developers with the choice of high-performance, full-featured relational and network DBMSs.

TurboIMAGE

TurboIMAGE continues in the DATAPRO-award-winning tradition of IMAGE/3000 database management systems designed for use with the HP 3000 computer family. The database architecture is a two-level network structure with owner/member data set relationships. This general-purpose database system is included with the Fundamental Operating Software (FOS) on all HP 3000 computer systems.

TurboIMAGE offers the capabilities to describe data structures, define data relationships, and create databases. A high-level language interface is provided for access and maintenance of the data within the database. This inter-

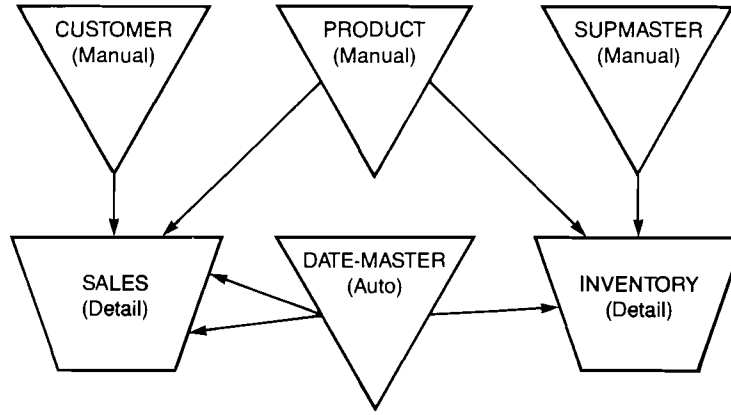


Figure 3-4. Simplified TurboIMAGE Network Structure

face supports applications written in COBOL, RPG/V, Pascal, SPL, FORTRAN, BASIC, Transact, C/XL, and fourth-generation languages.

TurboIMAGE allows data to be related logically between data sets. This linking minimizes data redundancy and facilitates fast information retrieval. In addition, a two-level security facility (at the data set and data item levels) protects the database against unauthorized access.

Since locking is controllable from the database level to the data entry level, applications and interactive users may share the database concurrently. With NS/3000 networking products, programs are able to access databases remotely. Remote access allows a user or program on one HP 3000 to access a TurboIMAGE database on another HP 3000 computer.

Performance enhancements have been incorporated into TurboIMAGE to support large, high-performance databases as well as those with less demanding requirements. The TurboIMAGE database management system provides the basis for developing information systems tailored to today's corporate, industrial, and educational needs.

Features:

- Logically related files can be handled as a single entity (a database), relieving the application of low-level details.
- Network structure allows fast access to complex relationships among data.
- TurboIMAGE intrinsics are callable from COBOL, RPG/V, Pascal, SPL, FORTRAN, BASIC, Business BASIC, Transact, C/XL, and fourth-generation languages.
- Files within a database may stand alone or be logically linked together, allowing flexible data storage.
- Serial, direct, calculated, and chained access methods provide flexible choices for data retrieval.
- Access to multiple databases allows you to logically associate the data while maintaining database independence.
- Deleted record space is automatically reused.
- Concurrent interactive and batch access allows multiple users to access data simultaneously.
- Privacy and security features allow you to control access to restricted information. Two-level security, at the data set and data item levels, defines subsets of the database, providing customizable access to data.

- Transaction Manager guarantees the physical integrity of the database in the event of a soft crash. (This is the default operating mode of the TurboIMAGE module of ALLBASE/XL.)
- Intrinsic-Level Recovery guarantees the physical integrity of the database in the event of a soft crash (TurboIMAGE/V).
- Roll-back recovery guarantees the logical and physical integrity of the database in the event of a soft crash.
- Roll-forward recovery guarantees the logical and physical integrity in the event of a hard crash.
- Changelog facility provides a logical link to new log files. It automatically switches to the new log files on disc or tape when the current log file becomes full.
- User-defined locking strategy, at database, data set, and data entry levels, allows optimum concurrence-level control.

QUERY/V

QUERY/V is a database support tool included with TurboIMAGE. It is designed for use by application programmers and database administrators. Through the use of QUERY/V, it is possible to locate, update, and report on data items within a TurboIMAGE database.

QUERY/V communicates with TurboIMAGE through a command-driven interface. It can be executed interactively (from a terminal) or in a batch mode. Output can be directed to a terminal or to any other output device (e.g., line printer, tape, disc). Frequently used QUERY/V procedures can be stored on disc for future use.

QUERY/V honors the TurboIMAGE database security system. A user must supply an appropriate TurboIMAGE password before access to the TurboIMAGE database is granted. Because QUERY/V supports DS/3000 and NS/3000, it is possible to access databases located on remote computers.

Features:

- On-line help facility provides information about commands and required parameters.
- Interactive or batch interrogation allows for flexible database access.
- TurboIMAGE updating through addition, deletion, and modification of data records facilitates on-the-fly database maintenance.
- Boolean logic provides fast access to variable data values.
- ADD command supports quick entry of test data into new database structures.
- Extensive locating, reporting, and updating commands support the testing of new database applications and structures.
- QUERY/V honors TurboIMAGE security to maintain database integrity.
- QUERY/V utilizes TurboIMAGE logging to maintain logical and physical integrity of the database.
- Remote database access allows for database inquiry across computers.

TurboIMAGE DBchange/V

DBchange/V is the interactive utility that allows dynamic restructuring and capacity expansion of a TurboIMAGE/V database. Database changes are input from a menu and executed on-line or in batch mode.

Because multiple restructuring changes can be requested during one DBchange/V session, there is no need to run separate programs for each change. DBchange/V allows you to review multiple change requests before actual updates are processed.

DBchange/V provides the database administrator with an important, easy-to-use tool to aid in the use and support of TurboIMAGE/V databases.

Features:

- Interactive forms access allows flexible and friendly database manipulation.
- Two-stage update process allows input and review of changes before actual update.
- Multiple changes can be made to the same database in one DBchange/V session.
- Database restructure requests are input and stored in a change file, which DBchange/V uses to process database modifications.
- Modifications can be processed immediately or scheduled for later batch processing.
- TurboIMAGE/V database modifications can be made in real-time, without requiring that the database be unloaded and reloaded.
- The database root file is checked for path information inconsistencies, allowing DBchange/V the option to make corrections.

TurboIMAGE Profiler/V

TurboIMAGE Profiler/V is an analysis tool that works with TurboIMAGE/V to guide developers in tuning databases and application programs.

Profiler/V provides performance and usage statistics that can be used to determine the optimal design of a TurboIMAGE/V database. Profiler/V uses trace data gathered while TurboIMAGE/V applications are running and, via a friendly, forms-driven interface, provides a wide range of statistical reports.

Features:

- Collects trace data at the job/session level or system-wide
- Collects trace data only during user-specified time intervals
- Consolidates trace data into manageable statistics
- Provides default or custom-tailored reports
- Runs without operator intervention

KSAM/V

KSAM/V (Keyed Sequential Access Method) allows you to create and maintain disc files whose records are accessed by the value of the key fields within the data records. Each data record contains 1 primary key field and may include up to 15 alternate key fields. Data records are written to a KSAM/V file in any order without regard to a key sequence, although they may be presorted if desired. Records are accessed sequentially or randomly by primary or alternate key value, by logical record number, or in chronological (physically sequential) order. Duplicate key values are allowed, and records can be accessed by generic keys (partial key values) or by approximate keys.

KSAM/V runs in Compatibility Mode on MPE XL systems.

Features:

- Multiple keys: one primary and up to 15 alternate keys
- Duplicate key values allowed
- Retrieval by generic key value or by approximate match
- Access from COBOL, RPG/V, FORTRAN, Pascal, BASIC, Business BASIC, C/XL, or SPL
- Fixed- or variable-length data records

Silhouette

Silhouette is a software product that provides high availability by automatically duplicating IMAGE and TurboIMAGE databases on multiple HP 3000s over network links. If the primary system is out of service for backup or because of a hardware failure, users can switch to a secondary system and keep on working.

Silhouette also facilitates load balancing across systems. Read-only users can be moved from the primary system to a secondary system.

Silhouette requires no modification to HP 3000 application software and is transparent to application users. Silhouette enables users to duplicate the databases from one primary system to multiple secondary systems or from multiple primary systems to one secondary system, and it enables two systems to mirror the databases of each other. The product is easy to use and customer-installable.

HP SQL

HP SQL is a functionally complete, relational database management system based on the industry-standard SQL relational language. SQL is a nonprocedural language whose powerful commands operate on entire sets of data at a time, rather than the one-record-at-a-time procedural approach of network and hierarchical databases.

HP SQL does not require that explicit relationships between different tables (data sets) be defined. Relationships are determined at the time a query is performed by matching values between common columns in two or more tables.

HP SQL/V is available on all MPE V systems and is upward compatible with the HP SQL module of ALLBASE/XL (and with ALLBASE/UX on HP 9000 800 Series systems). ALLBASE/XL has been designed specifically to exploit the Native Mode performance of the 900 Series of HP 3000 computers.

- Relational model allows the user to specify what data is required without having to specify how to retrieve it.
- SQL relational language is the industry standard for data definition and manipulation.
- Interactive SQL (ISQL) allows the database to be queried from a terminal.
- Language preprocessors allow the same SQL statements that are used for a direct query via a terminal to be embedded in COBOL and Pascal application programs.
- A sophisticated query optimizer relieves the programmer of the details of query planning.
- Dynamic restructuring allows the database structure, table capacities, and security designations to be changed without unloading and reloading the database.

- Data independence allows major changes to be made to the database structure without requiring that applications be modified.
- Various levels of access privileges can be specified for individual users or groups of users to maintain security.
- Concurrent access allows multiple users to access data simultaneously.
- User-controlled transactions ensure that data is always in a consistent state.
- Automatic locking ensures data integrity in a multiuser environment by preventing access to data while it is being updated.
- Automatic (roll-back) recovery guarantees logical data integrity in the event of a soft failure, and it can also be invoked programmatically.
- Roll-forward recovery guarantees logical and physical data integrity in the event of a hard failure.
- Views can be defined that allow a group of users to view parts of several tables as a single, virtual table customized to their particular needs.
- Null data values allow the use of fields that are relevant to some, but not all, records in a table.

Integration and Transparency

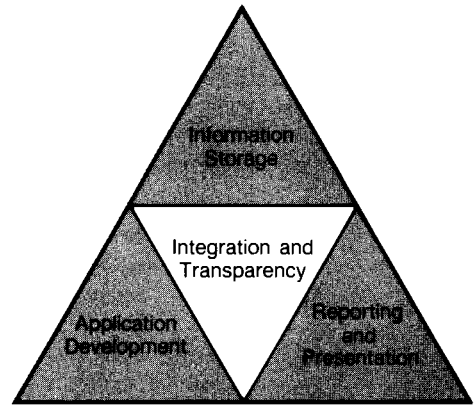


Figure 3-5. Integration and Transparency

HP System Dictionary

HP System Dictionary provides a central information resource for documenting data, applications, programs, files, users, input forms, and network configurations for HP 3000 systems. It is a global dictionary that assists data administrators in effectively managing system and network resources. It also increases programmer productivity by providing timely and accurate system information for software development, and it automates the generation of TurboIMAGE schemas and COBOL copylibs.

As a component of HP's Distributed Application Technology, it assists software developers and network administrators in documenting data, applications and hardware within a network. With the addition of compiled dictionaries and a copy/merge facility, HP System Dictionary can assist in managing distributed data and applications within a network.

HP System Dictionary plays a key role in HP's software development, reporting, and data modeling solutions. HP System Dictionary can be accessed and updated by software productivity tools as well as by packaged or user-written applications. HP System Dictionary is ideal for BRW, VIRTUOSO Code Generator, and Transact users.

Features:

- Entity-relationship model provides a documentation structure that closely matches the user's conceptual data model.
- Compiled dictionaries are fast, compact, read-only subsets of a HP System Dictionary that facilitate data sharing with a network.
- Copy/merge capability allows versions of data definitions to be merged within one dictionary or to be merged into a HP System Dictionary residing on another node in the network.
- Handles name conflicts by putting conflicting sets of definitions in separate "name spaces" or domains
- HP Dictionary/V conversion utility automates conversion from HP Dictionary/V to HP System Dictionary.
- Database utilities create TurboIMAGE schemas and root files from dictionary definitions and produce dictionary definitions from a TurboIMAGE root file.
- VPLUS forms definition loader loads information about VPLUS forms files into the dictionary.

HP Dictionary/V

HP Dictionary/V (formerly HP Dictionary/3000) is a data dictionary and data directory that provides the means to control and coordinate an organization's data processing resources more efficiently. Dictionary/V is required when you are using Transact, Report, and Inform. The data dictionary consists of a TurboIMAGE database that stores information about the data processing environment, a high-level user interface, and a set of powerful utilities. In the interactive mode, the dictionary guides the user through entry, update, deletion, and reporting operations. A friendly dialogue interface makes HP Dictionary/V easy to use and maintain.

Features:

- Provides one consistent source for all data definitions and locations
- Documents programs, TurboIMAGE databases and security, KSAM/V and MPE files, and VPLUS forms files
- Supplies data definitions for COBOL, Pascal, and Transact. Provides data environment documentation through built-in reporting capabilities.
- Supplies definitions for Report and Inform/V
- Loads TurboIMAGE database definitions and definitions for VPLUS forms files into the dictionary automatically
- Provides interactive user commands and prompts for dictionary entry
- Generates TurboIMAGE schemas and root files automatically
- Links to Materials Management and Production Management

Application Development

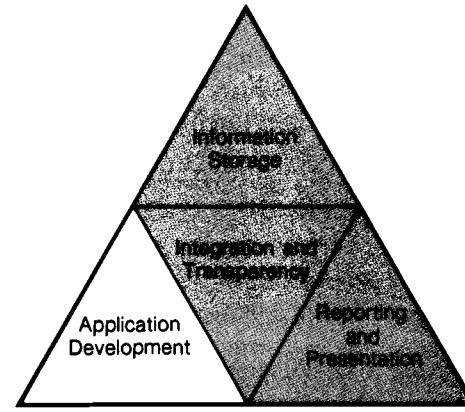


Figure 3-6. Application Development

The HP 3000 family supports a rich set of facilities and languages for program development:

- COBOL II implements the X3.23-1985 ANSI COBOL standard with extended features.
- HP FORTRAN 77 implements ANSI FORTRAN standards with HP extensions.
- Pascal/V and HP Pascal/XL implement 770X.397-1983 ANSI Pascal standard with extended features.
- HP C/XL is a general-purpose language that is an excellent choice for the development of transportable software.
- BASIC/V and HP Business BASIC include both interpreters and compilers. (HP Business BASIC runs on both MPE V and MPE XL systems.)
- RPG/V is highly compatible with industry standard RPG II.
- SPL/V is the system programming language for MPE V-based systems.
- Transact is a high-productivity programming language designed for the development of transaction processing applications. It runs on both MPE V and MPE XL systems.
- Cooperative Services facilitates development of cooperative processing applications where processing is shared between the PC and the HP 3000.
- VIRTUOSO Code Generator is a tool for developing large-scale, structured data processing applications.
- HP Toolset contains a symbolic, source-level debugger for programs written in COBOL, Pascal, and FORTRAN.
- HP Symbolic Debugger/XL provides source-level debugging for HP C/XL, HP FORTRAN 77/XL, and HP Pascal/XL programs.
- Screen Management Facility includes tools to simplify the creation of forms and development of terminal I/O routines.

This wide selection of languages gives customers the freedom to choose the languages with which their programmers are most familiar. In addition, a program written in one language can call programs and routines written in any other HP language. This means that each portion of an application can be written in the language that is best suited to perform the given task.

Debugging Facilities

Toolset contains a symbolic, source-level debugger for programs written in COBOL, Pascal, and FORTRAN. Also, HP Business BASIC/V contains its own powerful debugging facility. HP Symbolic Debugger/XL provides source-level debugging for HP C/XL, HP FORTRAN 77/XL, and HP Pascal/XL programs.

Forms Management

Screen Management Facility includes tools to simplify the creation of forms and development of terminal I/O routines. Screen Management Facility runs on MPE V systems and in Compatibility Mode on 900 Series systems.

900 Series Native Mode and Compatibility Mode Compilers

Languages with the "/XL" suffix provide compilers for Native Mode, the native run-time environment of MPE XL. In Native Mode, source code has been compiled into the native instruction set of the HP 3000 900 Series.

Languages with the "/V" suffix provide compilers for MPE V-based systems and for Compatibility Mode on MPE XL-based systems. Compatability Mode is the MPE XL run-time environment that provides object-code compatibility between MPE V-based systems and the 900 Series.

900 Series Compiler Optimization

The Native Mode compilers -- COBOL II/XL, HP FORTRAN 77/XL, HP Pascal/XL, HP C/XL, and Transact/XL -- are optimizing compilers that maximize a program's run-time performance while minimizing its memory requirements. HP developed these powerful compilers to take full advantage of the features, simplicity and uniformity of the machine instruction set of HPPA.

These compilers provide processing efficiency in several ways. For example, they analyze program behavior on a global basis and schedule instructions to fully utilize the advanced pipelining capabilities of the 900 Series. They also allocate the processor's registers very efficiently to take full advantage of HPPA's LOAD/STORE design. In addition, they can compensate for some inefficiency in source code. For instance, they can eliminate duplicate computations and unused code.

Run-Time Support

MPE XL provides run-time library support for all MPE V and MPE XL languages. MPE V provides run-time library support for MPE V languages and Compatability Mode compilers.

VIRTUOSO Code Generator

The VIRTUOSO Code Generator is a programmer's productivity tool that provides easy development and maintenance of large-scale business data processing applications. The VIRTUOSO Code Generator accomplishes this by structuring and standardizing the manner in which applications are developed. This structure and standardization provides many benefits: higher-quality and more consistent code; lower maintenance costs, since maintenance program-

mers understand more quickly how to fix problems; and less time spent in testing and debugging new applications, since standard, proven code is used.

Programmers can use the VIRTUOSO Code Generator essentially to create their own high-level programming language that generates high-performing, industry-standard source code. They can actually build their own application generator.

Features:

- A customizable programming methodology provides a framework for setting local programming standards and results in more productive, higher quality development and maintenance.
- A source-code generator allows applications to achieve high levels of performance using an industry-standard, third-generation language.
- High-level macros, representing often-used portions of code, can be created, modified, and shared, thus reducing the amount of programming required for new or changing applications.
- Model programs representing generic structures for program logic can also be created and shared.
- Central data definition in the HP System Dictionary gives programmers access to existing file structures and definitions. They are thus less likely to duplicate file structures and can more easily follow established data standards because they are aware that the information exists and is easily referenced.
- The ability to automatically generate program documentation from locally defined standards provides a means to keep up to date with modifications and establishes standardized documentation.

Transact

Transact is a high-level programming language for transaction processing applications. Transact/V includes the programming language and an interpreter. Transact/XL adds a Native Mode compiler.

Designed as a procedural language, Transact provides the functionality of a third-generation language, such as COBOL or Pascal, combined with a comprehensive set of powerful, high-level constructs that can perform several functions within a single statement.

Applications written in Transact require fewer lines of code than those in traditional third-generation languages. They are not only easier to write, they are also easier to understand and maintain. The result is significantly lower development and maintenance costs.

Integration with file management facilities is a major strength of Transact. Data definitions and locations can be accessed through HP System Dictionary or HP Dictionary/V, so they do not have to be defined individually in each program. With HP Dictionary/V, data resolution can take place dynamically as the program is executing, for total data independence, or at compile time, for increased performance. With HP System Dictionary, data resolution is accomplished at compile time.

Access to TurboIMAGE databases, MPE V files, KSAM/V files, and VPLUS/V forms files supports the creation of a wide variety of transaction-oriented applications.

Features:

- Automated resolution of data and file definitions through either HP System Dictionary or HP Dictionary/V eliminates the need for data definitions within the program.
- Both automatic and programmatic error handling and recovery support flexible error trapping.
- The ability to call HP 3000 system intrinsics offers extended capability to the application programmer.
- The ability to call run-time procedures written in other languages (such as COBOL II, Pascal/V, HP Pascal/XL, FORTRAN 77, and SPL/V) and in Transact permits sharing of commonly used routines.
- The ability to call Report/V, Inform/V, and Business Report Writer/V allows easy-to-design formatted output for reporting purposes. (Transact/XL can call BRW/XL.)

Cooperative Services

The Cooperative Services development tool helps software designers create cooperative processing applications between personal computers and an HP 3000 minicomputer. The development tool consists of both an MS-DOS procedure library and an HP 3000 intrinsic server. Cooperative Services includes the following features:

- Connection and Session Management enables the PC application to establish a connection to an HP 3000, initiate a session, terminate the session, and disconnect from the HP 3000.
- TurboIMAGE Intrinsic Support provides for the packaging of TurboIMAGE requests, transmitting the requests to the HP 3000 and returning the responses to the application.
- MPE Intrinsic Support provides for the packaging of file access requests, transmitting the requests to the HP 3000 and returning the responses to the application.
- Remote Procedure Call Support provides for the packaging of procedure requests, transmitting the requests to the HP 3000 and returning the responses to the application.
- Special Function Support provides for the loading of specialized code modules such as conversion routines, status messages, and version checks.
- Popular PC development languages are supported. Depending on the personal computer chosen for development, software designers may choose from a variety of languages.

COBOL II

COBOL II is a high-level language for business data processing that operates HP 3000 systems. It takes full advantage of the system facilities and architecture. COBOL II is based on the 1985 ANSI COBOL Standard X3.23-1985. HP has implemented several extensions to the standard in order to increase the capability of COBOL II. The most significant extensions are:

- The pre-processor function provides statements that allow the programmer to equate a particular macro or sequence of code ($DEFINE) or a file ($INCLUDE) to an identifier. This identifier can be referenced throughout the program, and at compilation it is replaced with the expanded source code or source program file it represents.

- Program debugging aids allow for the increased efficiency of the COBOL programming staff by providing tools that aid in finding problems within a program during the development cycle.
- CROSSREF provides a listing of all symbols and tables used in the expanded source file.
- VERB MAP provides a listing of COBOL statements and their locations within the object code.

HP FORTRAN 77

FORTRAN 77 is based on the most recent ANSI FORTRAN standard and incorporates a number of improvements and extensions over previous implementations. Among the more important are an IF-THEN-ELSE control structure, a CHARACTER data type, and generalized INPUT/OUTPUT FACILITIES. HP FORTRAN 77 is a superset of the ANSI FORTRAN 77 standard. It provides a well-defined language standard for software portability and offers extensions that enhance the flexibility and power of the FORTRAN 77 language.

HP FORTRAN 77 is an implementation of FORTRAN 77 for the HP 3000 MPE V-based computer systems. It is highly compatible with FORTRAN 66/V (formerly known as FORTRAN/3000).

HP FORTRAN 77 provides:

- Seven data types -- integer, double integer, logical, real, double-precision, complex, and character
- Character variables and character arrays
- Bit extract and deposit capability with partial-word designators
- Arrays with up to 255 dimensions
- Named common blocks initialized by block data subprograms
- Multiple entry points for subprograms
- Support of user-written error handling routines that are called under trap conditions
- ANSI FORTRAN 77 (X3.9-1978) full language
- MIL-STD-1753 language extensions
- HP language extensions
- MPE V system access

Pascal/V

Pascal/V (formerly known as Pascal/3000) is HP's implementation of the Pascal language for MPE V-based HP 3000 systems. It provides several extensions to the ANSI/IEEE standards for Pascal. Pascal/V is particularly useful for development of large systems and subsystems.

Pascal offers a very powerful set of data types and control structures. Along with control constructs, Pascal's basic building blocks -- namely procedures and functions -- permit a top-down approach to program development. The modular, self-documenting characteristic of Pascal programs produces code that is easy to maintain and enhance. As a further aid to program development, the language offers strong type checking and range checking capabilities. A significant portion of the debugging responsibility now rests with the compiler and the language.

Features:

- Integrated program development via HP Toolset provides symbolic debug, full screen editing, softkeys for compile and execute, and source and version management.
- HP Dictionary/V support for generation of TYPE and VAR declarations from previously stored definitions
- Character and string types, when coupled with predefined string handling functions, allow powerful string management operations.

HP Pascal/XL

HP Pascal/XL is HP's implementation of the Pascal language for the HP 3000 900 Series systems. It allows several extensions to the ANSI/IEEE and ISO standards for Pascal, including those that provide it with system programming capabilities. These extensions open many new areas for Pascal usage. HP Pascal/XL will be particularly useful for development of large systems and subsystems and those applications that require system-level programming.

Pascal offers a very rich and powerful set of data types and control flow structures. Along with control constructs, Pascal's basic building blocks of structure, namely procedures and functions, permit a top-down approach to program development. The modular, self-documenting characteristic of Pascal programs produces code that is easy to maintain and enhance. As a further aid to program development, the language offers strong type checking and range checking capabilities. A significant portion of the debugging responsibility now rests with the compiler and the language.

HP Pascal/XL offers system programming extensions to the above features. These extensions have permitted Pascal to be used extensively within Hewlett-Packard for system-level applications.

Features:

- Integrated program development via HP Toolset/XL provides symbolic debug, full screen editing, softkeys for compile and execute, and source and version management. Additional symbolic debug support is available via HP Symbolic Debugger/XL.
- Conformant array parameter type provides flexibility in parameter passing.
- Character and string types, when coupled with predefined string handling functions, allow powerful string management operations.

HP C/XL

HP C/XL is Hewlett-Packard's implementation of C for the HP 3000 900 Series. It is a general-purpose programming language that features modern control flow and data structures, a rich set of operators, and economy of expression. It combines the convenience and portability of a high-level language with the flexibility and efficiency of assembly language. While C is the system programming language for UNIX(1), it is also widely used for application programming. And due to its portable nature, C is regarded as an excellent vehicle for transporting software between vendors' systems.

(1) UNIX is a trademark of AT&T.

Features:

- Functions are recursive and can return scalar structure or union values or void.
- Block structured scope of variables is provided.
- Public and private functions and data are provided.
- Structured programming statements -- IF-ELSE, FOR, WHILE, SWITCH -- are available.
- Pragmas are provided to specify optimization options, copyright information, version identification, listing control, and MPE XL intrinsic access.
- Access to MPE XL run command arguments PARM and INFO via ARGC and ARGV

BASIC/V

BASIC/V (formerly known as BASIC/3000) is an easy-to-learn language designed especially for interactive terminal use. BASIC/V provides most of the features commonly found in a BASIC system.

BASIC/V consists of both an interpreter and a compiler, which allow you to create and debug your BASIC programs interactively and then compile them for faster operation. The BASIC/V compiler provides the means for converting BASIC/V programs (including those that have been written, debugged, and saved via the BASIC/V interpreter) into machine code. Compiled BASIC/V programs exist in the system as actual code segments and can be run directly, rather than through line-by-line interpreting.

Features:

- Four numeric data types: real, integer, real extended precision, and complex
- Mixed-mode arithmetic
- All standard functions (SIN, COS, LOG, etc.) plus matrices (up to 2 dimensions), strings, and files
- Program segmentation with common storage
- User-definable security including password
- Interpreter can be used alone or in conjunction with BASIC compiler
- IMAGE database calls built into the language
- Compiler provides shareable machine code

HP Business BASIC/V

HP Business BASIC/V (formerly known as HP Business BASIC/3000) offers the complete language solution. With a variety of features to ease the programming task, HP Business BASIC supports the commercial applications programmer pursuing serious development as well as the novice programmer involved in ad hoc production of simple programs and tools.

(HP Business BASIC/V runs in Compatibility Mode on 900 Series systems. A Native Mode compiler, HP Business BASIC/XL, will be available in the future.)

The interpreter provides immediate feedback on the effect of program modifications and indicates syntax errors as the program lines are entered. Extensive debugging tools also simplify application development. All or part of a program may be compiled, resulting in significant performance improvements for most types of applications.

HP Business BASIC/V not only provides ease of use for the programmer, but also allows the programmer to write applications that are easy for the end-user. Run-time errors and interrupts from the keyboard can be trapped by the program and appropriate action taken. Statements are provided to support applications with softkey-based user interfaces.

Features:

- All program development tasks are integrated. The interpreter and compiler, as well as all features of an editor, debugger, and calculator, are directly accessible through HP Business BASIC/V commands and statements.
- Callable subprograms and multiline functions are supported with parameter passing and shared common data areas.
- The Program ANALYST, a code inspection tool, simplifies the task of optimizing, restructuring, and maintaining applications.
- Flexible Report Writer statements easily generate reports and tabular output.
- Advanced database statements provide easy but flexible data manipulation and access capabilities including retrieval, sorting, searching, and automatic packing of buffers.
- Full support is provided for calling intrinsics for operating system services or access to other subsystems.
- Long identifier names and alphanumeric labels improve program maintenance. Keywords can be used as identifiers.
- Conversion utilities and tools, such as direct KSAM/V interface, JOINFORM (an HP 260-like forms package) and JOINFORM EDITOR (which creates and modifies JOINFORM files) are included for BASIC/V AND BASIC/260 application conversion.
- Native language support is provided for date, time, and collating sequence.

RPG/V

RPG/V, or Report Program Generator, is a machine-independent, problem-oriented report generating language that is easy to learn, use, and code. It allows you to specify many important operations with a minimum of effort by making simple entries on specially formatted coding sheets. HP's RPG/V is highly compatible with the RPG II languages offered by other vendors. Minimal effort is required to upgrade standard RPG II programs from other vendors' systems to HP. Converting from IBM RPG II is accomplished by the TRANSFORM/IBM conversion tools. In addition, the RPG/V compiler helps detect errors at the source language level with extensive diagnostic messages.

(RPG/V runs in Compatibility Mode on 900 Series systems. A Native Mode compiler, RPG/XL, will be available in the future.)

Features:

- Calculation control of I/O
- Preselected or dynamic run-time error options
- Source-level debugging with DEBUG operator
- Local Data Area (LDA); User Data Structure (UDS)
- Command key and function key indicators
- Message catalog access with MSG and DSPLM
- Figurative literals *BLANK(S), *ZERO(S)
- Structured programming constructs

SPL/V

SPL/V is the system programming language for the MPE V-based HP 3000 systems. Because it combines the efficiency of a machine-dependent language with the simple structure of a high-level language, SPL/V was used to write the operating system, language compilers, system utilities, and database management and data communication subsystems for the MPE V-based computers.

Features:

- Self-documenting for ease of readability
- Permits access to all hardware features and data types
- Dynamic allocation of local storage for working space and local variables in procedures. Memory is de-allocated on exit form procedures.
- Program segmentation feature
- Assemble statement permits machine-level coding
- Six data types -- logical, byte, integer, double integer, real, and long real

Toolset

Toolset provides a set of tools that work together to maximize the productivity of COBOL II and Pascal programmers in the coding, symbolic debugging, and version management phases of development on the HP 3000. Toolset/XL extends symbolic debugging to include support for FORTRAN 77. These tools perform many of the fundamental and routine programming tasks and simplify or facilitate others.

Features:

- Workspace File Manager for COBOL II and Pascal/V
- Friendly and powerful user interface
- Full-screen editor for COBOL II and Pascal/V
- COBOL II COPY library editing and management
- COBOL II and Pascal/V data definition retrieval from HP Dictionary/V
- Program translation manager for COBOL II and Pascal/V
- Toolset/V offers symbolic debug for COBOL II and Pascal/V
- Toolset/XL offers symbolic debugger for COBOL II, HP Pascal/XL, and FORTRAN 77/XL
- Help facility

HP Symbolic Debugger/XL

HP Symbolic Debugger/XL is a powerful, full-featured symbolic debugger to help the user locate and correct errors in programs. The feature set facilitates high programmer productivity and user friendliness. HP Symbolic Debugger/XL is the interactive source-level debugger for the HP C/XL, HP FORTRAN 77/XL, and HP Pascal/XL languages and runs under the MPE XL operating system on the HP 3000 900 Series.

HP Symbolic Debugger/XL allows the user to examine the program state in which an error or some other condition occurs. The user may then take corrective action and resume execution or abort the program.

Features:

- Provides language-sensitive expression evaluation for HP C/XL, HP FORTRAN 77/XL, and HP Pascal/XL
- Friendly user interface including on-line help, support of multiple skill levels, and windowing with up to three panes for viewing source statements and assembly instructions simultaneously
- Breakpoints can be set, deleted, suspended, and activated at specified locations, allowing the user to examine the state of a program.
- Single-stepping through a program or over procedures is provided at the source statement or the equivalent assembly instruction level.
- Assertions allow the execution of a list of commands before every source statement for tracing elusive bugs.
- Allows the display and modification of program variables
- Multilevel stack tracing allows the user to trace program flow.
- Extensive interrogation of the state of the debugger, including breakpoints, files, globals, procedures, and variables, is provided.
- Record and playback of debug commands recreate debugging sessions.
- Provides access (within the debugger) to the MPE XL operating system via the command interpreter
- Macro facility allows users to define their own names for command strings.

Screen Management

HP's Screen Management Facility simplifies the creation of forms and the development of terminal I/O portions of applications. These services consist of FORMSPEC/V and VPLUS/V. Both are included as part of the Fundamental Operation Software (FOS). Screen Management Facility runs on MPE V systems and in Compatibility Mode on 900 Series systems.

FORMSPEC/V

FORMSPEC/V is an easy-to-use, menu-driven, interactive form design facility for application programmers. The form developed with FORMSPEC/V can be manipulated by applications using VPLUS/V intrinsics. Separating the screen interface from the application allows you to maintain the screen image without having to change the application.

Application screen formats are laid out interactively on a terminal screen. Each form contains fields with characteristics defined from a set of standard descriptions such as type of field (e.g., required, optional, or display only) and data type (e.g., character, numeric, or date). Default values can be provided for each field.

FORMSPEC/V runs on MPE V systems and in Compatibility Mode on 900 Series systems.

Features:

- Comprehensive data editing capabilities include length checking, range checking, list checking, equality checks, pattern matching, and check digit verification (modulo 10 or 11).
- Data can be formatted as it is being collected. Standard routines are available that justify, fill, strip, and upshift data in the fields specified.
- Data movement can be specified to transfer values between fields in a single form or between forms. For example, the sum of several fields can be moved to another field in the same form reserved for the total.

- Arithmetic and conditional processing, dependent on the value entered in a field, can be specified as needed.
- Custom error messages to be displayed at run-time can be specified with each error characterization.
- Through use of the Application Ready Buffer, programmers can specify the data editing rules and final format for all the data fields within a form. VPLUS/V will then handle the entire form display, data entry, validation, and transformation process before returning to the application with the data ready to use.
- FORMSPEC/V supports the creation of forms that utilize the various special features of HP workstations.

VPLUS/V

VPLUS/V consists of a set of intrinsics that programmers can use to develop the terminal I/O portions of applications. VPLUS/V runs on MPE V systems and in Compatibility Mode on 900 Series systems.

VPLUS/V provides facilities to:

- Configure the terminal workstation
- Retrieve a form definition from a forms file
- Display a form with application-provided data and window message and enhanced fields
- Return data that is entered into a displayed form along with the value of the last key pressed to the application
- Execute logical groups of system-level terminal management routines with high-level intrinsics
- Perform diagnostic activities during program development and debugging

Reporting and Presentation

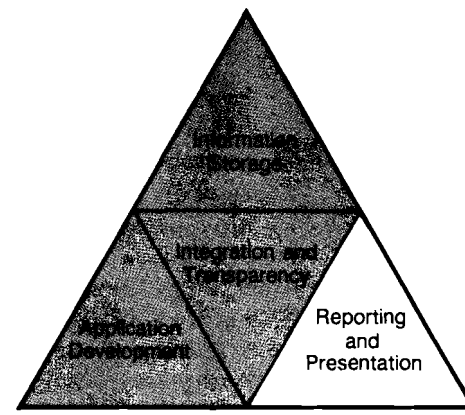


Figure 3-7. Reporting and Presentation

Business Report Writer

Business Report Writer (BRW) is a high-performance report writing system for data processing professionals (programmers, system analysts, and database administrators). Comprehensive report development no longer requires numerous lines of programming code or complex report syntax. With BRW, your EDP department can refer report development tasks to the database administrators and system administrators.

Ease-of-use separates BRW from other reporting tools. A menu-driven interface, assisted by an on-line help facility, aids users in specifying reports. The backlog of report requests is reduced because turnaround times are shorter. "Sample layout" features allow report developers to quickly verify the format and design of reports without compiling. A help facility built into BRW guides users through logical report development and maintenance.

Reports have to do more than list data; they have to transform raw data into information. And they have to do it quickly. BRW reduces the time required to design reports so users get the information they need faster. Good business reporting also provides analysis to facilitate decision making. The more analysis a report provides, the sooner business people can finalize decisions. BRW's advanced features perform the analysis. Detailed calculations, date and time functions, and exception reports are just a few examples.

BRW uses HP System Dictionary, HP Dictionary/V, or the HP Application Dictionary. These products store data definitions, maintain documentation and define access paths to data. BRW can access TurboIMAGE and IMAGE/V databases, MPE files, and KSAM/V files. Once data is selected, BRW optimizes the access to the files and data sets using a predefined set of algorithms, ensuring maximum run-time performance.

In addition to database security and MPE file security, BRW has its own internal security system to prevent unauthorized access to report specifications and report execution. The combination of these protective measures ensures the safety of information throughout the data processing environment.

Minimizing the programming effort required for report development results in productivity increases for the entire data processing department. Reports are more timely. Computer resources are conserved. Information and analysis, not just data, are presented for immediate decisions.

Features:

- "Fill in the box, see what you get" report specification menus allow immediate design verification and reduce maintenance time.
- Relational views of data eliminate the problem of determining how to get data and allow the designer to focus on report contents.
- Multiple-pass reports (reporting on the results of other reports) allow the output file of a report to be queried directly by another BRW report or by other applications.
- Powerful calculation features for specifying equations and business functions provide the analysis that decision makers need from a report writing system.
- Integration with HP System Dictionary, HP Dictionary/V, and HP Application Dictionary for reporting data from several applications
- Performance tuning allows users to optimize performance and conserve system resources.
- Remote access for selecting data from a remote HP 3000
- On-line help facility guides users through report design and maintenance.
- Run-time support of programs as part of the FOS
- Intrinsics for programmatic access to reports, with no need to exit an application
- Integration with the VIRTUOSO Code Generator
- Conversion utility to convert Report/V or Inform/V report definitions to BRW programs
- Security over report definition and execution to safeguard sensitive information

Information Access

Information Access is a unique information management tool. It is an information server that extends the reach of your data processing systems by delivering key business data to authorized PC users. Information Access can provide the means for your people to make better decisions based on up-to-the-minute information wherever it resides. Additionally, centralizing the administration of information access improves the manageability of essential data processing systems.

Features:

- Host processing is reduced because Information Access combines PC, HP 3000 and mainframe processing power to make the best use of your organization's computing resources.
- The Database Administrator utility provides control over the access and distribution of database information by centralizing its administration.
- An upload capability allows PC data to be transferred to the HP 3000 and saved in a variety of standard formats. PC or HP 3000 data can also be transferred to the mainframe and stored in a Cullinet C/ICMS format.
- Automatic conversion of business data into many popular formats is accomplished in one easy step. Information Access reformats PC, HP 3000, and C/ICMS information for use in popular applications such as Lotus 1-2-3, R:Base 5000, d:BASE II®, C/ICMS tables, or popular word processing and graphics packages.
- A tabular view of data is provided so end-users do not require knowledge of data structure or data location. Users can view data from several mainframe, HP 3000, and PC databases just by selecting a menu item.
- The built-in personal report writer allows generation of both ad hoc and routine reports. The report writer is menu-driven and allows preprinted forms and custom templates for repeated use.
- Batch capabilities allow data access requests to be run as batch jobs.

HP Visor

HP Visor is an easy-to-use, terminal-based interface to HP SQL/V and the HP SQL module of ALLBASE/XL. HP Visor's flexible selection of access and reporting modules enables end-users or database administrators to perform queries and generate their own reports without involving a programmer. HP Visor also provides powerful facilities for programmers to use in preconfiguring complex tasks or to improve their own productivity when working with SQL databases.

The HP Visor interface is forms-based, so the user only needs to mark boxes and press function keys to step through tasks such as performing an ad hoc query or generating a customized report. Additional capabilities are provided for experienced users to directly enter HP Visor or SQL commands.

Features:

- A common, forms-based interface is presented to the user no matter what module is in use, similar tasks are performed in the same manner.
- Context-sensitive help, available at any time with a single keystroke, provides quick answers to questions.
- Two access methods are provided: menu-driven EZAccess for novice or infrequent database users; SQLAccess for users familiar with both HP SQL and the database structure.

- Queries, reports, and sequences of commands can be saved for future use, thus streamlining frequently performed tasks.
- Data security is maintained. Visor relies on the SQL system catalog to determine each user's authority to access data.
- Default mode of operation shields novice users from complex functions and smoothly steps them through tasks that cross module boundaries. Experienced users can easily select advanced features.
- Batch-mode operation is available to automate time-consuming tasks.

Inform/V

Inform/V is an interactive inquiry and report generation facility oriented toward end users (for example, managers, purchasers, clerks, or secretaries). Inform/V provides an interactive menu that allows access to data and the generation of reports in a fraction of the time needed by traditional methods.

Inform/V and HP Dictionary/V work together to simplify data access. Inform/V accesses the dictionary for definitions and locations of data stored in TurboIMAGE/V databases and KSAM/V and MPE V files. It can also access TurboIMAGE/XL databases and KSAM/V and MPE XL files on 900 Series HP 3000 computers. End-users can access information without knowing how or where it is stored.

Inform/V protects the integrity of corporate data by allowing read-only access to databases and files. In addition, security can be assigned to individuals to prevent unauthorized access to sensitive data.

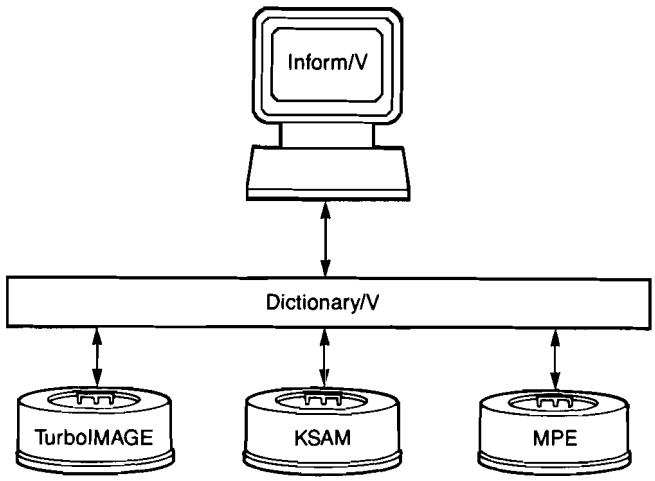


Figure 3-8. Inform/V

Inform/V can generate reports either on-line at the terminal or in batch mode. In batch mode, Inform/V can perform all of its work in the background and return terminal control to the end-user immediately.

Features:

- Fast, friendly, direct interactive link between end-users and data stored in HP 3000 databases and files
- Inform/V security limits user access to data to authorized users.
- Inform/V is designed specifically for the end-user, relieving the programmer of the time-consuming task of report writing.

- Immediate report production provides information as it is needed.
- Report definitions can be saved and reused.
- Access to multiple TurboIMAGE databases and KSAM/V, MPE V, and MPE XL files means reports can be created from more than one file source.
- Automated report formatting supports easy report generation.
- Friendly menu interface
- Automated resolution of data and file definitions through HP Dictionary/V provides data access transparency.

4

HP Precision Architecture

Foundation for the Next-Generation HP 3000s

HP Precision Architecture (HPPA), incorporated in the 900 Series HP 3000 systems, is the foundation for HP 3000 computer systems for the 1990's and beyond. HPPA is a reduced-complexity architecture that is based on Reduced Instruction Set Computing (RISC) principles, coupled with key architectural extensions. The advantages of HPPA directly translate into high performance and industry leadership in price/performance and cost of ownership in commercial distributed data processing environments.

HPPA maximizes the performance benefits that can be realized for a given semiconductor technology. This performance potential allows for development of high-performance systems that provide a cost-effective, compatible growth path designed to meet growing performance requirements in commercial environments. And the inherent simplicity of HPPA is ideal for fast, single-chip microprocessors that can be utilized for cost-effective desktop and workgroup systems.

Finally, the 900 Series systems provide both object and source code compatibility with the other HP 3000 systems, thereby saving investments in application software and providing a smooth migration to these next-generation HP 3000 900 Series systems.

Designed to Last

A key design objective of HPPA was to ensure that the architecture will be able to meet evolving computing needs and take full advantage of new hardware and software technologies. Providing an architecture with high performance potential and the capability to support a broad, compatible family of products was the first step. Next, unlike the majority of today's systems, which must attempt to force-fit features such as multiprocessors and high-availability extensions into existing architectures, HPPA has been designed with these capabilities taken into account. Future systems can take advantage of these capabilities to meet expanding requirements for system performance and availability.

Finally, provisions have been made to ensure that the architecture has a large degree of flexibility and expandability. For example, industry analysts have estimated that addressability requirements of systems double every year. By allowing for either 48-bit or 64-bit virtual addressing, HPPA systems will be able to provide sufficient expandability to meet these growing requirements. Consider that 48-bit addressing provides over 64,000 times the addressability of typical 32-bit systems! It all adds up to an architecture designed to last through the 1990's and into the next century.

Key Features

- Reduced Instruction Set
- 32-bit, fixed-format instructions
- 48-bit or 64-bit virtual addresses
- Hardwired, single-cycle instruction execution
- 32 general-purpose registers
- Hardware support for floating-point and decimal calculations
- Multiprocessors and coprocessors

Why RISC?

In the late 1970's and early 1980's, research in industry and at several leading universities showed that computers tend to spend the great majority of the time performing relatively simple functions. In addition to directly supporting such simple functions in the instruction set, conventional computer systems typically provide instruction set support for many complex functions as well. For commercial workloads on conventional systems, 80 percent or more of the time is spent executing very simple instructions such as ADD, LOAD, BRANCH, and STORE. Only about 20 percent of the time is spent executing relatively complex instructions, but implementation of these instructions results in additional processor overhead, often resulting in a performance penalty for all instructions.

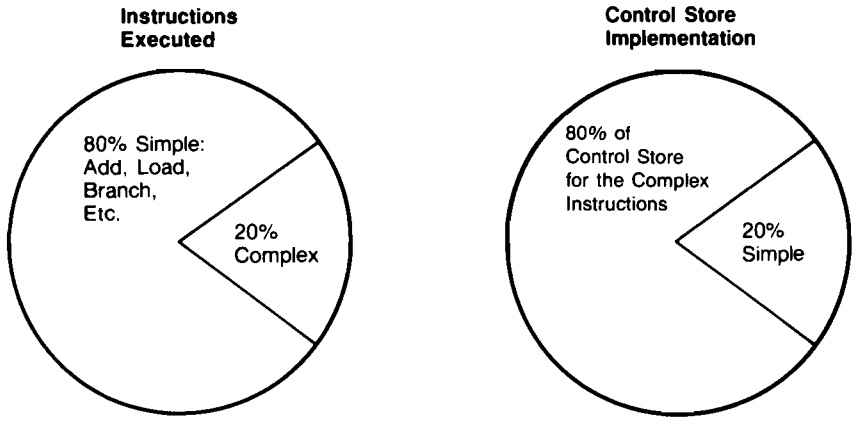


Figure 4-1. RISC Motivations

Researchers concluded that optimizing the processor for the simple, often-executed functions would result in a significant performance advantage over more conventional designs. Thus, the RISC approach: maximize system performance by optimizing the processor for the simple, often-executed functions. HPPA not only embodies RISC principles, it also provides significant architectural extensions that allow for true high-performance, cost-effective business solutions.

The Advantages of Simplicity

Reducing processor complexity allows for several key advantages when compared to conventional system architectures. Compatibility, lower cost, and higher performance are all direct benefits of the reduced complexity approach of HPPA.

Compatibility

Compatibility has always been a cornerstone of the HP 3000 product strategy, and maintaining compatibility when moving to the next-generation HP 3000

systems was a critical design consideration. A simple instruction set is ideal for emulating more complex instruction sets, and thus the reduced complexity HPPA allows for compatibility of non-privileged object code as well as source code. When moving from the MPE V-based systems to the 900 Series systems, object code can be run "as is," via emulation of the MPE V-based HP 3000 instruction set. Or, source code can simply be recompiled to exploit the full performance potential of the 900 Series system.

Lower Cost

Eliminating much of the hardware complexity associated with conventional computer systems directly translates into a reduced part count and a system that is easier to design, develop, and manufacture. The result is a system that costs less to bring to market, and this cost saving is directly reflected in the superior price/performance of the 900 Series systems as compared to competitive offerings.

Higher Performance Potential

With the 900 Series systems, the performance potential of a wide variety of semiconductor technologies can be maximized. For example, the Series 935, implemented in NMOS III technology, delivers performance that typically is achieved by conventional systems only via utilization of ECL semiconductors. With HPPA, a given level of performance can be achieved at a significantly lower cost than with conventional systems.

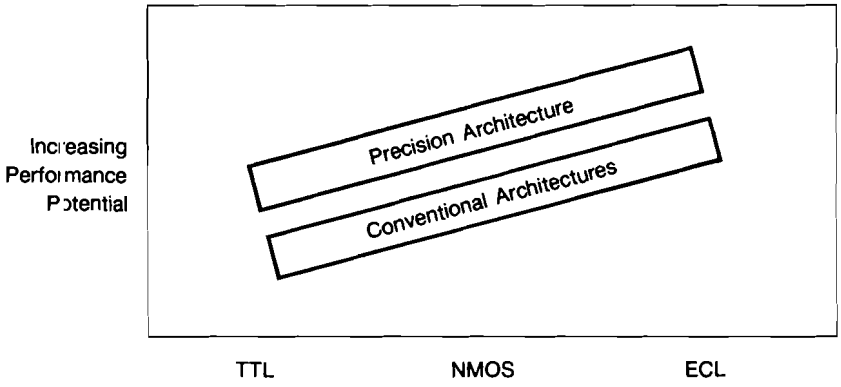


Figure 4-2. Higher Performance Potential

Allows for a Broader Family of Systems

The reduced amount of processor circuitry associated with a RISC-based design is ideal for development of fast, single-chip microprocessors that can be used to develop cost-effective desktop of workgroup computers. And at the high end of the HP 3000 family, the performance advantage of HPPA, coupled with support for multiprocessor systems, allows for development of products delivering very high performance solutions with the power of today's water-cooled mainframes.

Ideal for Advancing Technologies

The simplicity of HPPA makes it ideal for maximizing benefits from advancing hardware technologies such as Very Large Scale Integrated (VLSI) components. Hewlett-Packard has long enjoyed a leadership position in high-performance,

high-density semiconductors, and this experience is extremely beneficial with the 900 Series systems. Processor performance can be maximized by placing an entire CPU on a single chip, thus keeping signal delays short and allowing CPU cycle time to be decreased. With further integration, such as placing CPU and processor caches on-chip, instruction and data access times can also be minimized, providing for additional performance gains.

Higher Processor Reliability

Just as requiring fewer parts to build a processor directly results in decreased cost, it also implies that there are fewer parts to fail. Thus, HPPA systems provide increased processor reliability. In addition, HPPA is designed to support future extensions for providing higher system availability. For example, future multiprocessor systems could support the capability of redundant processors, such that if one processor failed, another could automatically take its place, allowing the system to continue operating without interruption.

RISC Attributes: Maximizing Processor Performance

The 900 Series systems are the first business computing systems that are true RISC systems. RISC actually goes far beyond simply implementing a reduced number of instructions. There are actually several key RISC attributes, and each of them is discussed below. Note that the 900 Series systems adhere to all of these principles.

Hardwired Control and Single-Cycle Execution

The goal with RISC systems is to perform the simple, often-executed functions as quickly as possible. Unlike conventional systems, which utilize a microcoded control store and thus typically require several machine cycles to execute even the most simple instructions, with RISC systems, instructions are executed directly in hardware in a single CPU cycle. More complex functions, which are often directly supported in the instruction sets of conventional systems, are performed via a sequence of simple instructions generated by high-level language compilers.

Reduced Number of Instructions

So that the machine can be cycled as quickly as possible, RISC systems support a reduced number of instructions and fewer addressing modes than typical systems. For example, typical complex architectures may utilize over 300 instructions plus a large number of addressing modes, compared to the 140 simple instructions provided with HPPA systems. This reduced complexity allows the instruction decoding and control circuitry to be simplified, resulting in lower cost and higher performance.

Fixed Instruction Length and Format

All instructions defined in the HPPA Instruction Set are fixed-length, 32-bit instructions. A fixed instruction length helps facilitate the simultaneous execution of multiple instructions, a capability known as instruction pipelining. Furthermore, all instructions are fixed-format, which means that the instruction opcode and the operand registers are always specified in the same place in the instruction. Having fixed-format instructions allows for instruction decoding and fetching of required operands to occur in parallel, thus increasing processor efficiency and performance.

Register-Intensive Operation

Calculations are performed only on operands held in high-speed, general-purpose registers in the CPU, so calculations do not have to be slowed by accesses to relatively slow cache or main memory. With a relatively large number (32) of these high-speed registers available, it is possible for compilers to produce and arrange instructions such that operands can be re-used as often as possible, minimizing the number of accesses to slower cache storage and main memory. Furthermore, register-intensive operation allows for simplified data and control paths, which simplifies pipeline design and helps minimize the CPU cycle time.

Load/Store Memory

So that processor complexity can be minimized and CPU cycle time reduced, only Load and Store instructions access memory. Since Load instructions access storage that is relatively slow compared to CPU registers, these instructions require longer to execute. So that the CPU cycle time does not have to be increased because of these instructions, they are implemented such that they require multiple cycles. However, compilers can schedule instructions so that multicycle Load instructions are overlapped with other processing, thus allowing the effective instruction execution rate to still approach one cycle per instruction.

Decreased Effort at Run Time

With a reduced-complexity system, a fundamental principle is to shift the burden of complexity from the processor to the high-level language compilers. With a large degree of complexity in the processor, conventional systems pay a performance penalty each time a program is run. With a reduced-complexity system, complexity and effort are shifted to compile time, so that any penalties for having a more sophisticated compiler are paid only once, when the program is compiled. In this way, object code can be streamlined and optimized for performance and the program can be run as quickly as possible.

HP Precision Architecture: Extending RISC

The RISC principles are keys for providing high-performance processors. However, providing a long-lasting architecture that can deliver high-performance, cost-effective solutions in commercial processing environments requires additional architectural features. HPPA goes beyond RISC with the important extensions discussed below.

Expanded Addressability

HPPA systems can be implemented with either 48-bit or 64-bit virtual addresses, thus expanding addressability far beyond that of typical 32-bit systems. For example, 48-bit addressability provides over 64,000 times the virtual addressability typically available on conventional 32-bit systems! This flexibility for supporting large virtual address spaces ensures that 900 Series systems will be able to meet expandability requirements as next-generation software evolves and as commercial processing needs continue to grow.

Multiprocessors

HPPA allows for the development of systems that utilize tightly coupled symmetric multiprocessors. Multiprocessors share the same memory and I/O

buses and I/O devices. They can be used to enhance system performance through distribution of the system workload, or they can be configured redundantly to provide fault tolerance.

Floating-Point Coprocessors

The modular design of HPPA allows for the addition of special-function coprocessors for accelerating execution of those complex functions that may be important in some application mixes. For example, some scientific, engineering, and statistical applications run on general-purpose systems may require high-performance floating-point calculations. For such applications, a floating-point coprocessor is available to enhance performance.

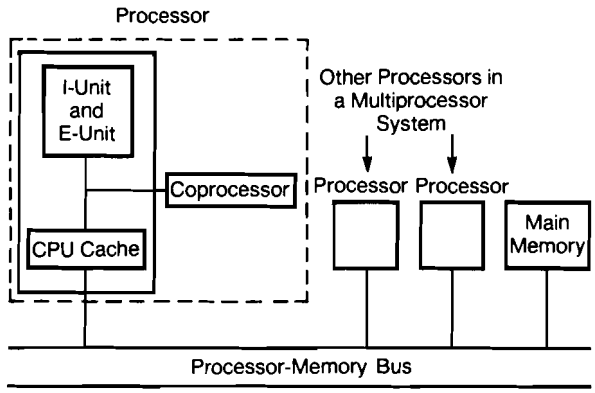


Figure 4-3. Coprocessor and Multiprocessor

Decimal Arithmetic Support

Decimal arithmetic is a data type commonly used in commercial applications, and HPPA provides simple, powerful instruction primitives to ensure high-speed decimal calculations. For example, the Decimal Correct and Unit Add Complement instructions allow for packed and unpacked decimal addition to be performed with the binary Add instruction. Decimal calculations actually require fewer CPU cycles to execute on 900 Series systems than on conventional systems.

High-Performance Input/Output

Providing effective support of database management systems is one of the key strengths of the HP 3000 family. Thus, one of the key design objectives with HPPA was to ensure a high level of data security and high throughput in I/O intensive database applications. The first step was to provide a large virtual address space, which can be very effectively utilized by MPE XL's file mapping schemes. Furthermore, HPPA incorporates a memory-mapped I/O scheme, whereby I/O operations are initiated and controlled via a series of Load/Store instructions to reserved virtual or real memory locations. A key advantage of this scheme is that I/O accesses utilize the same access protection mechanisms as code and data. Coupled with other I/O subsystem features such as DMA chaining, which allows multiple transactions to be processed without CPU intervention, I/O operations on HPPA systems carry less overhead and deliver increased I/O performance.

Instruction Pipelining

Instruction pipelining refers to the simultaneous execution of multiple instructions. For example, while one instruction is being fetched and decoded, a calculation specified by a second instruction can be performed and the result of a calculation specified by a third instruction can be saved to a CPU register. Such a pipeline organization is representative of the 900 Series systems. Fixed-length, fixed-format instructions help streamline instruction pipelining. Additionally, Load/Store RISC-based machines are ideal for minimizing the number of pipeline stages required for high performance and for ensuring that the time required to perform each stage is as short as possible.

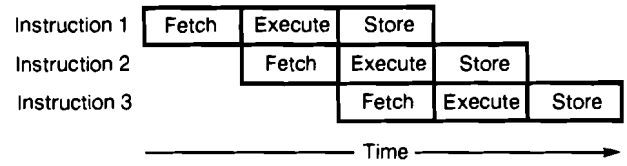


Figure 4-4. Instruction Pipeline

Delayed-Branch Capability

On conventional computers, the instruction sequentially following a taken branch instruction is loaded into the pipeline but is not executed. The result is a "dead cycle" that is not utilized for useful processing. On HPPA systems, a branch instruction can specify that the instruction sequentially following the branch is to be executed, so that this cycle can be utilized for processing. Because branches constitute roughly one-sixth of typical instruction mixes, utilizing the available cycle after a branch results in increased performance with HPPA systems.

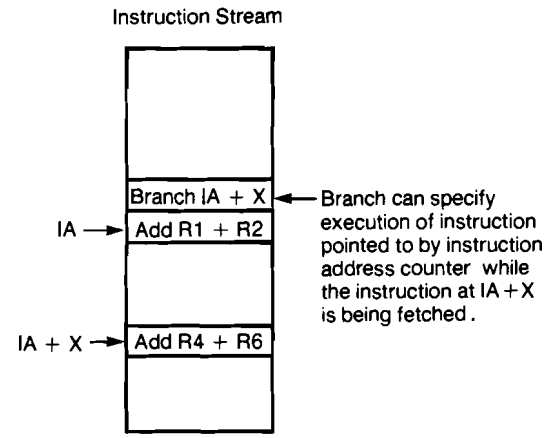


Figure 4-5. Delayed Branch Capability

Optimizing Compilers

Optimizing compilers ensure the best possible match between high-level languages and HPPA machine instructions. Reduced complexity systems are ideal for optimizing compilers, and the best performance on such systems depends upon effective optimization. Optimizing compilers utilized with the 900 Series systems analyze program behavior at a global level and ensure that instructions are executed in the most efficient order. Frequently accessed operands are allocated to CPU registers, so that the number of accesses to cache and main

memory is minimized. Instructions are scheduled such that the efficiency of the instruction pipeline is maximized. For example, compilers schedule instructions so that the available cycle after a taken branch is utilized for useful processing, and they overlap other instructions with Load instructions to keep execution rates close to one cycle per instruction.

Millicode

The 900 Series systems utilize "millicode" routines to perform some of the more frequently executed complex tasks. Millicode routines, quite simply, are sequences of HPPA instructions that can be accessed and executed very efficiently by MPE XL, and provide complex functions such as moving characters, etc. These performance-tuned millicode routines ensure effective support of complex functions sometimes required by high-level languages.

Extensive Data and Code Protection Mechanism

HPPA specifies a four-level privilege scheme for all code, data, and I/O accesses. This is supplemented by a 15-bit Protection Identifier that is assigned to each virtual page and checked each time the page is accessed. The flexibility of this scheme allows for efficient data and code sharing and ensures a high level of data and code security from unauthorized accesses.

A Closer Look at HP Precision Architecture

Additional details of HPPA are provided below. For further information, refer to the "HP Precision Architecture Data Sheet."

Instruction Set

HPPA defines 140 instructions. Each is 32 bits long and has a fixed format. To minimize complexity and to enable the machine to be cycled as quickly as possible, the instruction set directly supports only simple functions. Nonetheless, some of the HPPA instructions provide functions that typically would require multiple instructions on conventional system. For example, the Add and Branch instruction performs a calculation and a conditional branch in a single cycle. Such a function on conventional systems typically requires multiple instructions.

Floating-Point Instructions

Floating-point calculations are specified by compilers for any high-level language variables declared by the programmer as "real" numbers. In particular, engineering, scientific, and statistical applications often utilize floating-point data types. HPPA supports single-precision (32-bit), double-precision (64-bit), and quadruple-precision (128-bit) arithmetic operations. Floating-point calculations can be performed in software by a sequence of integer calculations and conversions, but they can be executed much faster by floating-point coprocessor hardware. With a floating-point coprocessor, floating-point calculations can be performed while the CPU continues to execute in parallel, thus allowing HPPA to provide high performance in applications that use floating-point calculations.

Data Types

HPPA supports 16-bit and 32-bit integers, either signed or unsigned. Characters are stored as 8-bit quantities, conforming to the ASCII standard for values 0 through 127, and HP's 8-bit extended Roman 8 character set for values 128 through 255. HPPA supports both packed and unpacked decimal data representations. Single, double, and quadruple-word floating-point operands are represented in accordance with the ANSI/IEEE 754 1985 standard.

CPU Register Set

There are 32 available general-purpose registers, each 32 bits wide, for holding operands and results of processor computations. Additionally, a total of 32 control and status registers are available in the CPU for interrupt processing, virtual memory access protection, and other system functions. CPU status is maintained in the 32-bit Processor Status Word (PSW), which reflects the state of key CPU flags and status bits.

Two CPU registers are used to point to the next instruction to be executed. The Instruction Address Space Register (IA Space) points to the 4 Gb space that holds the next instruction. The Instruction Address Offset Register (IA Offset) points to the location, within that space, that holds the instruction.

Virtual Memory

Virtual memory allows the programmer to use a memory space that is actually many times larger than the physical memory installed in the system. The advantage of a virtual memory scheme is that a programmer generally does not have to be concerned about limitations in available memory space. The huge virtual address space available on the 900 Series systems is fully supported by the MPE XL operating system.

Virtual memory is organized as a set of linear regions called "spaces," with each space 4 Gb in length. Spaces are further divided into fixed-length, 2 Kb pages, which can hold either code or data. Space registers hold either 16 bits (for 48-bit addressing) or 32 bits (for 64-bit addressing), and they are used to point to the virtual space to be accessed. The specific location within that space is specified by a 32-bit quantity called the byte offset. With eight space registers available in the CPU, simultaneous multiple spaces can be supported.

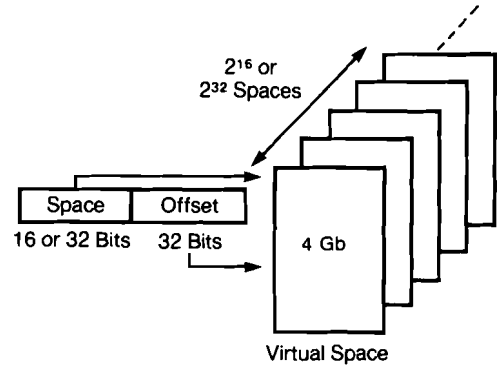


Figure 4-6. Virtual Memory Organization

Virtual Address Translation

The 48-bit or 64-bit virtual address generated by the processor must be translated into a physical address that will be transmitted to physical memory to access the desired code or data. Virtual addresses are translated by physical addresses by Translation Lookaside Buffer (TLB) hardware in the processor. Conceptually, the TLB can be thought of as a table containing translations for recently accessed virtual pages.

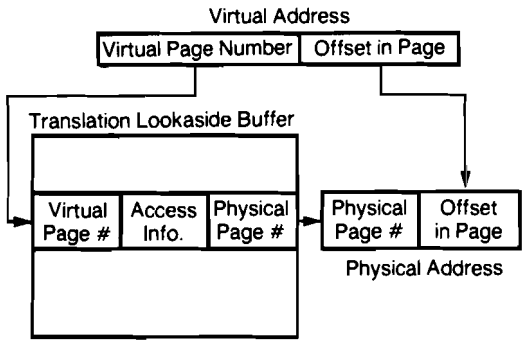


Figure 4-7. Virtual Address Translation

Virtual Memory Access Protection

The TLB hardware supports protection mechanisms to ensure that the currently executing process can perform only the code, data, or I/O accesses for which it is authorized. Included in the access checking mechanisms are four privilege levels. Protection parameters associated with each page define what privilege level is required to access that page and what types of accesses are permitted. For each requested access, these privilege parameters are checked against the privilege level of the currently executing process to ensure that the process has sufficient authorization to perform that access. Additionally, within each protection access level, there is a 15-bit protection identifier associated with each page. This identifier, maintained by the operating system and checked by the TLB hardware, provides the flexibility for data and code sharing while providing a high level of protection against unauthorized accesses.

Instruction Set Listing

Memory Reference Instructions

Load Word
Load Halfword
Load Byte
Load Word Indexed
Load Halfword Indexed
Load Byte Indexed
Load Word Short
Load Halfword Short
Load Byte Short
Load Word and Modify
Load Word Absolute
Load Word Absolute Short
Load Offset
Load and Clear Word Indexed
Load and Clear Word Short
Store Word
Store Halfword
Store Byte
Store Word Short
Store Halfword Short
Store Byte Short
Store Word and Modify
Store Word Absolute Short
Store Bytes Short

Unconditional Branches

Branch and Link
Gateway
Branch and Link Register
Branch Vectored
Branch External
Branch and Link External

Conditional Branches

Move and Branch
Move Immediate and Branch
Compare and Branch if True
Compare and Branch if False
Compare Immediate and Branch if True
Compare Immediate and Branch if False
Add and Branch if True
Add and Branch if False
Add Immediate and Branch if True
Add Immediate and Branch if False
Branch on Variable Bit
Branch on Bit

Arithmetic/Logical Instructions

Add
Add Immediate
Add Immediate Left
Load Immediate Left
Add Logical
Add and Trap on Overflow
Shift One and Add
Shift Two and Add
Shift Three and Add
Shift One and Add Logical
Shift Three and Add Logical
Shift One, Add, and Trap on Overflow
Shift Two, Add, and Trap on Overflow
Shift Three, Add, and Trap on Overflow
Add with Carry
Add with Carry and Trap on Overflow
Subtract
Subtract from Immediate
Subtract and Trap on Overflow
Subtract Immediate and Trap on Overflow
Subtract with Borrow
Subtract with Borrow and Trap on Overflow
Subtract and Trap on Condition
Subtract and Trap on Condition or Overflow
Inclusive OR
Exclusive OR
AND
AND Complement
Unit XOR
Unit Add Complement
Unit Add Complement and Trap on Condition
Decimal Correct
Intermediate Decimal Correct
Add Immediate and Trap on Overflow
Add Immediate and Trap on Condition
Add Immediate, Trap on Condition or Overflow
Compare Immediate and Clear
Variable Shift Double
Shift Double
Variable Extract Signed
Variable Extract Unsigned
Extract Signed
Variable Deposit
Variable Deposit Immediate
Deposit
Deposit Immediate
Zero and Variable Deposit
Zero and Variable Deposit Immediate
Zero and Deposit
Zero and Deposit Immediate
Divide Step
Compare and Clear

System Control Instructions

Break
Return from Interrupt
Set System Mask
Load Hash Address
Purge Instruction TLB
Purge Instruction TLB Entry

Reset System Mask
Load Space ID
Move to Space Register
Move to Control Register
Move from Space Register
Move from Control Register
Move to System Mask
Synchronize Caches
Probe Read Access
Probe Read Access Immediate
Probe Write Access
Probe Write Access Immediate
Load Physical Address
Purge Data TLB
Purge Data TLB Entry
Insert Data TLB Address
Insert Data TLB Protection
Insert Instruction TLB Address
Insert Instruction TLB Protection
Purge Data Cache
Flush Data Cache
Flush Instruction Cache
Flush Data Cache Entry
Flush Instruction Cache Entry
Diagnose

Special Function Unit Operations

Special Operation Zero
Special Operation One
Special Operation Two
Special Operation Three

Coprocessor Loads and Stores

Coprocessor Load Word Short
Coprocessor Load Word Indexed
Coprocessor Load Doubleword Short
Coprocessor Load Doubleword Indexed
Coprocessor Store Indexed
Coprocessor Store Doubleword
Coprocessor Store Doubleword Indexed
Coprocessor Operation[1]
Coprocessor Store Word

[1] Floating-Point Operations Included

5

HP 3000 Hardware Overview

Introduction

The HP 3000 family of computers spans a broad range of capabilities and capacities, from the entry-level MICRO 3000LX to the top-of-the-line Series 955. The following table will help you compare systems and find the one that best fits your needs.

	Micro 3000LX	Micro 3000GX	Micro 3000XE	Series 70	Series 925LX	Series 925	Series 935	Series 950	Series 955
Operating System	MPE V	MPE V	MPE V	MPE V	MPE XL	MPE XL	MPE XL	MPE XL	MPE XL
Processor Technology	NMOS VLSI	NMOS VLSI	NMOS VLSI	ECL MSI	NMOS VLSI	NMOS VLSI	NMOS VLSI	NMOS VLSI	NMOS VLSI
Main Memory (min./max.)	2/4 Mb	2/4 Mb	2/8 Mb	8/16 Mb	24/96 Mb	32/96 Mb	48/96 Mb	64/128 Mb	64/128 Mb
CPU Cache	NA	NA	128 Kb	128 Kb	16 Kb	16 Kb	128 Kb	128 Kb	256 Kb
Max. Workstations	8	16	56	400	40	152	240	400	>400
Typical # Users	2-8	6-16	12-30	50-120	16-32	32-75	60-150	75-200	120-300
Max. Disc Storage	304 Mb	2.0 Gb	4.5 Gb	13.7 Gb	4.5 Gb	9.1 Gb	13.7 Gb	17.1 Gb	>17.1 Gb
Max. Tape Drives	1	4	4	8	4	4	4	8	8
Max. System Printers	NA	2	4	10	4	4	6	8	8
Max. Serial Printers	1	3	8	16	8	8	16	32	>32

Figure 5-1. HP 3000 System Comparison

MICRO 3000LX/GX

HP's MICRO 3000LX and 3000GX computers are complete, entry-level business systems that deliver exceptional performance for departmental, distributed branch office, and small business applications. They bring the power of transaction processing, text and graphics processing, data communication, and data management to the office in a small, unobtrusive package.

The MICRO 3000LX is a low-cost system for up to eight users, while the MICRO 3000GX supports up to 16 users with extended data storage and I/O options.

Based on proprietary NMOS III VLSI technology, the MICRO 3000 computers feature outstanding system performance, reliability, and data protection. The MICRO 3000 computers have a friendly, menu-driven user interface that simplifies the use of the system. State-of-the-art powerfail/autorecovery capability protects your data and minimizes downtime. Software compatibility preserves your software investment by providing a smooth, conversion-free growth path to larger HP 3000s, including HP's new Precision Architecture (HPPA). With low operating, maintenance, and personnel requirements, the MICRO 3000 is a system that is affordable today and tomorrow.

Features:

- High-performance MPE V operating system
- Disc caching provided through virtual memory
- 113-ns system clock cycle
- Compact, quiet design for the office
- One-step startup
- System completely factory integrated including disc, cartridge tape, operating system, and console
- Power fail recovery; 15-minute battery backup of system memory with automatic system recovery when power resumes
- High-speed bus on processor board; backplane bus for connection to terminals and Local Area Networks (LANs)
- One synchronous line for system-to-system communication. Asynchronous system-to-system communication via Reliable Asynchronous System Protocol (RASP) software. One LAN (ThinLAN) for system-to-system and local worktation communication. HP StarLAN is also supported for PC connection.
- Network database standard; relational database supported
- AdvanceNet networking solution
- Compatible upgrade path for future growth

Configuration maximums:

- Memory: 2 Mb standard; 4 Mb maximum
- Users: 3000LX: 5 point-to-point standard (4 modem-capable), maximum of 8 point-to-point (4 modem-capable)
  3000GX: 8 point-to-point standard (4 modem-capable), maximum of 16 point-to-point (8 modem-capable)

Figure 5-2. The MICRO 3000GX

▪ Discs:	3000LX:	One 81-, 152-, or 304-Mb internal disc drive
	3000GX:	One or two 152- or 304-Mb internal disc drives. Also supports 81-, 152-, 304-, 307-, and 571-Mb disc drives up to a maximum of four drives on the system. Maximum 2.0 Gb storage
▪ Tape drives:	3000LX:	67-Mb cartridge tape drive standard
	3000GX:	67-Mb cartridge tape drive standard. Supports a maximum of 4 tape drives, including external cartridge tape drive, cartridge tape autochanger, 1600- and 1600/6250-bpi tape drive
▪ System printers:	3000GX	Supports up to 2 system printers (3000LX does not support a system printer)
▪ Serial printers:	3000LX	Supports 1 serial printer
	3000GX	Supports up to 3 serial printers

System Organization

The MICRO 3000LX and 3000GX take an NMOS III VLSI CPU chip and new 1-Mbit RAM technology and combine them with a VLSI version of the Peripheral Interface Controller (PIC) on a single system processor board. Both 2- and 4-Mb versions of this combined CPU, memory, and I/O board are available. In addition to lower cost and higher reliability, this new board provides an extra I/O slot for system expansion.

These elements communicate through the Synchronous Inter-Module Bus (SIMB). The SIMB interface section is used to transfer information between the high-speed SIMB and the lower-speed backplane SIMB.

Interactive terminals are attached through the Advanced Terminal Processor Model M (ATP/M), which is connected to the backplane. External peripherals are attached through the PIC. Data communication links are established via Intelligent Network Processors (INPs) or a Local Area Network Interface Channel (LANIC).

(See Figure 5-4 for a diagram of the system organization.)

MICRO 3000LX/GX Processor

At the heart of these new systems is an NMOS III VLSI processor chip. This is the same hardware technology used in several 900 Series products and delivers both high performance and high reliability. In fact, the CPU chip of the MICRO 3000 systems is the most dense NMOS III chip HP has ever developed.

The chip comprises the CPU, 2000 words of control store (for the most frequently executed microcode routines and boot code), a 256-word register file, bank registers, Power Supply Monitor (PSM), and a miscellaneous maintenance block.

The external support circuitry consists of the system clock generation circuitry, the Time-of-Century (TOC) clock, a maintenance panel interface, a special 8-volt power supply for the MICRO 3000 processor chip, 8000 words of "slow" Writable Control Store (WCS), and an additional 8000 words of EPROM microcode storage.

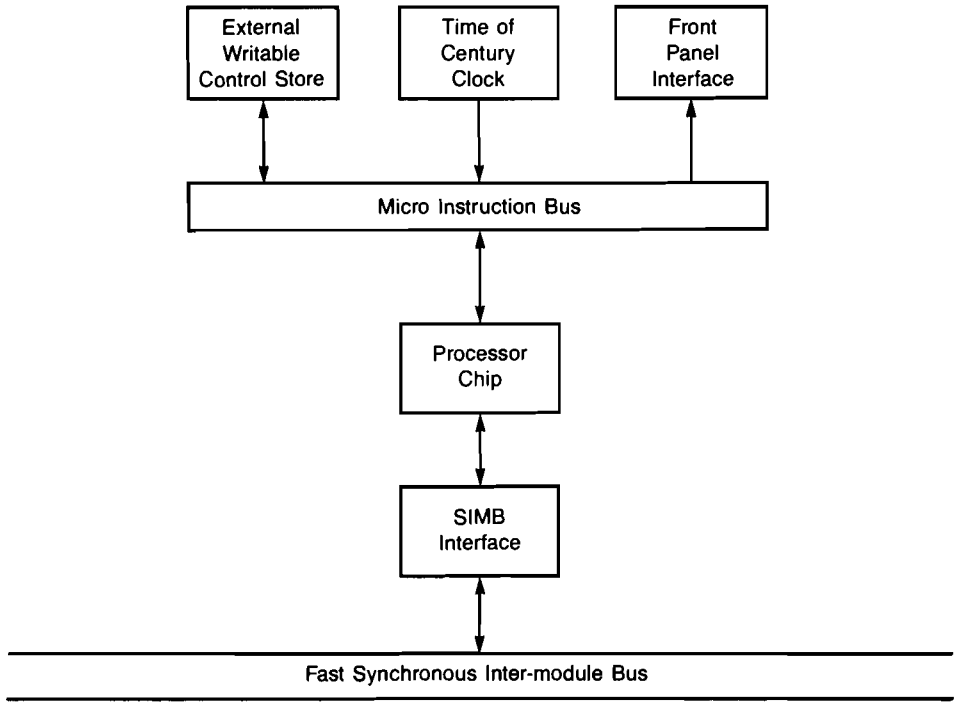


Figure 5-3. The MICRO 3000GX Processor

Memory Subsystem

The memory subsystem of the MICRO 3000LX and 3000GX uses high-density, 1-Mbit RAM technology that, coupled with the VLSI implementations, allows memory, the CPU, and the PIC to be mounted on a single board. Data can be passed between the CPU and memory at a high speed using the 113-ns bus on the CPU board.

The 3000LX and 3000GX come with 2 Mb of memory standard, and they can be upgraded to 4 Mb at the time of purchase or later, in the field.

Subsystems

Buses

The MICRO 3000LX and 3000GX use a high-speed Synchronous Inter-Module Bus (SIMB) on the processor board to connect the CPU, memory, and the PIC. This on-board bus operates at 113 ns. A second SIMB (called the backplane SIMB, operating at 226 ns) serves as the connection to networks and to peripherals such as terminals and printers.

An SIMB interface on the processor board buffers data between the high-speed and low-speed SIMBs.

Peripheral Interface Controller

The Peripheral Interface Controller (PIC) is a hardware input/output channel. The PIC interfaces with the SIMB. It provides the interface necessary to control and communicate with the HP-IB peripherals. The channel is controlled by standard I/O instructions or by the execution of channel programs.

On the MICRO 3000LX and GX, the PIC, which uses VLSI components, is mounted on the CPU board. Only one PIC is supported on the MICRO 3000LX

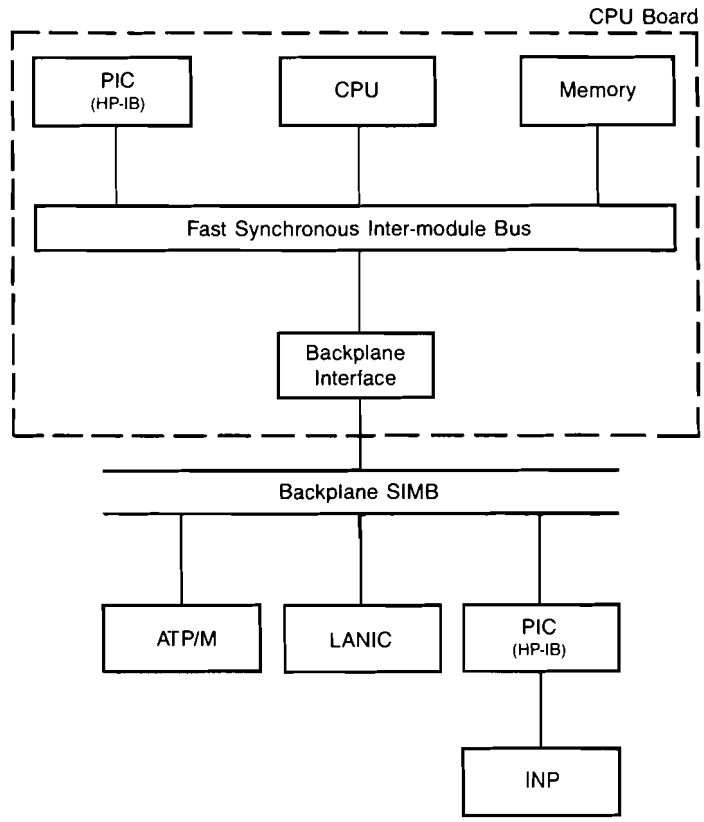


Figure 5-4. MICRO 3000GX System Structure

and GX. The circuitry consists of two main blocks, the actual Interface Controller Chip (ICC) and the HP-IB interface. On the MICRO 3000GX, up to six HP-IB devices with I/O channel programs can be supported on a PIC.

Peripheral Connections

Integrated peripherals on the MICRO 3000LX -- cartridge tape and disc -- are connected with the internal PIC. (The MICRO 3000LX does not offer external HP-IB connections.) Other than the workstations connected via RS-232 or LAN, no other external peripherals can be connected to the 3000LX. All printers must be serial RS-232 connections.

The 3000GX does provide external connections to HP-IB devices. Discs, tapes and printers are connected via the PIC channel, which supports the 8-bit-wide IEEE-488 standard HP-IB. The PIC supports a maximum of six devices.

Workstation and Serial Connections

The MICRO 3000LX comes standard with 5 port connections (4 modem 25-pin connections, 1 direct 25-pin connection) and can be upgraded to 8 connections. The interface between the system and terminals is the ATP/M. The 3000LX supports only one ATP/M, which has a maximum of 8 ports. The 3000LX also supports personal computer connections over a LAN or HP StarLAN. With a maximum of 8 RS-232 connections and up to 30 connections over the LAN, the 3000LX can support a maximum of 38 workstations.

The MICRO 3000GX comes with 8 ports (4 modem 25-pin connections, 4 direct connections) and can be expanded to 16 ports. It can use two ATP/M boards. The 3000GX also supports personal computer connections over a LAN or

HP StarLAN. With a maximum of 16 terminals connected to ATP/M boards and 30 connected on a LAN, the 3000GX can support up to 46 workstations.

System-to-System Data Communication

Both MICRO 3000LX and 3000GX support local and wide area networks simultaneously. The 3000LX and 3000GX handle one wide area connection and one local area connection.

AdvanceNet-compatible local HP 3000-to-HP 3000 communication is supported via the LAN, with available services including Network File Transfer, Remote File Access, Virtual Terminal, and Remote Data Base Access to TurboIMAGE databases.

Environmental Specifications

▪ Line voltage frequency (nominal):	100-120 VAC (47-63 Hz) 200-240 VAC (47-63 Hz)
▪ Input voltage tolerance:	± 10% from nominal
▪ Input current:	4 amps @ 100-120 VAC, 50-60 Hz 2.5 amps @ 200-240 VAC, 50-60 Hz
▪ Heat dissipation, max.:	1450 BTU/hr
▪ Physical dimensions (system cabinet):	
- Height:	609 mm (24 in)
- Width (top):	212 mm (8.4 in)
- Width (base):	360 mm (14.2 in)
- Depth:	539 mm (21.2 in)
- Weight	16 Kg (80 lbs), 18.6 Kg (93 lbs) with cabinet
▪ Operating temperature, system:	5-40°C (40-104°F)
▪ Relative humidity, system (operating):	20-80% (non-condensing)
▪ Altitude (operating):	Up to 4572 m (15,000 ft)
▪ Battery backup time, min.:	15 minutes
▪ Acoustics (inc. system cabinet):	5.5 Bels sound power (A)

MICRO 3000XE

HP's MICRO 3000XE combines expandability with performance to provide an interactive business system that is ideal for departmental, distributed branch office, and business applications. It brings the power of concurrent transaction processing, word processing, batch processing, data management, data communication, and program development to the office environment. Providing greater workstation, memory, and data communication support than the MICRO 3000LX and 3000GX, its powerful capabilities make the MICRO 3000XE the right choice for expanding distributed processing networks and for meeting the single computer needs of the growing branch office or small/medium business.

Software compatibility preserves your software investment by providing a smooth and conversion-free growth path to larger HP 3000 systems. In addition, the MICRO 3000XE is available as a cost-effective board-swap field upgrade from existing HP 3000 Series 37 systems.

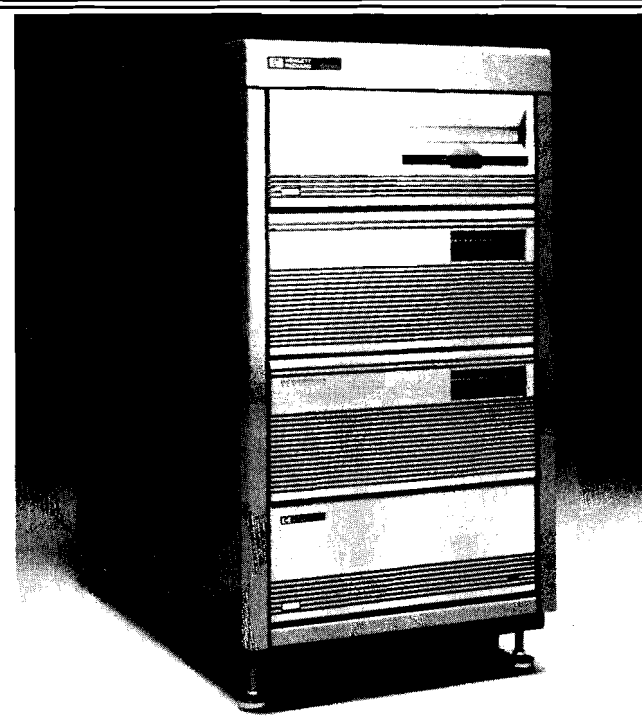


Figure 5-5. The MICRO 3000XE

Features:

- High-performance MPE V operating system
- 128-Kb memory cache
- 117-ns system clock cycle
- Compact, quiet design for the office
- Power-fail recovery; 15-minute battery backup of system memory with automatic system recovery when power resumes
- Single-bus structure
- Up to three synchronous lines for system-to-system communication plus one Local Area Network (LAN) for system-to-system and local workstation communication. HP StarLAN is also supported for local PC connections.
- Network database standard; relational database supported
- AdvanceNet networking solution
- Compatible upgrade path for future growth

Configuration maximums:

▪ Memory:	2 Mb standard; expandable to 8 Mb in 2-Mb increments
▪ Users:	Up to 56 point-to-point (28 modem-capable)
▪ Discs:	Up to 8 disc drives, including support for 55-, 81-, 130-, 152-, 304-, 307-, 404-, and 571-Mb disc drives. Maximum of 4.5 Gb storage
▪ Tape drives:	Up to four 1/2" tape drives including support for 1600-, 800/1600-, and 1600/6250-bpi tape drives. Up to four 1/4" cartridge tape drives and up to two 1/4" tape cartridge autochangers

- System printers: Up to 4 system printers including support for 300-, 600-, 900-, and 1200-lpm printers and intelligent page printers
- Serial printers: Up to 8 serial printers including intelligent laser page printers, dot matrix, and daisywheel printers

System Organization

The MICRO 3000XE utilizes an NMOS III VLSI CPU chip combined with a 128-Kb memory cache on the CPU board. This board works in conjunction with a 2- or 4-Mb memory board and supports a maximum of 8 Mb of memory. Communication is accomplished through the Synchronous Inter-Module Bus (SIMB) for all necessary bus control and data transfers. The microinstruction cycle time on the MICRO 3000XE is 113 ns.

The system also includes a Time-of-Century (TOC) clock, MPE timer, status display, and four 16-bit bank registers.

(See Figure 5-7 for a diagram of the system structure.)

MICRO 3000XE Processor

At the heart of the MICRO 3000XE is an NMOS III VLSI processor chip. This is the same hardware technology used in several 900 Series systems and delivers both high performance and high reliability. In fact, the CPU chip of the MICRO 3000 systems is the most dense NMOS III chip HP has ever developed.

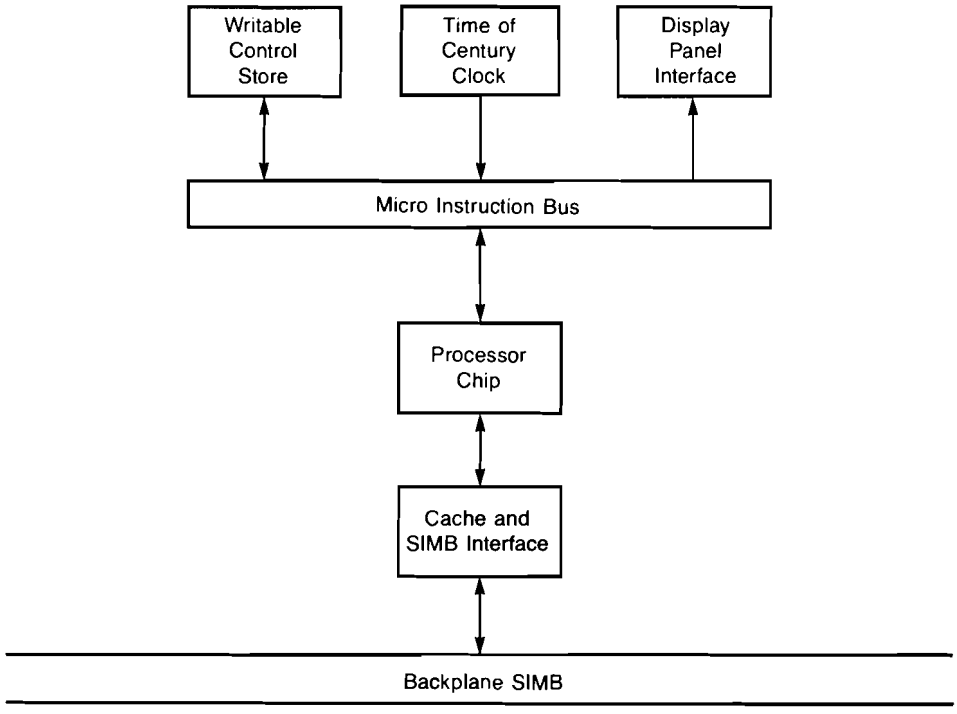


Figure 5-6. The MICRO 3000XE Processor

Cache

The MICRO 3000XE CPU board includes a 128-Kb memory cache. The use of high-speed CPU caches significantly increases system performance by minimizing accesses to main memory. Cache access can be up to five times faster than main memory access.

The system automatically moves into cache from main memory the code and data that are most likely to be required based upon a "locality" algorithm. As a result, the required code and data are found in cache almost all the time. An access to main memory needs to be made only in the event of a cache miss. Since the CPU usually finds the required code or data in the cache, relatively slow acceses to main memory are minimized.

Memory Subsystem

The MICRO 3000XE comes with 2 Mb standard memory but can be expanded to 8 Mb maximum in increments of 2 or 4 Mb. The system uses both 256-Kb RAM and advanced 1-Mbit DRAM to expand main memory capacity.

Error Correcting Code (ECC) memory is standard on the MICRO 3000XE. Single-bit errors are automatically detected and corrected to ensure data integrity. Multibit errors are automatically detected and a high-priority interrupt is sent to the system software for appropriate action.

Subsystems

Buses

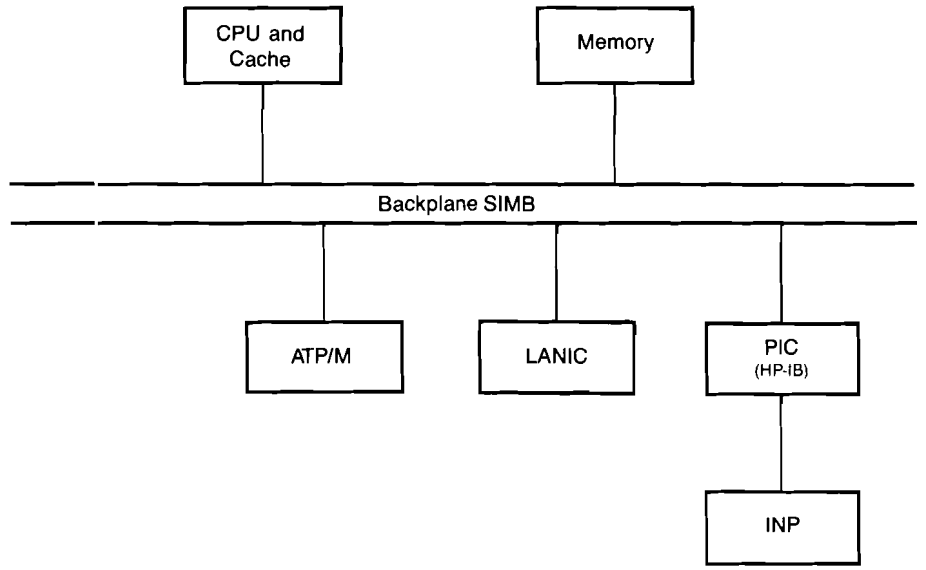


Figure 5-7. MICRO 3000XE System Structure

The MICRO 3000XE uses a single Synchronous Inter-Module Bus (SIMB) that operates at 170 ns. The SIMB is the backplane of the computer, into which all boards are plugged. This SIMB is the main communication vehicle for transferring data between the CPU/cache, memory, the HP-IB interface, Advanced Terminal Processors (ATPs), and Local Area Networks (LANs).

Peripheral Interface Controller

The Peripheral Interface Controller (PIC) is a hardware input/output channel. The PIC interfaces with the SIMB. It provides the interface necessary to control and communicate with the Hewlett-Packard Interface Bus (HP-IB) peripherals. The channel is controlled by standard I/O instructions or by the execution of channel programs. The PIC is made up of three main blocks: the SIMB interface logic, PIC control logic, and HP-IB interface logic. Up to six HP-IB devices with I/O channel programs can be supported on a PIC.

Peripheral Connections

Discs, tapes and printers are connected via the PIC channel, which supports the 8-bit-wide IEEE-488 standard HP-IB. The PIC supports a maximum of six devices. The 3000XE will support up to three PICs (when the second I/O bay is purchased).

Workstation and Serial Connections

The MICRO 3000XE will support up to 7 ATP/Ms with a maximum of 56 direct-connect ports, 28 of which are modem-capable. The 3000XE also supports PC connections over HP StarLAN or an 802.3 LAN.

System-to-System Data Communication

The MICRO 3000XE supports local and wide area networks simultaneously. It can handle one LAN and up to three Wide Area Networks (WANs).

AdvanceNet-compatible local HP 3000-to-HP 3000 communication is supported via the LAN, with available services including Network File Transfer, Remote File Access, Virtual Terminal, and Remote Data Base Access to TurboIMAGE databases.

Environmental Specifications

▪ Line voltage frequency (nominal):	100-120 VAC (47-63 Hz) 200-240 VAC (47-63 Hz)
▪ Input voltage tolerance:	±10% from nominal
▪ Input current:	6 amps @ 100-120 VAC, 50-60 Hz 4 amps @ 200-240 VAC, 50-60 Hz
▪ Heat dissipation, max.:	3278 BTU/hr
▪ Physical dimensions (system cabinet):	
- Height:	720 mm (29 in)
- Width:	375 mm (15 in)
- Depth:	711 mm (28.5 in)
- Weight	33 Kg (73 lbs)
▪ Operating temperature, system:	10-40°C (50-104°F)
▪ Relative humidity, system (operating):	20-80% (non-condensing) @ 40°C
▪ Altitude (operating):	Up to 4572 m (15,000 ft)
▪ Battery backup time, min.:	15 minutes
▪ Acoustics (inc. system cabinet):	5.6 Bels sound power (A)

Series 70

The HP 3000 Series 70 is the highest-performance MPE V-based system Hewlett-Packard offers. It is a full-function computer that provides the processing power and capabilities to handle a full range of EDP and distributed data processing applications. The tight integration of MPE V and TurboIMAGE with the hardware provides high performance for large departments, manufacturing plants, and regional headquarters.

The Series 70 can support up to 400 users, and the hardware design allows the user to expand the system as needs grow and applications change. The system software accommodates this growth by allowing additional hardware modules and peripheral devices to be configured easily on the system.

The Series 70 CPU uses an HP-designed microcoded processor with high-speed Emitter-Coupled Logic (ECL) technology.

Features:

- MPE V operating system
- Virtual memory for code
- Instructions are 8, 16, and 32 bits in length
- 128-Kb cache memory
- 75-ns microinstruction cycle time
- Multiple instruction execution
- Dual 16-bit Arithmetic Logic Units (ALUs)
- Power fail recovery; 15-minute battery backup of system memory with automatic system recovery when power resumes
- RS-232 and RS-422 terminal connection; supports IEEE 802.3 Local Area Network (LAN) and HP StarLAN PC connections
- Network database standard; relational database supported
- AdvanceNet networking solutions

Configuration maximums:

▪ Memory:	8 Mb standard, expandable to 16 Mb in 1- and 4-Mb increments
▪ Users:	Maximum of 400 per system
▪ Discs:	Supports maximum of 24 discs per system for maximum of 13.7 Gb of disc storage
▪ Tape drives:	Supports maximum of 8 per system
▪ System printers:	Supports maximum of 10 per system
▪ Serial printers:	Supports maximum of 16 per system
▪ Intelligent laser page printers:	Supports maximum of 2 per system

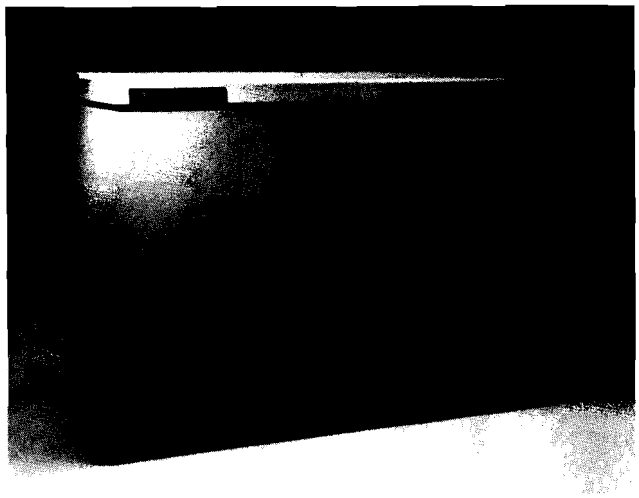


Figure 5-8. The Series 70

System Organization

The design of the Series 70 allows independent elements to be connected through a multiple-I/O bus structure. These elements include a CPU with dual Arithmetic Logic Units (ALUs), cache memory, main memory, I/O adapters, General I/O Channels (GICs), Advanced Terminal Processors (ATPs), Intelligent Network Processors (INPs), and LANs.

Communication between modules is accomplished with a high-speed Central System Bus and up to three Intermodule Buses (IMBs). Peripheral devices are connected to the system through the GICs. Interactive terminals are attached to the system through the ATP or INPs running the Multipoint Terminal Software. Data communication links are established via INPs or LANs.

The system also requires a system console, system display panel, and a Diagnostic Control Unit (DCU).

(See Figure 5-10 for a diagram of the system organization.)

Series 70 Processor

The CPU uses an HP-designed microcoded processor with high-speed ECL technology and dual ALUs.

Series 70 instructions are up to 32 bits long (except stack operation instructions, which are 8 bits long). Floating-point arithmetic can be performed in single precision (32 bits) or double precision (64 bits). Integer arithmetic can be performed in 16-bit and 32-bit lengths, and packed decimal instructions can be extended to 28 digits of precision.

The hardware processor consists of two ALUs, a shift register, specific-purpose registers, and related data manipulating and testing logic. A unique dual-ALU design is used to increase arithmetic processing power. The Series 70 CPU can perform two 16-bit or one 32-bit operation in a single CPU cycle. Performance is increased as fewer microinstruction cycles are required.

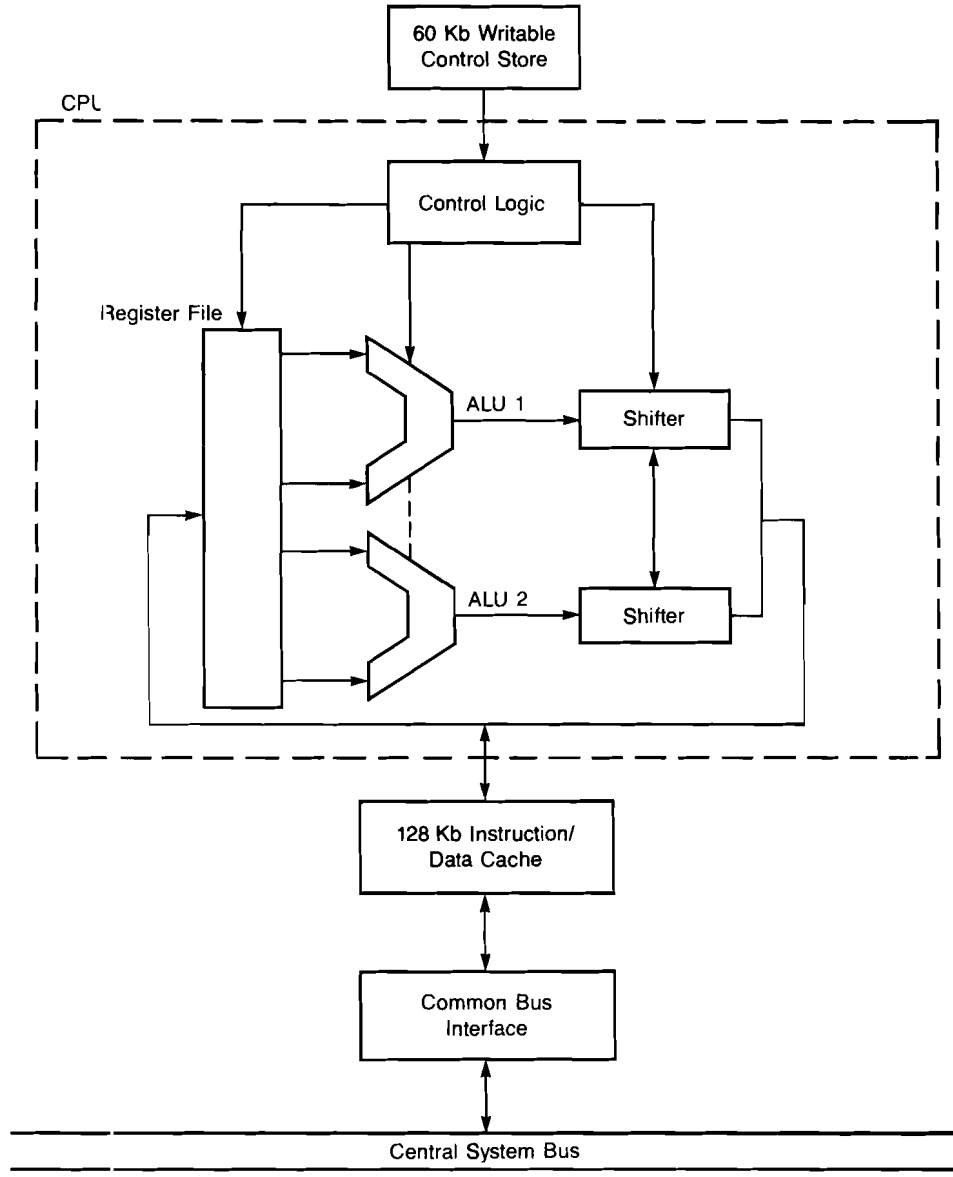


Figure 5-9. The Series 70 Processor

Cache

The Series 70 uses a hierarchical memory to reduce the time required to access memory. The hierarchical memory consists of a main memory module and a 128-Kb cache memory.

Cache memory supplies data to the CPU upon request. The cache, acting as a high-speed buffer between the CPU and main memory, increases system performance by decreasing memory access time.

Only a fraction of main memory can be in the cache at one time. On average, the CPU will find the word it needs in the cache 98 percent of the time. The other 2 percent of the time, the word will be in main memory, and the CPU will have to wait while it is read.

Data is transferred between cache and main memory in eight-word blocks. Since the CPU is likely to request adjacent words of main memory, this method reduces the number of times the CPU cannot find words in the cache.

Pipelining

The CPU uses instruction pipelining to improve throughput by overlapping operations. While one instruction is being executed, the next instruction is fetched and placed in the Next-Instruction Register (NIR). Upon completion of the current instruction, the contents of the NIR are loaded into the Current-Instruction Register (CIR) and the cycle is repeated. The microinstruction cycle time is 75 nanoseconds.

Memory Subsystem

The Series 70 uses high-speed RAM modules with automatic fault detection and correction. The memory subsystem can detect and log single-bit and double-bit errors and can correct single-bit errors. Main memory can be expanded from 8 Mb to 16 Mb in 1- or 4-Mb increments.

At any time, the latest updated copy of a block of memory may reside in main memory, in the I/O buffer of an Input/Output Adapter (IOA), or in cache memory. To ensure that the latest copy is accessed, cache memory and I/O buffers will supply data for a memory request if they have the latest updated copy.

Main memory has battery backup to ensure that information is maintained for a minimum of 15 minutes in the event of an interruption in AC power. This allows the operating system to be automatically restarted and processing to continue without data loss, upon resumption of power.

Subsystems

Buses

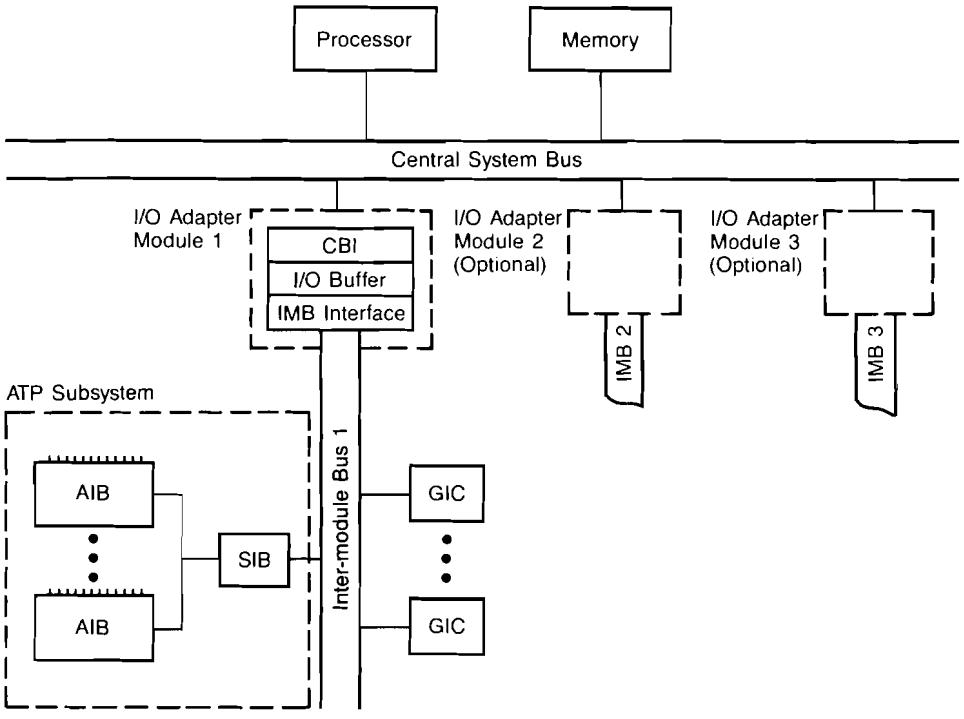


Figure 5-10. Series 70 System Structure

Central System Bus. The Central System Bus (CSB) is the communication link between the CPU Module, Main Memory Module, and IOAs. A 53-Mb per second bandwidth allows the CSB to support multiple Intermodule Buses (IMBs). No module has implied control over the CSB. Modules operate independently of each other except when it is necessary to transfer data or send commands. When this is necessary, the initiating module asks for and receives control of the CSB.

The Common Bus Interface (CBI) is the interface to the CSB. Each of the modules -- ICA, cache memory, and main memory -- requires a CBI to communicate across the CSB to another module.

Input/Output Adapters (IOAs) provide an interface between the CSB and IMBs to allow communication between the I/O system and the main memory and CPU. IOAs interface the slower IMB with the CSB. The IOA controls Direct Memory Access (DMA) between main memory, which is on the CSB, and I/O channels on the IMB. A 64-byte cache memory included with each IOA buffers communication between the 16-bit IMB and the 32-bit CSB.

Intermodule Bus. The Intermodule Bus (IMB) is the connection for terminals (via ATPs), peripherals (via GICs), and networks (via INPs).

General I/O Channel. The General I/O Channel (GIC) is the primary channel for communication between the CPU and I/O devices other than terminals. It provides the interface between the computer (via the IMB) and peripheral devices connected to the HP-IB. The GIC translates I/O commands from the CPU into the proper HP-IB protocol.

The GIC contains DMA hardware, which allows large records of data to be transferred at the maximum speed of the HP-IB (about 1 Mb per second).

Peripheral Connections

Discs, tapes and printers are connected via a GIC, which supports the 8-bit wide, IEEE-488 standard HP-IB. Each GIC supports up to eight HP-IB peripheral devices.

Workstation and Serial Connections

Connections for workstations, serial printers and other serial devices are provided via an RS-232 or RS-422 port through an ATP. In addition, personal computers may be connected through HP StarLAN or an IEEE 802.3 LAN.

System-to-System Data Communication

AdvanceNet compatible local HP 3000-to-HP 3000 communication is supported via the LAN, with available services including Network File Transfer, Remote File Access, Virtual Terminal, and Remote Data Base Access to TurboIMAGE databases.

The Series 70 also supports IBM communication, including SNA NRJE/IMF and Bisync RJE, MRJE and IMF, as well as remote HP 3000-to-HP 3000 communication.

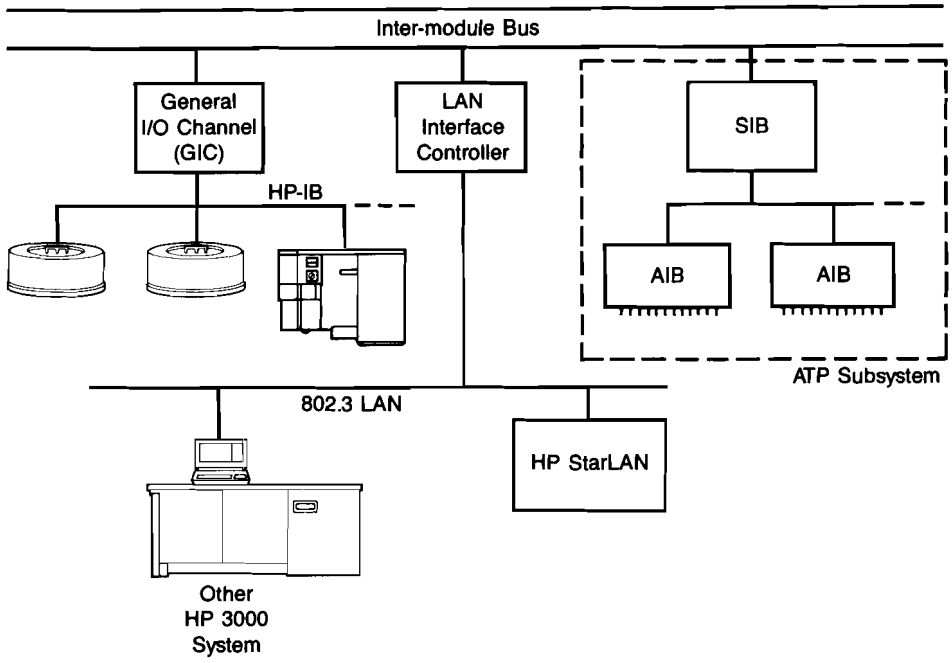


Figure 5-11. Series 70 I/O Attachments

Environmental Specifications

▪ AC input voltage (nominal):	208 VAC, three phase @ 60 Hz 380 VAC, three phase @ 50 Hz 415 VAC, three phase @ 50 Hz
▪ Input voltage tolerance:	±10% from nominal
▪ Input current:	24 amps @ 208 VAC 60 Hz 13 amps @ 380 VAC 50 Hz 12 amps @ 415 VAC 50 Hz
▪ Heat dissipation, max.:	12,871 BTU/hr
▪ Physical dimensions:	
- Height:	1219 mm (48.0 in)
- Width:	1753 mm (69.0 in)
- Depth:	660 mm (26.0 in)
- Weight	545.5 Kg (1200 lbs)
▪ Operating temperature, system:	15-30° C (59-86°F)
▪ Relative humidity, system (operating):	40-60% (non-condensing)
▪ Altitude (operating):	Up to 4572 m (15,000 ft)
▪ Battery backup time, min.:	15 minutes
▪ Acoustics:	<6.5 Bels sound power (A)

Series 925 and 935

The HP 3000 Series 925LX, 925, and 935 are mid-range members of the HP 3000 family of business computers. The Series 925 and 935 are based on HP Precision Architecture (HPPA) and use sophisticated NMOS III VLSI technology to deliver super-minicomputer performance in a surprisingly small size and low cost. The hardware performance of the Series 925 and 935, combined with the enhanced MPE XL operating system, provides excellent throughput and industry-leading price/performance in both transaction processing and batch data processing environments.

The Series 925LX is a low-cost entry-level version of the Series 925. The Series 925LX has the same packaging and performance as the Series 925, but supports fewer users. The Series 935 provides significantly higher performance and configurability than a Series 925. You can move easily from a Series 925LX to a Series 925, and finally to a Series 935.

The Series 925 and 935 are available in a compact, attractive cabinet with the capacity to rack mount an entire entry-level system. They can also be easily expanded to handle larger terminal and disc configurations. The Series 925 and 935 are highly reliable, due to their low number of parts, and do not require a special computer room environment, making them the ideal computing systems for small- to medium-size businesses, departments, and remote office locations. And they are backed by the high standards of quality and support for which the HP 3000 is known.

Features:

- MPE XL operating system
- Single-chip VLSI CPU. 3.2 MIPS (925) or 6.0 MIPS (935) CPU performance
- HP Precision Architecture
- 48-bit virtual addressing
- High-speed CPU cache, 16 Kb (925) or 128 Kb (935)
- Instruction cycle time 80 ns (925); 67 ns (935)
- Advanced instruction pipelining techniques
- Floating-Point Coprocessor
- Translation Lookaside Buffer (TLB) for virtual-to-physical address translation, 2048 entry (925); 4096 entry (935)
- Battery backup and auto-restart standard
- Terminal connection via IEEE 802.3 Local Area Network (LAN). HP StarLAN is also supported.
- Network and relational database management systems standard
- AdvanceNet networking solutions
- Low power and cooling requirements, compact packaging

Configuration maximums:

▪ Memory:	925LX	24 Mb standard, expandable to 96 Mb in 8- and 16-Mb increments
	925	32 Mb standard, expandable to 96 Mb in 8- and 16-Mb increments
	935	48 Mb standard, expandable to 96 Mb in 8- and 16-Mb increments
▪ Users:	925LX	Maximum of 32 per system
	925	Maximum of 152 per system
	935	Maximum of 240 per system
▪ Discs:	925LX	Maximum of 8 discs, 4.5 Gb of disc storage
	925	Maximum of 16 discs, 9.1 Gb of disc storage
	935	Maximum of 24 discs, 13.7 Gb of disc storage
▪ Tape drives:	925LX	Maximum of 4
	925	Maximum of 4
	935	Maximum of 4
		All support 1600/800- and 6250/1600-bpi tape drives, 1/2 inch

▪ System line printers:	925LX	Maximum of 4
	925	Maximum of 4
	935	Maximum of 6
		All support 600- and 900-lpm printers
▪ Remote serial printers:	925LX	Maximum of 8
	925	Maximum of 8
	935	Maximum of 32
		All support laser and dot matrix printers
▪ Intelligent laser page printers:		Maximum of 4 per system
		All support 12- and 45-ppm printers
▪ I/O channel multiplexers:	925LX	Maximum of 1
	925	Maximum of 2 (1 standard)
	935	Maximum of 2 (1 standard)

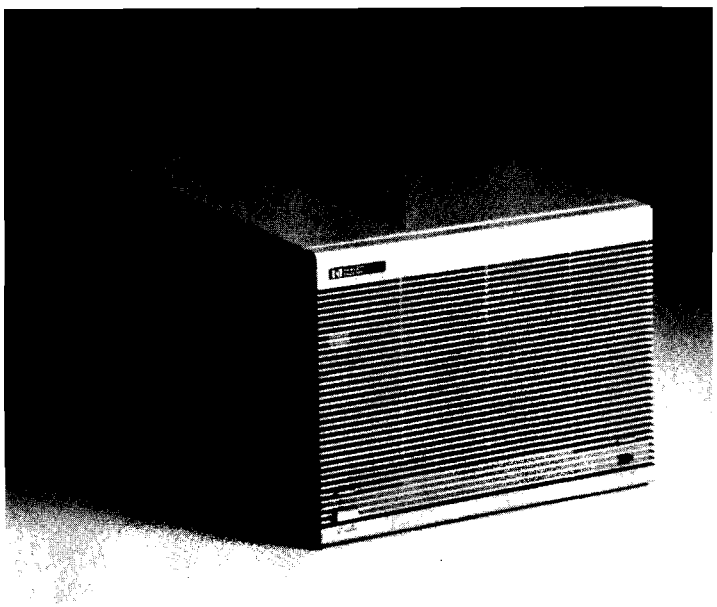


Figure 5-12. The Series 925

System Organization

The processor communicates with memory and I/O via the Central Bus (CTB). The CTB provides a 32-bit data path and can support data transfer rates of up to 20 Mb per second on the Series 925 and over 22 Mb per second on the Series 935. The CTB is interfaced to a separate 16-bit-wide Channel I/O Bus (CIB) via a Channel I/O Bus Adapter (or Channel Adapter, for short). The CIB supports I/O interfaces to peripheral devices and data communication links.

(See Figure 5-16 for a diagram of the system organization.)

Series 925 and 935 Processor

The Series 925 and 935 processor is a single-chip CPU implemented with NMOS III VLSI logic.

The Series 925 system processor is contained on a single compact board that includes a CPU, a TLB Control Unit (TCU), two Cache Control Units (CCUs), a System Interface Unit (SIU), and a Math Interface Unit (MIU). A second board, the system board, contains the Floating-Point Coprocessor and the Channel Adapters.

On the Series 935, the Floating-Point Coprocessor is located on the processor board, and there are two Channel Adapters on the system board.

With hardwired control, the Series 925 is capable of executing one instruction with every 80-ns instruction cycle, while the Series 935 can execute one instruction with every 67-ns instruction cycle. Separate Instruction and Execution Units facilitate pipelining and allow for efficient, parallel use of processor resources.

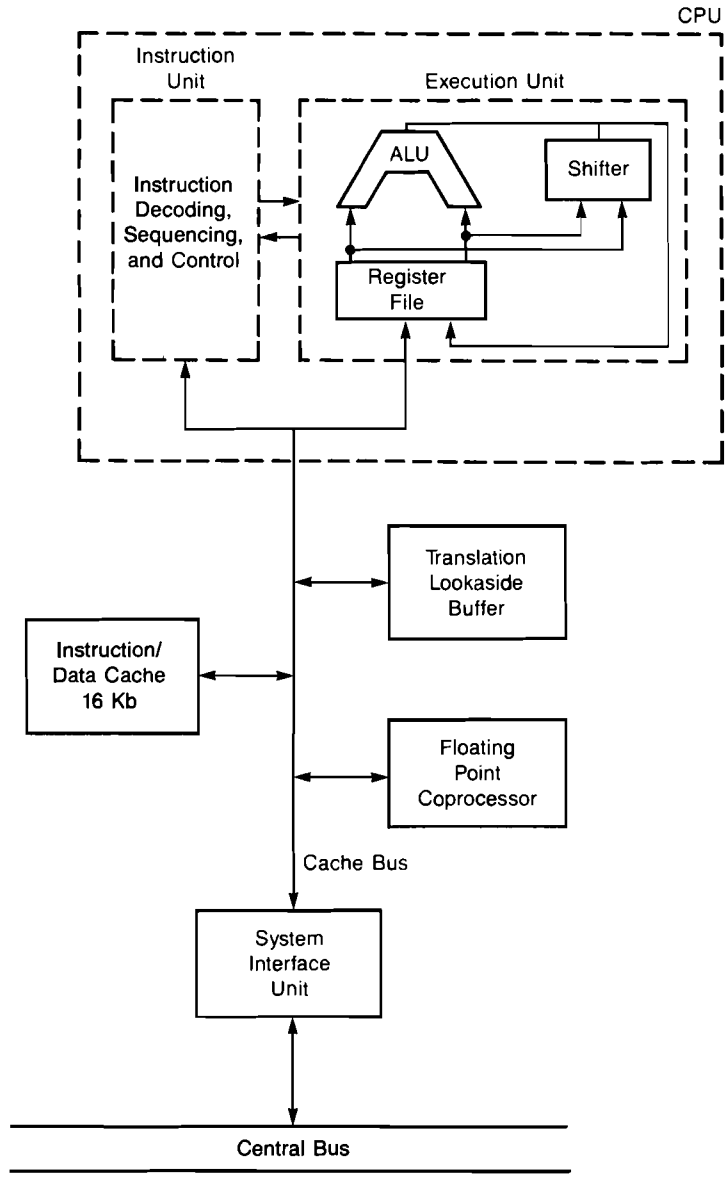


Figure 5-13. The Series 925 Processor

Cache

The use of high-speed CPU caches significantly increases system performance by minimizing accesses to main memory. Cache access can be up to an order of magnitude faster than accesses to main memory.

The system automatically moves into cache from main memory the code and data that are most likely to be required based upon a "locality" algorithm. As a result, the required code and data are found in cache almost all the time. An access to main memory needs to be made only in the event of a cache miss. Since the CPU usually finds the required code or data in the cache, relatively slow accesses to main memory are minimized.

One of the primary differences between the Series 925 and 935 is the size of their caches. The Series 925 has a 16-Kb cache, while the Series 935 has a 128-Kb cache to provide higher performance and support for more users.

Both the Series 925 and 935 employ a combined cache for code and data that is two-way associative (direct mapped). The Series 925 cache is organized in sets of 516 cache lines; the Series 935 is organized as sets of 4096 cache lines. In both cases, the cache lines are 32 bytes each. Modified data in the cache is written to main memory only when the processor requires other data to be in that cache location, when a Direct Memory Access (DMA) operation is performed within that data area, or upon a power failure.

Pipelining

Separate Instruction and Execution Units help facilitate instruction pipelining and provide efficient, parallel use of processor resources.

The Instruction Unit controls instruction sequencing. It fetches instructions from the instruction cache and stores them in the Instruction Register. The Instruction Unit executes branch instructions, maintains processor status, and handles traps and interrupts. It also generates the system's master clock.

The Execution Unit executes all instructions requiring data manipulation. It contains the ALU and barrel shifter, which together perform arithmetic, logical, shift, extract and deposit instructions. The Execution Unit contains 32 general-purpose registers, which store the results of these operations.

The Series 925 and 935 use a three-stage instruction pipeline so that up to three machine instructions can be operated on simultaneously. Each stage is a CPU cycle. While one instruction is fetched, another instruction is executed, and the result of a third instruction is stored. The net effect is that, except for penalties such as cache misses (which occur infrequently), *one instruction completes (exits the pipeline) every CPU cycle.*

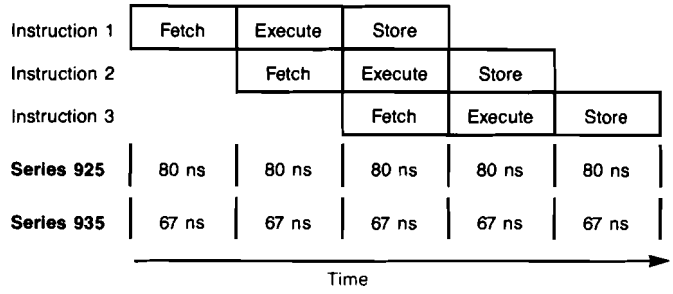


Figure 5-14. Instruction Pipelining

Floating-Point Coprocessor

For scientific, engineering and statistical applications that require high performance in floating-point calculations, the Series 925 and 935 come equipped with a coprocessor that significantly accelerates floating-point calculations.

The Floating-Point Coprocessor supports single (32 bit) and double (64 bit) precision floating-point operands of the ANSI/IEEE 754-1985 standard. The Floating-Point Coprocessor and the CPU operate in parallel, with the CPU performing integer calculations and other functions while the coprocessor performs floating-point calculations. This parallel operation helps provide a high level of performance for applications that use floating-point calculations.

On the Series 925, the Floating-Point Coprocessor consists of three HP proprietary NMOS III VLSI chips attached to the CPU's processor interconnect bus. The Series 935 Floating-Point Coprocessor is implemented on two ECL VLSI chips, which provide much faster floating-point performance than the Series 925.

Virtual Memory Management

Virtual addresses on the Series 925 and 935 are 48 bits in length, ensuring sufficient expandability to meet growing software needs. Virtual Memory is divided into a set of 65,536 spaces, with each space 4 Gb in length. Spaces are further divided into fixed-length, 2-Kb pages, with a given page holding data, code, or both. A single data structure can be up to 1 Gb in length, and code can span multiple spaces.

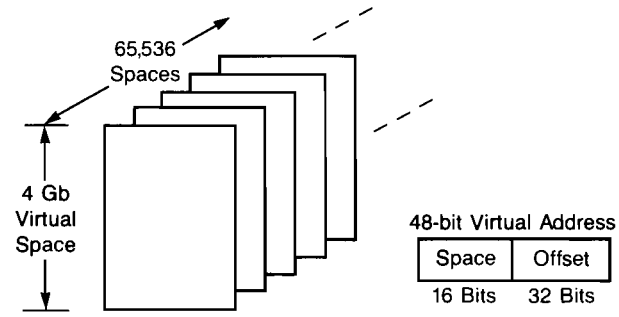


Figure 5-15. Virtual Memory Organization

Virtual Address Translation

Since the processor generates 48-bit virtual addresses, and memory access is via 28-bit physical (real) addresses, virtual-to-physical address translation is required. A high-speed RAM buffer called the Translation Lookaside Buffer (TLB) optimizes this task. The TLB can be considered to be a table that holds the most recently referenced virtual addresses and their corresponding physical addresses. The Series 925 TLB holds addresses for 2048 virtual pages, while the Series 935 TLB holds addresses for 4096 virtual pages. In both cases, the TLB pages are equally divided between instructions and data.

Memory is divided into 2-Kb pages, with access protection provided at the page level for all code, data and I/O access. When a virtual-to-physical address translation occurs, the TLB checks whether the executing process can access the page and, if so, what type of access is allowed (read, write, execute, etc.).

If the address is not in the TLB, a hashing scheme is used to find the required code or data in main memory. If the instruction or data is on a page that is not in main memory, then a page fault occurs and the required page is copied from disc. Together, the TLB and hashing scheme provide a very fast and efficient means for retrieving code and data from main memory and disc.

Memory Subsystem

Main memory capacities of the Series 925 and 935 are shown in the table below. The memory subsystem uses 1-Mbit Nibble-mode Dynamic RAMs. Main memory has battery backup to ensure that information is maintained for a minimum of 15 minutes in the event of an interruption in AC power. This allows the operating system to be automatically restarted and processing to continue without data loss, upon resumption of power.

Error Correcting Code (ECC) memory is standard on all 900 Series systems. The internal memory word size for the Series 925 and 935 is 72 bits: 64 bits for data and 8 bits dedicated to error detection and correction. Single-bit errors are automatically detected and corrected to ensure data integrity. Multibit errors are automatically detected and a high-priority interrupt is sent to the system software for appropriate action.

System	Standard Memory	Expansion Increments	Maximum Memory
925LX	24 Mb	8 and 16 Mb	96 Mb
925	32 Mb	8 and 16 Mb	96 Mb
935	48 Mb	8 and 16 Mb	96 Mb

Subsystems

Buses

The Series 925 and 935 employ a two-level bus hierarchy for high-performance I/O throughput.

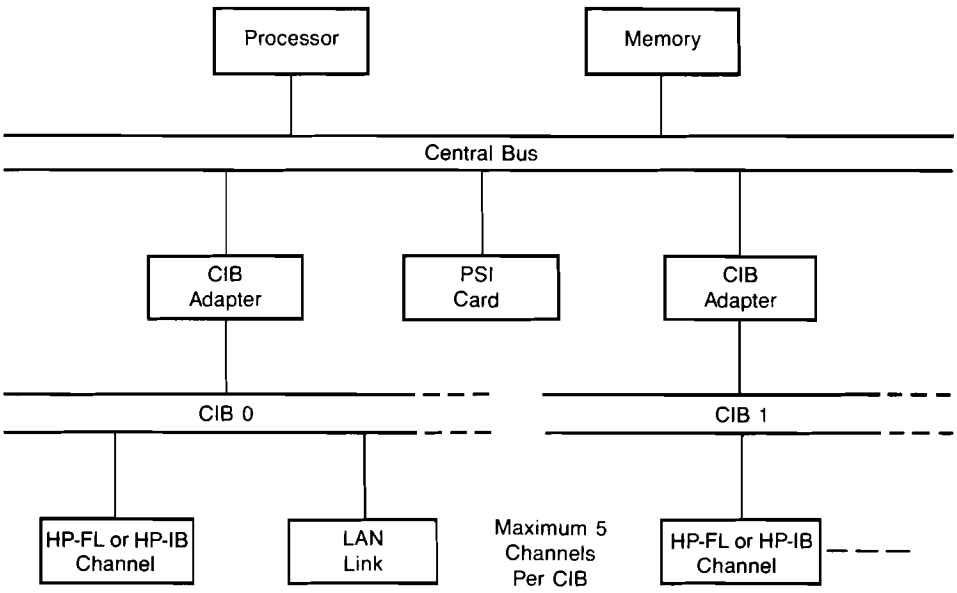


Figure 5-16. Series 925 System Structure

Central Bus. The Central Bus (CTB) is the communication path between the CPU, main memory, and the Channel Adapters. The CTB provides a 32-bit data path and, on the Series 925, runs synchronously with an 8-MHz clock, supporting data transfer rates of up to 20 Mb per second. The Series 935 CTB runs synchronously with a 10-MHz clock and supports a data transfer rate of over 22 Mb per second.

In addition, the CTB directly supports a Programmable Serial Interface (PSI) card to provide host-based Wide Area Networking (WAN) and IBM SNA NRJE/IMF communication.

Channel I/O Bus Adapters. The Series 925 and 935 Channel I/O Bus (CIB) Adapters, or Channel Adapters, for short, provide the interface between the CTB and the CIBs. Each Channel Adapter serves as a high-performance channel multiplexer providing full DMA for all HP-IB, HP-FL, and LAN I/O Channels and synchronizing the different speeds and bandwidths of the CTB and the CIBs. DMA allows large blocks of data to be transferred to and from main memory with minimum CPU intervention, thereby reducing CPU overhead.

Channel I/O Buses. The Series 925 and 925LX include one Channel Adapter standard; on the Series 925, a second may be added. The Series 935 comes standard with two Channel Adapters. The Series 925LX supports a single Channel I/O Bus (CIB), while the Series 925 and 935 support up to two CIBs, each supporting up to seven cards for interfacing peripheral devices and providing data communication functions. Each CIB provides a 16-bit-wide, bidirectional data path that runs synchronously with a 4 MHz clock and has a data transfer rate of up to 5 Mb per second.

A significant benefit of having multiple CIBs and Channel Adapters is that this approach provides multiple concurrent paths to I/O devices.

Memory-Mapped I/O

Input/output operations are initiated and controlled via a memory-mapped I/O scheme, such that the processor only needs to access reserved virtual or physical memory locations to control I/O operations. Memory mapped I/O allows for streamlined I/O operations and increases system performance in I/O intensive applications.

Peripheral Connections

Discs, tapes and printers are connected via an HP-IB Channel, which supports the 8-bit wide, IEEE-488 standard HP-IB. Each HP-IB channel supports up to six peripheral devices. In addition, discs can be connected via HP-FL, a high-speed fiber-optic link with a data transfer rate of up to 5 megabytes per second.

Workstation and Serial Connections

Connections for workstations, serial printers and other serial devices are provided via Distributed Terminal Controllers (DTCs), which are distributed over an IEEE-802.3 standard LAN. This flexible connection scheme allows DTCs to be situated in the department they serve, saving the cost and effort of running cables from each workstation back to the processor. Each DTC can support up to 48 direct-connect ports or 36 modem ports or a combination of the two. Both RS-232 and RS-422 interfaces are supported. In addition, PCs can be connected directly to a LAN or HP StarLAN.

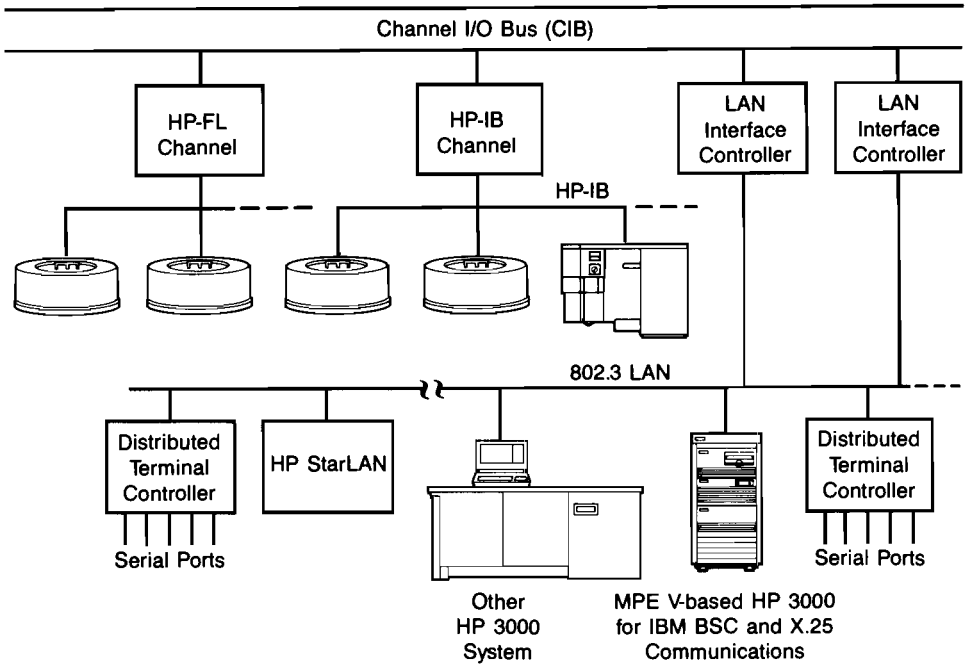


Figure 5-17. Series 925 I/O Attachments

System-to-System Data Communication

AdvanceNet-compatible local HP 3000-to-HP 3000 communication is supported via the LAN, with available services including Network File Transfer, Remote File Access, Virtual Terminal, and Remote Data Base Access to TurboIMAGE databases. For point-to-point WAN support to an HP 3000 and host-based IBM SNA communication, the Series 925 and 935 use a Programmable Serial Interface (PSI) card connected directly to the CTB. IBM communication is supported through the SNA NRJE/IMF facility. X.25 communication and IBM Bisync RJE, MRJE, and IMF are supported on an MPE V-based HP 3000 acting as a data communication server on the LAN.

System Packaging

The Series 925 and 935 are available in two compact, attractive cabinets: a 0.53-m and a 1.6-m cabinet. The 0.53-m cabinet is capable of holding the SPU and the optional CIB expander. The 1.6-m cabinet has been designed to hold an entire modular system in a very small amount of space, maximizing the efficiency of office or computer room space. It is capable of holding the SPU, one DTC, a tape drive, and two disc drives. If desired, the CIB expander can be installed in the cabinet in place of the second disc drive.

Environmental Specifications

▪ AC input voltage (nominal):	100/120/240 VAC
▪ Input voltage tolerance:	90-132 VAC
	180-264 VAC
▪ Input voltage frequency	50 Hz - 60 Hz
▪ Input current:	9.5/8/5.3 amps
▪ Heat dissipation, max.:	2050 BTU/hr

▪ Physical dimensions:	
- Height:	234 mm (9.21 in)
- Width:	325 mm (12.8 in)
- Depth:	500 mm (19.7 in)
- Weight:	23 Kg (51 lbs)
▪ Operating temperature, system:	0-55°C (32-131°F)
▪ Relative humidity, system (operating):	5-95% (non-condensing) at 0-40°C
▪ Altitude (operating):	Up to 4572 m (15,000 ft)
▪ Battery backup time, min.:	15 minutes
▪ Acoustics:	5.0 Bels sound power (A)

Series 950 and 955

The Series 950 is a high-performance member of the broad family of HP 3000 business computers. By incorporating the latest in VLSI technology with HP Precision Architecture (HPPA), the Series 950 delivers 7 MIPS of CPU performance to provide highly reliable, cost-effective solutions to high-end data processing needs.

At 11 MIPS, the Series 955 is the highest-performance member of the HP 3000 family. The Series 955 incorporates an enhanced VLSI processor and large cache memory to provide a significant performance boost over the Series 950.

You can easily upgrade to the Series 955 from the Series 950. Moving to the Series 955 is simply a matter of doing a field upgrade from the Series 950.

To excel in large commercial applications, the Series 950 and 955 combine their high-speed CPUs with an operating system specifically designed for commercial data processing -- MPE XL. Add to this a tightly integrated network and relational database and the result is systems that provide high performance and functionality in multiuser, multitasking interactive and batch environments. Due to their powerful processor, the Series 950 and 955 also are very effective in computationally intensive applications.

The reduced complexity of HPPA allows the high-performance Series 950 and 955 to fit in a meter-high, dual-bay package, which is smaller and has significantly lower cooling and power requirements than typical systems in their performance class.

Through use of the Hewlett-Packard Interface Bus (HP-IB) and HP's new Distributed Terminal Controller (DTC), the Series 950 and 955 support most of the same peripherals and workstations that are used on other HP 3000 systems.

Features:

- MPE XL operating system
- Single-chip VLSI CPU, single-board processor. 7 MIPS (S950); 11 MIPS (S955) CPU performance
- HP Precision Architecture
- 48-bit virtual addressing
- High-speed CPU cache for data and instructions 128 Kb (S950); 256 Kb (S955)
- Instruction cycle time 73 ns (S950); 40 ns (S955)
- Advanced instruction pipelining, three-stage (S950); five-stage (S955)
- Floating-Point Coprocessor standard
- Translation Lookaside Buffer (TLB) for virtual-to-real address translation. 4000 entries (S950); 16,000 entries (S955)

- Battery backup, auto restart standard
- Three-level I/O hierarchy providing high I/O bandwidth. High-speed, 100 Mb per second System Memory Bus (SMB)
- IEEE 802.3 Local Area Network (LAN) terminal connection; HP StarLAN also supported
- Network and relational database management systems standard
- AdvanceNet networking solutions
- Low cooling and power requirements; compact packaging

Configuration Maximums:

▪ Memory:		64 Mb standard, expandable to 128 Mb in 16-Mb increments
▪ Users:	S950	Maximum of 400 per system
	S955	>400 users per system (to be determined)
▪ Discs:		Maximum of 30 discs per system for maximum of 17.1 Gb of disc storage
▪ Tape drives:		Supports 1600/800- and 6250/1600-bpi tape drives, 1/2 inch; maximum of 8 per system
▪ System printers:		Supports 600- and 900-lpm printers; maximum of 8 per system
▪ Serial printers:	S950	Maximum of 32 spooled printers per system
	S955	>32 printers (to be determined)
		Both support laser and dot matrix printers
▪ Intelligent laser per page printers:		Supports 12- and 45-ppm printers; maximum of 4 system
▪ I/O channel multiplexers:		Up to 4 Channel Adapters per system (2 standard)

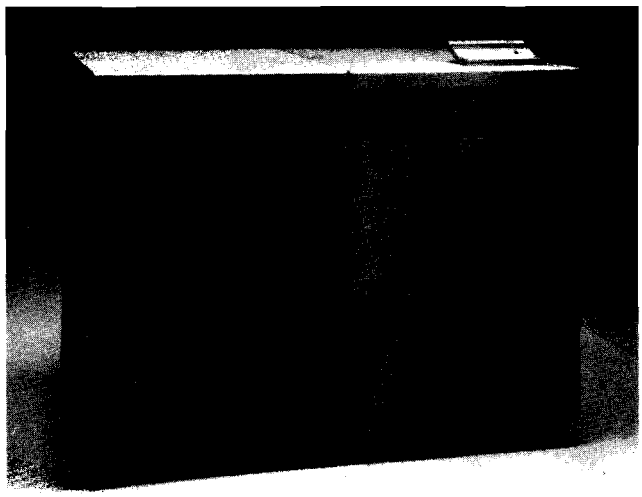


Figure 5-18. The Series 950

System Organization

The processor communicates with main memory via the SMB. The SMB is a very high-speed bus that provides a 64-bit data path and can support an average data transfer rate of 100 Mb per second. The SMB connects to two Central Buses (CTBs) through separate CTB Adapters. Each CTB supports two Channel I/O Buses (CIBs) via separate Channel Adapters. The CIBs support I/O interfaces to peripheral devices and LAN links.

(See Figure 5-22 for a diagram of the system organization.)

Series 950 and 955 Processor

The entire Series 950 and 955 processor, implemented with HP's proprietary NMOS III VLSI technology, is contained on a single board. The processor module includes a single-chip CPU, a single-chip TLB Control Unit (TCU), two

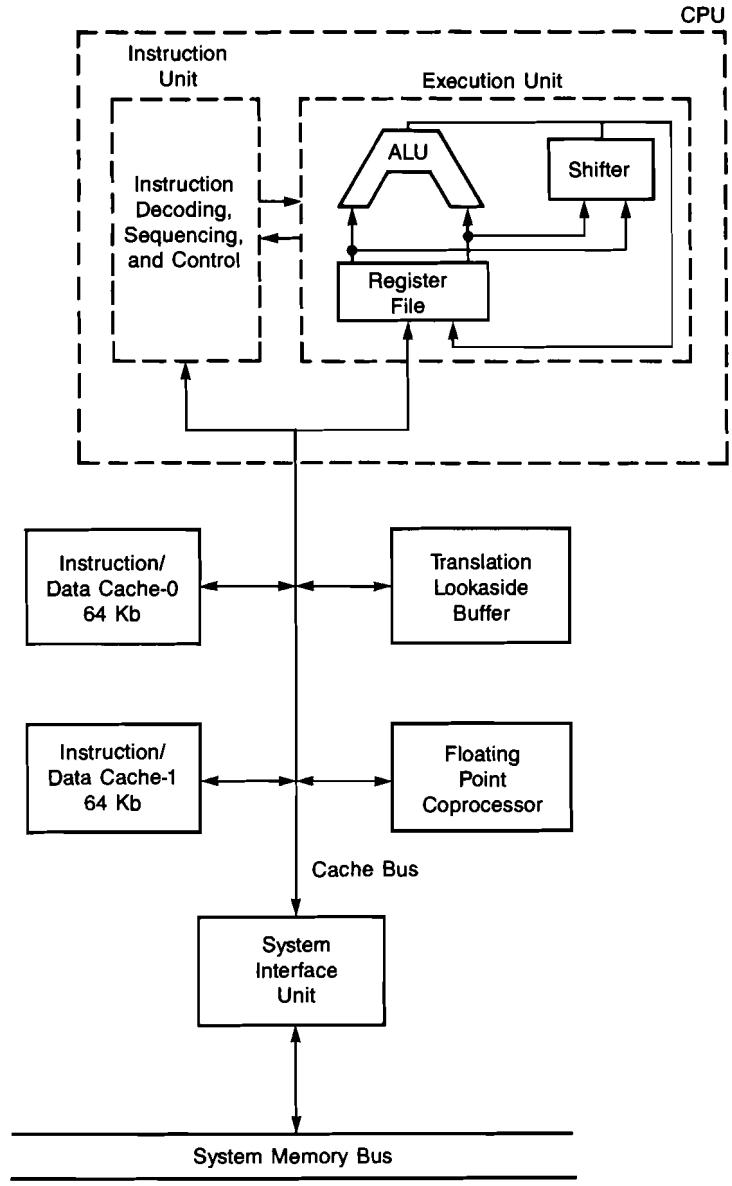


Figure 5-19. The Series 950 Processor

Cache Control Units (CCUs), a single-chip System Interface Unit (SIU), and the Floating-Point Coprocessor.

Cache

The use of high-speed CPU caches significantly increases system performance by minimizing accesses to main memory. Cache access can be up to an order of magnitude faster than accesses to main memory.

The system automatically moves into cache from main memory the code and data that are most likely to be required based upon a "locality" algorithm. As a result, the required code and data are found in cache almost all the time. An access to main memory needs to be made only in the event of a cache miss. Since the CPU usually finds the required code or data in the cache, relatively slow accesses to main memory are minimized.

By providing a large amount of CPU cache, the Series 950 and 955 maximize the cache benefits. The larger the CPU cache, the more likely it is that the required data and code will be in cache.

One of the primary differences between the Series 950 and the Series 955 is the organization and size of their caches. The Series 950 uses a 128-Kb combined cache for instructions and data. The cache on the Series 955 is divided into two separate caches for instructions and data, each 128 Kb in size. The two caches operate in parallel, which further enhances processing efficiency. For example, data can be loaded from the Data Cache while the next instruction is fetched from the Instruction Cache.

	Total Cache Size	Instruction Cache	Data Cache
Series 950	128 Kb	NA	NA
Series 955	256 Kb	128 Kb	128 Kb

Pipelining

Separate Instruction and Execution Units facilitate instruction pipelining and provide efficient, parallel use of processor resources.

The Instruction Unit controls instruction sequencing. It fetches instructions from the Instruction Cache and stores them in the Instruction Register. The Instruction Unit executes branch instructions, maintains processor status, and handles traps and interrupts.

The Execution Unit executes all instructions requiring data manipulation. It contains the Arithmetic Logic Unit (ALU) and barrel shifter, which together perform arithmetic, logical, shift, extract and deposit instructions. The Execution Unit contains 32 general-purpose registers, which store the results of these operations.

The Series 950 employs a three-stage instruction pipeline. The Series 955 uses a five-stage instruction pipeline. While one instruction is being executed, others are being fetched, and the results of still others are being stored. The net effect is that, except for penalties such as cache misses (which occur infrequently), *one instruction completes (exits the pipeline) every CPU cycle.*

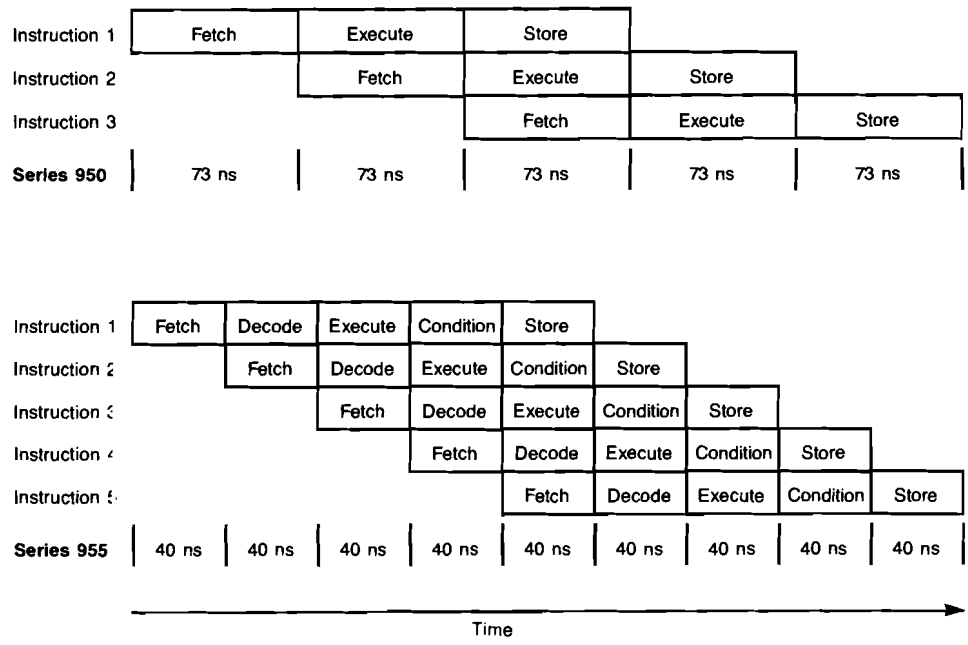


Figure 5-20. Instruction Pipelining

Floating-Point Coprocessor

For scientific, engineering and statistical applications that require high performance in floating-point calculations, HP offers a coprocessor that significantly accelerates floating-point calculations.

The Floating-Point Coprocessor supports single (32 bit) and double (64 bit) precision floating-point operands of the ANSI/IEEE 754-1985 standard. The Floating-Point Coprocessor and the CPU operate in parallel, with the CPU performing integer calculations and other functions while the coprocessor performs floating-point calculations. This parallel operation helps provide a high level of performance for applications that use floating-point calculations.

A Floating-Point Coprocessor is standard on both the Series 950 and 955. It consists of twelve 64-bit-wide registers for operands and is implemented on three HP proprietary NMOS III VLSI chips on the Series 950 or two high-speed ECL chips on the Series 955. The Series 955 provides higher floating-point performance than the Series 950. In both cases, the Floating-Point Coprocessor is attached to the CPU's cache bus.

Virtual Memory Management

Virtual addresses on the Series 950 and 955 are 48 bits long. This greatly extended address space ensures sufficient expandability to meet evolving software needs. Virtual Memory is divided into a set of 65,536 spaces, with each space 4 Gb in length. Spaces are further divided into fixed-length, 2-Kb pages, which hold data, code, or both. A single data structure can be up to 1 Gb or 4 Gb in length (compiler-dependent), and code can span multiple spaces.

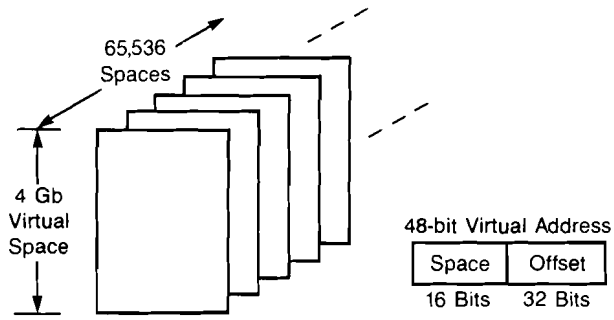


Figure 5-21. Virtual Memory Organization

Virtual Address Translation

Since the processor generates 48-bit virtual addresses, and memory access is via 28-bit physical (real) addresses, virtual-to-physical address translation is required. A high-speed RAM buffer called the Translation Lookaside Buffer (TLB) optimizes this task. The TLB can be considered to be a table that holds the most recently referenced virtual addresses and their corresponding physical addresses.

Memory is divided into 2-Kb pages, with access protection provided at the page level for all code, data and I/O access. When a virtual-to-physical address translation occurs, the TLB checks whether the executing process can access the page and, if so, what type of access is allowed (read, write, execute, etc.).

Capacities of the TLBs are as follows:

	Total Entries	Data Entries	Instruction Entries
Series 950	4096	2048	2048
Series 955	16384	8192	8192

The needed address is found in the TLB more than 99 percent of the time. If the address is not in the TLB, a software scheme that involves hashing is used to find the address of the required code or data in main memory. If the instruction or data is on a page that is not in main memory, then a page fault occurs and the required page is copied from disc. Together, the TLB and hashing scheme provide a very fast and efficient means for retrieving code and data from main memory and disc.

Memory Subsystem

The Series 950 and 955 come standard with 64 Mb of main memory, expandable to 128 Mb in 16-Mb increments. The memory subsystem uses 1-Mbit Nibble-mode Dynamic RAMs. Main memory has battery backup to ensure that information is maintained for a minimum of 15 minutes in the event of an interruption in AC power. This allows the operating system to be automatically restarted and processing to continue without data loss, upon resumption of power.

Error Correcting Code (ECC) memory is standard on the Series 950 and 955. The internal memory word size is 39 bits: 32 bits for data and 7 bits dedicated to error detection and correction. Single-bit errors are automatically detected

and corrected to ensure data integrity. Multibit errors are automatically detected and a high-priority interrupt is sent to the system software for appropriate action.

Subsystems

Buses

The wide data paths and fast, synchronous clocking of the Series 950 and 955 buses provide high-performance I/O throughput. I/O performance is further enhanced because there are multiple paths to I/O devices (through up to four adapters and low-level buses).

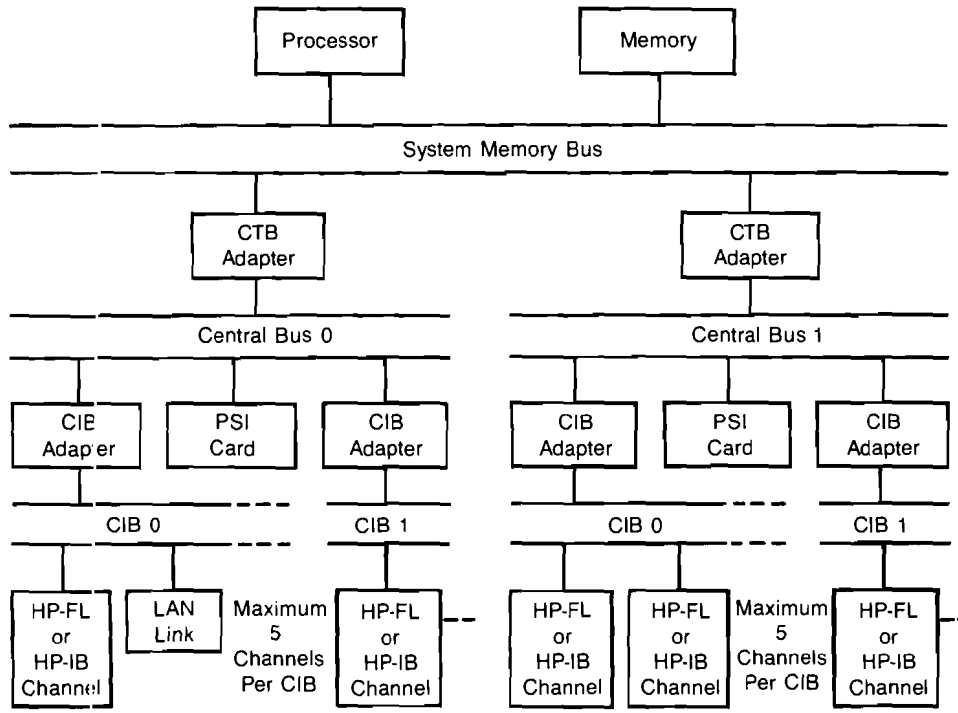


Figure 5-22. Series 950 System Structure

System Memory Bus. The System Memory Bus (SMB) is the communication path between the CPU, main memory, and the CTB Adapters. The SMB provides a 64-bit-wide data path and runs synchronously with a 27.5 MHz clock. It supports an average data transfer rate of 100 Mb per second.

Central Bus Adapters. The Series 950 and 955 Central Bus Adapters provide the interface between the SMB and the CTBs. The CTB Adapters act as transfer agents for Direct Memory Access (DMA) transfers and direct I/O transfers between the Channel Adapters and the CPU and main memory. The Series 950 and 955 comes standard with two CTB Adapters.

Central Bus. The Central Bus (CTB) is the communication path between the CTB Adapters and the Channel Adapters. The CTB provides a 32-bit data path and runs synchronously with a 9.2 MHz clock. It supports sustained data transfer rates of up to 20 Mb per second.

In addition, the CTB directly supports a Programmable Serial Interface (PSI) card to provide host-based Wide Area Networking (WAN) and IBM SNA NRJE/IMF communication.

Channel I/O Bus Adapters. The Series 950 and 955 Channel I/O Bus Adapters, or Channel Adapters, for short, provide the interface between the CTB and the CIBs. Each Channel Adapter serves as a high-performance channel multiplexer providing full DMA for all HP-IB, HP-FL, and LAN I/O Channels and synchronizing the different speeds and bandwidths of the CTB and the CIBs. DMA allows large blocks of data to be transferred to and from main memory with minimum CPU intervention, thereby reducing CPU overhead. The Series 950 and 955 include two Channel Adapters standard; a third and fourth may optionally be added.

Channel I/O Buses. The Series 950 and 955 supports up to four Channel I/O Buses (CIBs), each supporting up to seven cards for interfacing peripheral devices and providing data communication functions. Each CIB provides a 16-bit-wide, bidirectional data path that runs synchronously with a 4 MHz clock and has a data transfer rate of up to 5 Mb per second.

A significant benefit of having multiple CIBs and Channel Adapters is that this approach provides multiple concurrent paths to I/O devices.

Memory-Mapped I/O

Input/output operations are initiated and controlled via a memory-mapped I/O scheme, such that the processor only needs to access reserved virtual or physical memory locations to control I/O operations. Memory Mapped I/O allows for streamlined I/O operations and thus increases system performance in I/O intensive applications.

Peripheral Connections

Discs, tapes and printers are connected via an HP-IB Channel, which supports the 8-bit wide, IEEE-488 standard HP-IB. Each HP-IB channel supports up to six peripheral devices. In addition, discs may be connected via HP-FL, a high-speed fiber-optic link with a data transfer rate of up to 5 Mb per second.

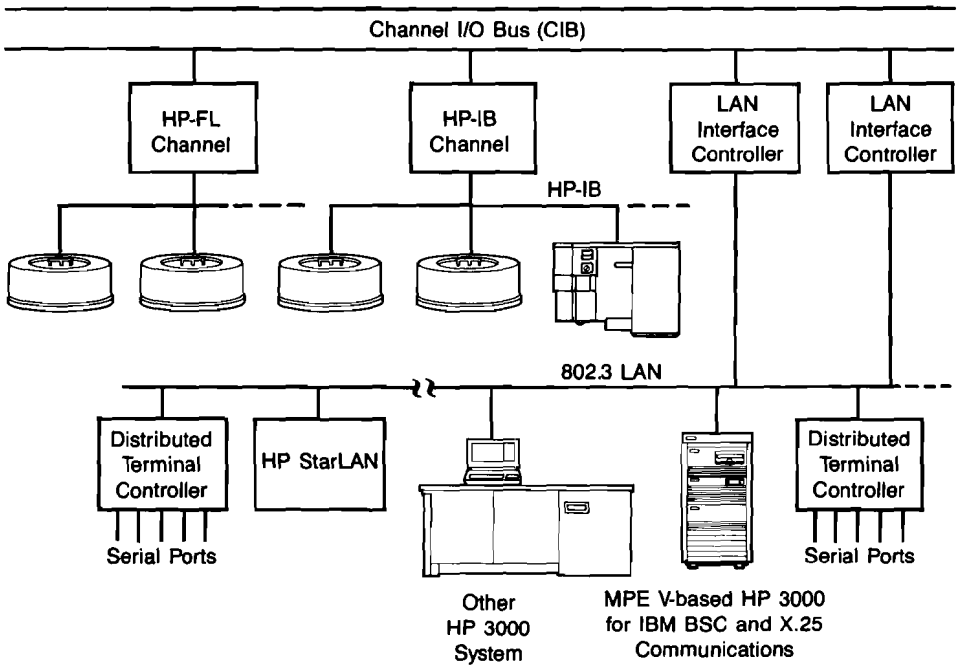


Figure 5-23. Series 950 I/O Attachments

Workstation and Serial Connections

Connections for workstations, serial printers and other serial devices are provided via DTCs, which are distributed over an IEEE-802.3 LAN. This flexible connection scheme allows DTCs to be situated in the departments they serve, saving the cost and effort of running cables from each workstation back to the processor. Each DTC can support up to 48 direct-connect ports or 36 modem ports or a combination of the two. Both RS-232 and RS-422 interfaces are supported. In addition, PCs can be connected to a LAN of HP StarLAN.

System-to-System Data Communication

AdvanceNet-compatible local HP 3000-to-HP 3000 communication is supported via the LAN, with available services including Network File Transfer, Remote File Access, Virtual Terminal, and Remote Data Base Access to TurboIMAGE databases. For point-to-point WAN support to an HP 3000 and host-based IBM SNA communication, the Series 950 and 955 use a PSI card connected directly to the CTB. IBM communication is supported through the SNA NRJE/IMF facility. X.25 communication and IBM Bisync RJE, MRJE, and IMF are supported on an MPE V-based HP 3000 acting as a data communication server on the LAN.

Environmental Specifications

▪ AC input voltage (nominal):	208 VAC, three phase @ 60 Hz 380 VAC, three phase @ 50 Hz 415 VAC, three phase @ 50 Hz
▪ Input voltage tolerance:	±10% from nominal
▪ Input current:	8.0 amps @ 208 VAC 60 Hz 4.4 amps @ 380 VAC 50 Hz 4.0 amps @ 415 VAC 50 Hz
▪ Heat dissipation, max.:	7900 BTU/hr
▪ Physical dimensions:	
- Height:	991 mm (39 in)
- Width:	1296 mm (51 in)
- Depth:	711 mm (28 in)
- Weight	400 Kg (880 lbs)
▪ Operating temperature, system:	20 - 25.5°C (68 - 78°F)
▪ Relative humidity, system (operating):	40 - 60% (non-condensing)
▪ Altitude (operating):	Up to 4572 m (15,000 ft)
▪ Battery backup time, min.:	15 minutes
▪ Acoustics:	7.3 Bels sound power (A)

6

Networks

Overview

HP AdvanceNet Solutions

Different business environments require different sets of networking functionality. HP's AdvanceNet Solutions cover groups of products that collectively provide the communication capabilities required in these different business environments.

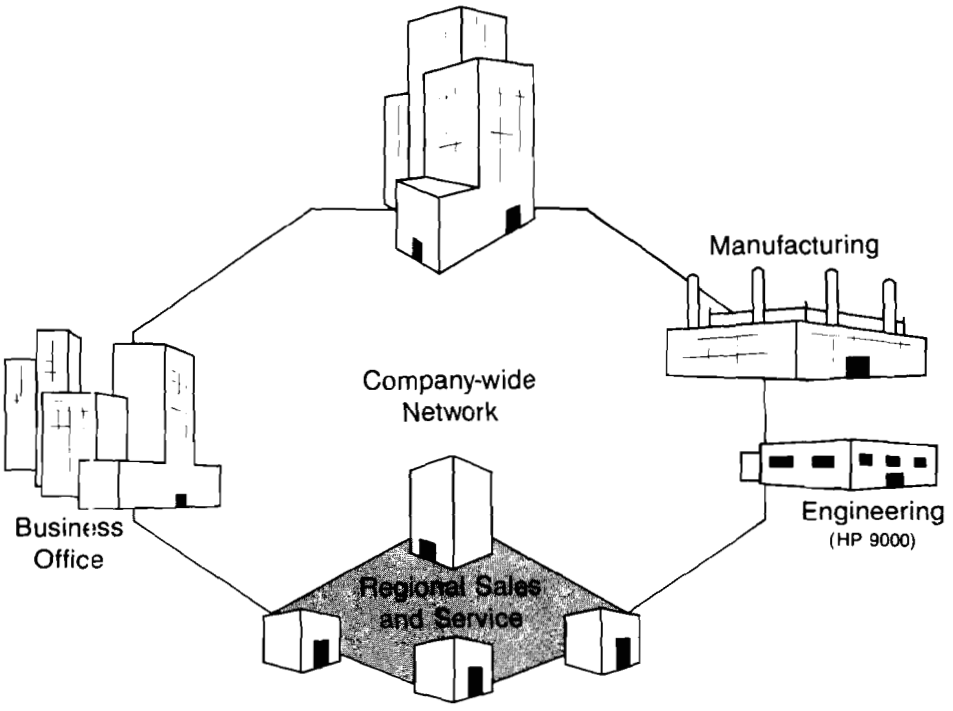


Figure 6-1. AdvanceNet Solutions

The HP AdvanceNet Solutions include:

- Business Office
- Regional Sales and Service
- Computer Integrated Manufacturing
- Company-wide

With the products described in this section, the HP 3000 family of computers can be successfully networked in any of these solution environments.

HP AdvanceNet Strategy

The data communication capabilities of the HP 3000 systems fit under the umbrella of HP AdvanceNet. HP AdvanceNet is a family of hardware and software communication products that enable HP systems to communicate with each other and with equipment made by other vendors. HP AdvanceNet products adhere to industry and de facto standards for data communication. The International Standards Organization (ISO) seven-layer Open Systems Interconnect (OSI) model is the basis for HP AdvanceNet product design. HP also offers products for batch and interactive communication to IBM mainframes in SNA and bisynchronous environments.

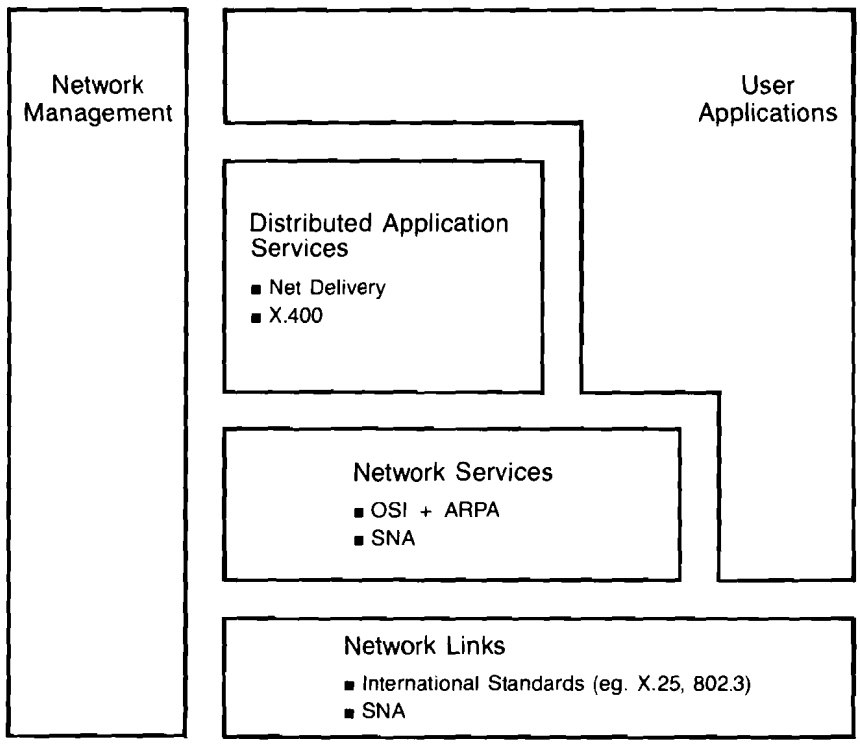


Figure 6-2. AdvanceNet Strategy

Because HP AdvanceNet products are based on industry standards, they provide a foundation for the development of applications that span multiple vendors' systems.

This chapter summarizes the HP AdvanceNet products that provide the communication capabilities of the HP 3000 systems. These products are grouped in five broad categories:

- Workstation-to-system
- System-to-system
- HP-to-IBM systems
- HP Network Management
- Information Distribution

Workstation-to-System Communication

By workstations, we refer to the terminals, personal computers, and serial printers that are connected to an HP 3000 system. On 900 Series systems, workstation-to-system communication is provided by the Distributed Terminal Controller (DTC).

MPE V workstation-to-system communication is handled by the Advanced Terminal Processor (ATP). Used in conjunction with the DTC or ATP, the Terminal Server 8-Port (TS8) provides switching to multiple systems on a Local Area Network (LAN).

Distributed Terminal Controller

HP 2345A Distributed Terminal Controllers (DTCs) connect asynchronous terminals and serial printers to the 900 Series systems of the HP 3000 family. The DTCs are attached to the system using an industry standard IEEE 802.3 LAN. Interface options allow devices to be connected to the DTCs either locally, at up to 1220 m (4000 ft) in a building, or remotely, using full-duplex modems.

HP 2345A DTCs are typically placed in an EDP room, or they can be located throughout a building on the LAN cable. Using HP 92223A Repeater Kits and ThickLAN cable, an HP 2345A controller can be up to 1500 m (5000 ft) from the system that controls it.

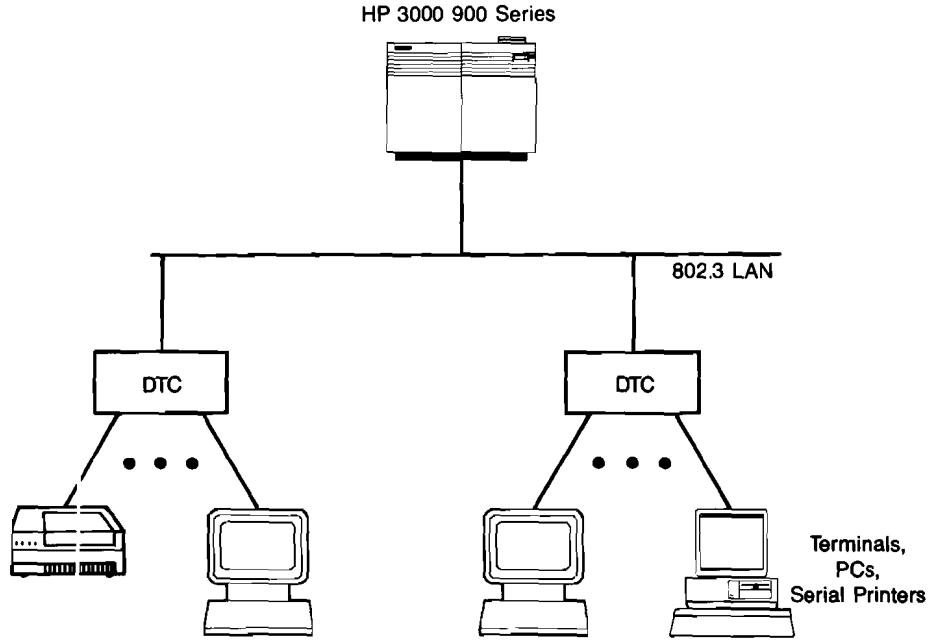


Figure 6-3. Workstation-to-System Communication

The HP 2345A DTC:

- Provides up to 48 connections for asynchronous terminals and serial printers
- Contains six slots, each offering a choice of
  - -- eight local connections at up to 15 m (50 ft) with the Type RS-232 option, or to 1220 m (4000 ft) with the Type RS-422 option
  - -- six remote connections for devices connected over full-duplex modems
- Transfers data at the rate of 300, 1200, 2400, 4800, 9600, or 19200 bps
- Speed sensing up to 19200 bps

- Parity sensing
- Powerfail session recovery
- Connects to the 900 Series system over either ThinLAN (Type 10BASE2) cable or ThickLAN (Type 10BASE5) cable
- Supports full-duplex modems and spooled serial printers

Currently, each DTC communicates with a single MPE XL system. With a later release, the DTC will evolve into a LAN terminal server and will be able to switch between multiple MPE XL systems that are on the same LAN.

Terminal Server 8-Port

The HP Terminal Server 8-Port (TS8) provides terminal connection to the HP 3000 and terminal switching within a multivendor environment.

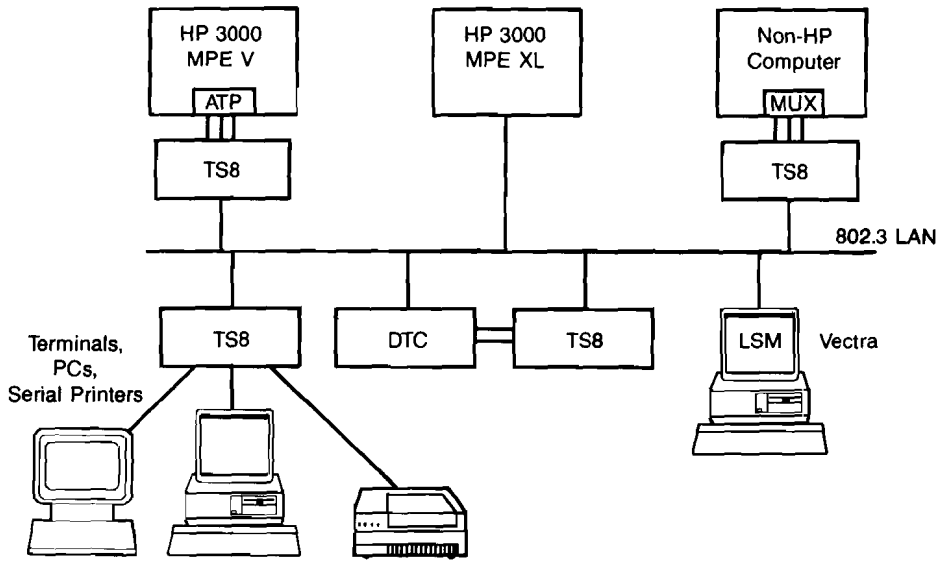


Figure 6-4. HP Terminal Server 8-Port

The HP TS8 connects a maximum of eight asynchronous workstations to multiple computer systems through a LAN.

On the computer side, the TS8 is connected to an ATP or a DTC for the HP 3000, or an asynchronous multiplexer for another system. Alternately, the TS8 provides direct connections to systems supporting TCP/IP Telnet.

The TS8s are controlled by a Local Server Manager (LSM) running in an HP Vectra. The LSM provides all network management facilities such as configuration, downloading, statistics, diagnostics, and control.

Advanced Terminal Processor

The Advanced Terminal Processor (ATP) is designed to interface asynchronous workstations to the MPE V-based HP 3000 systems in a point-to-point configuration. Interfaces are available to allow workstations to be connected either directly (for local communication) or through full-duplex modems (for remote communication).

The Advanced Terminal Processor Model M (ATP/M) is a communication interface designed for the Micro 3000 systems. It provides connections for up to eight asynchronous workstations (personal computers, terminals, and printers with a serial interface) in a point-to-point configuration. Workstation ports come integrated with the MICRO 3000LX and GX but are based on the same ATP/M hardware.

Both the ATP and ATP/M allow workstations to transmit and receive in either character or block mode at speeds up to 19.2 Kbps.

Local workstations can be connected to the system via RS-232C direct-connect ports, modem ports, or RS-422 direct-connect ports. Remote workstations can be connected via RS-232C modem ports with full-duplex asynchronous modems or with HP 2334A statistical multiplexers and full-duplex synchronous modems. (Note: The MICRO 3000LX and GX do not support RS-422.)

Remote Terminal Connections over X.25

Applications that serve multiple remote locations can benefit from the cost effective use of X.25 Packet Switched Networks (PSN). The DTC, TS8, and ATP support connections to workstations on X.25 PSNs through the use of the HP 2334A Plus X.25 Multiplexer. One HP 2334A Plus X.25 Multiplexer located at a remote site can be connected to a maximum of 16 workstations. A second X.25 Multiplexer is connected to the DTC, TS8, or ATP ports.

System-to-System Communication

System-to-system networking for the HP 3000 family of computers is provided by the following HP AdvanceNet products: NS3000 Network Services, LAN3000 Link, Point-to-Point Link, NS X.25 Link, and NS ASNL. For 900 Series systems, X.25 network access is currently provided by an MPE V-based datacom server.

Along with these HP networking products, the ARPA Services are provided for HP 3000 MPE V systems from an independent software vendor. The supported ARPA Services include Telnet (Virtual Terminal), File Transfer Protocol (FTP), and Simple Mail Transfer Protocol (SMTP). ARPA Services for the 900 Series will be provided in a future release.

Network Services 3000

NS3000, which corresponds to OSI layers 5 through 7, provides powerful networking services. It is used in conjunction with the LAN3000 Link, Point-to-Point Link, and NS X.25 Link to provide Virtual Terminal, Network File Transfer, Remote File Access, Remote Database Access, Network InterProcess Communication, and Remote Process Management.

The network services include:

Virtual Terminal

Virtual Terminal provides interactive access to other HP 3000 systems and PCs on the network. A terminal configured to one system is "virtually" connected to all other systems on the network. Virtual terminal allows you to log onto any system on the network as easily as logging onto your "home" system.

Network File Transfer

Network File Transfer is a file copy utility that lets you easily copy files from one HP system to another. The transfer can be done interactively or programmatically.

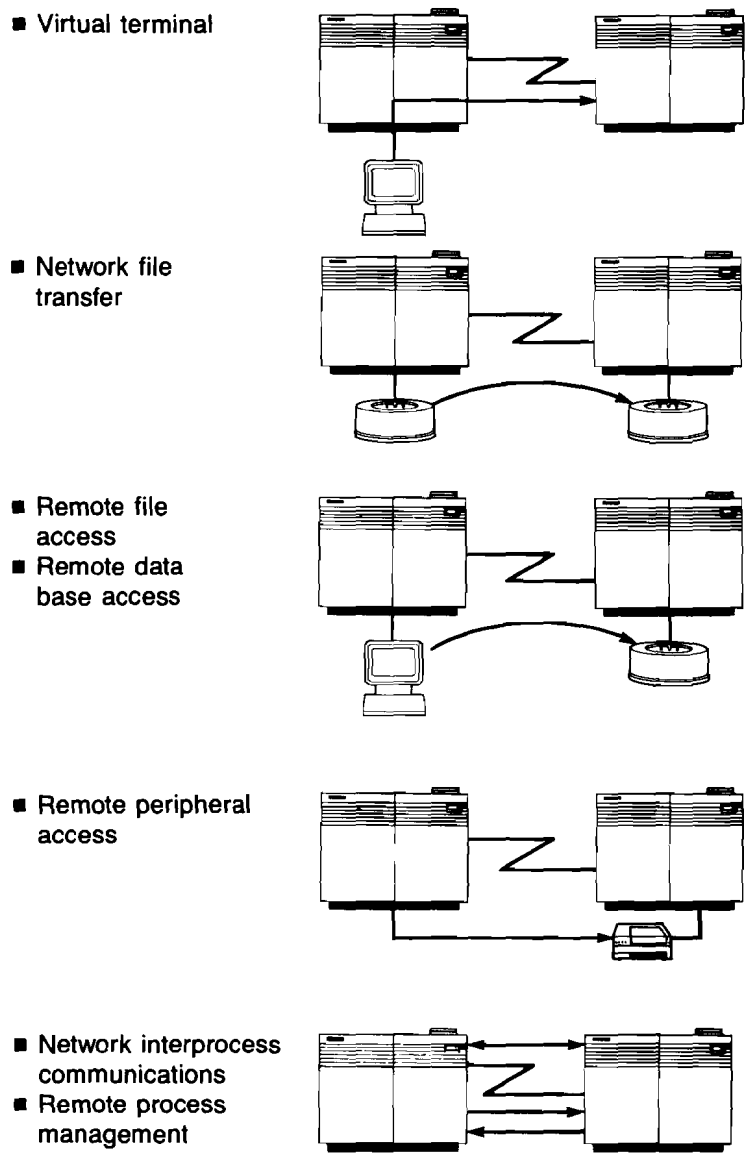


Figure 6-5. NS3000 Functionality

Remote File and Peripheral Access

This service gives you access to the files and peripherals of other HP 3000 systems in the network. Access can be interactive or programmatic. The MPE operating system contains intrinsics for file manipulation. Since MPE treats peripherals similarly to files, the same intrinsics can be used for peripheral operations. NS3000 extends this capability throughout the network and allows peripheral devices, such as printers, to be shared by multiple systems on the network.

Remote Database Access

Through Remote Database Access, TurboIMAGE databases can be accessed on different HP 3000 systems in the network. Access can be interactive (through Query/3000) or through application programs.

Remote Database Access provides valuable flexibility for database applications. Data captured by applications on different systems can be consolidated in a centralized database and shared by applications throughout the network. For instance, distributed applications for accounts payable and accounts receivable can access a general ledger database centralized on one system in the network.

Network InterProcess Communication

Network InterProcess Communication (Network IPC) is the ideal means for implementing efficient distributed applications.

Network IPC is a set of programmatic calls that facilitate the rapid exchange of data between processes on multiple HP systems. The relation between the processes is peer-to-peer so that any process can initiate communication and any process can send or receive messages.

Remote Process Management

Remote Process Management consists of a set of programmatic calls for initiating and terminating remote processes. These calls will normally be used in conjunction with the Network IPC calls, allowing an entire distributed application to be controlled from a single system.

Security

NS3000 honors the security provisions of the MPE operating system and the database management systems. Beyond this, NS3000 allows the system manager to apply security measures specific to the network. For instance, one-way access can be specified and node passwords can be required.

Local Area Networking

LAN3000 Link

LAN3000 Link provides the hardware and communication software needed to connect HP 3000 systems to a network for system-to-system communication. It includes a Local Area Network Interface Controller (LANIC) and transport software that perform the functions specified in layers one to four of the OSI reference model. LAN3000 Link is used in conjunction with NS3000 or, for MPE V systems, with ARPA Services.

On the 900 Series, one LANIC is included for workstation communication, and a separate LANIC can be purchased for system-to-system communication.

The same LAN cable used for workstation communication can be used for system-to-system networking.

Features of HP's LAN3000 Link include:

- Integrated node management software is provided for on-line configuration, diagnostics and logging.

- Any node may be attached or removed while the network is still active.
- Carrier-Sense Multiple Access with Collision Detection (CSMA/CD) protocol controls network access. There is no centralized control; all nodes have equal access.
- The data transfer rate is up to 10 Mbits per second, depending on the application.
- Transport-level protocols are based on the Defense Advanced Research Project Agency and Transmission Control Protocol/Internet Protocol (DARPA TCP/IP).
- Network interprocess communication provides process-to-process communication across HP's family of computers.

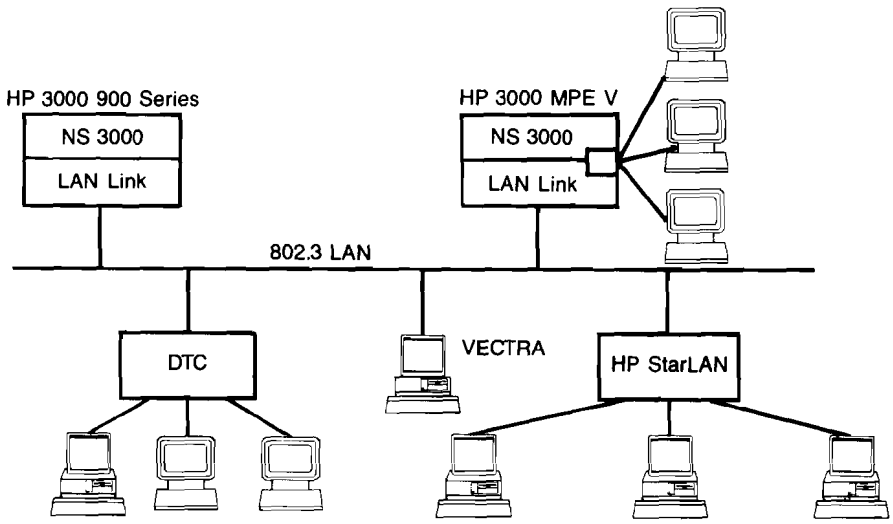


Figure 6-6. NS3000 over a LAN

In a future release, Ethernet support will be added to the LAN3000 Link for MPE V systems for use with ARPA Services.

HP Local Area Networks

For system-to-system communication in a local area, Hewlett-Packard provides the HP ThinLAN Local Area Network. HP ThinLAN complies with industry standard IEEE 802.3 and runs over Type10 Base2 thin coax cable. The HP 3000 connects to HP ThinLAN via the LAN3000 Link.

HP StarLAN and HP StarLAN-10 are offered primarily for networking Vectra PCs and IBM PC/XTs and ATs in a local area. Both StarLAN products work over standard unshielded twisted-pair phone wire. While HP StarLAN supports 1 Mbps data transfer rates, HP StarLAN-10 operates at 10 Mbps.

Systems attached to HP ThinLAN and HP StarLAN can communicate via bridges that connect the two LANs.

Remote Communication

Point-to-Point Link

The Point-to-Point Link provides the network connection to allow an HP 3000 system to communicate with another remote HP 3000. It includes an Intelligent Network Processor (INP) for MPE V systems or a Programmable Serial Inter-

face (PSI) for MPE XL systems as well as transport software that perform the functions specified in layers one to four of the OSI reference model.

Point-to-Point Link, in conjunction with NS3000, allows systems to communicate over wide areas via modem connections.

Features of HP's Point-to-Point Link include:

- Support of dial, leased line, X.21, and digital phone network modems
- A programmable microprocessor-driven line controller that reduces the HP 3000 overhead associated with communication-link handling
- Support of RS-232C up to a line speed of 19.2 Kbps and CCITT V.35 up to a line speed of 64 Kbps

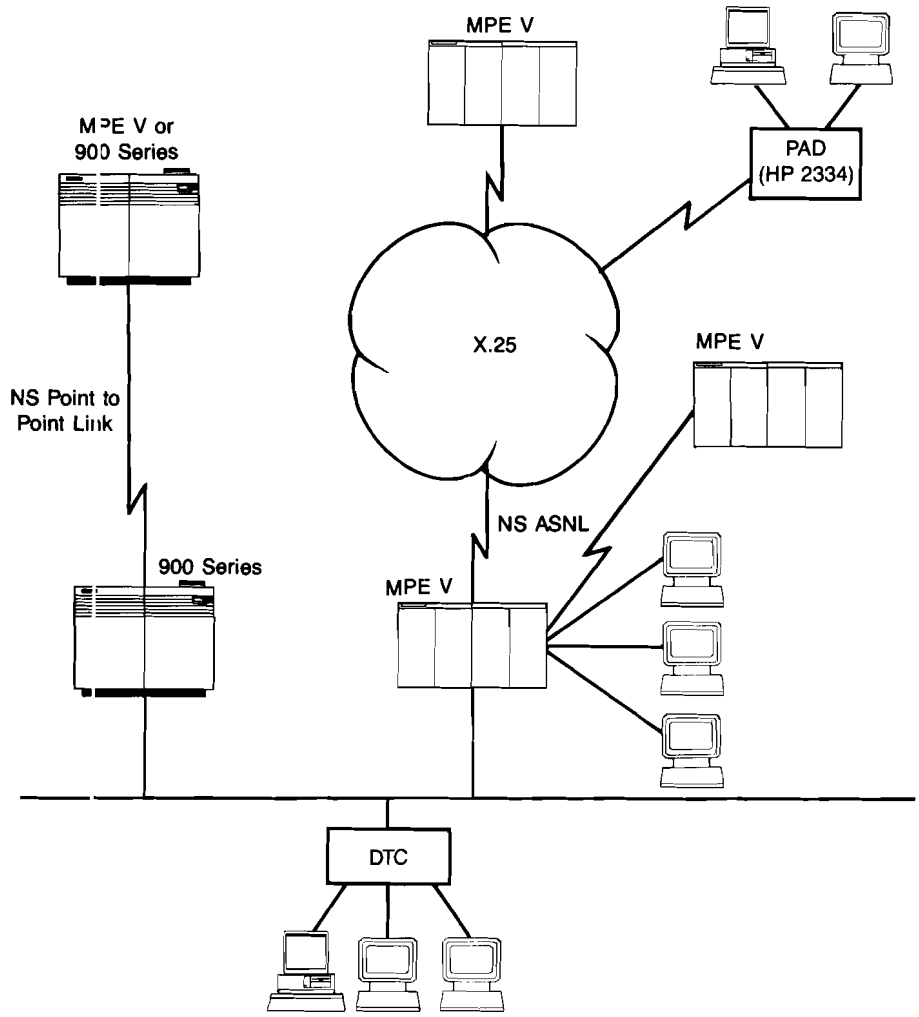


Figure 6-7. NS3000 over a Wide Area Network

NS X.25 3000/V Link

The NS X.25 Network Link for MPE V-based systems provides the network connection on HP 3000 systems to private and public X.25 Packet Switched Networks (PSN). The NS X.25 3000/V Link can be used in conjunction with NS3000/V (or ARPA Services) for higher-level user services such as network

file transfer, virtual terminal, and remote data base access. In addition, NS X.25 3000/V Link provides programmatic access to protocol at level 3 or level 4. This allows you to develop your own protocol and services for communication with remote HP or non-HP systems over an X.25 network.

NS PAD support for the NS X.25 3000/V link is a service within the NS architecture. It allows communication between an HP 3000 host and remote terminals and printers connected to a Packet Assembler/Disassembler (PAD).

The features provided by NS X.25 3000/V Link include:

- Industry-standard DARPA TCP/IP protocols
- Full support of NS3000/V Network Services
- Programmatic access to X.25 and transport layers for the development of multivendor or customized applications
- Packet routing and gateway capability for transparent access over multiple nodes and between networks
- Extensive X.25 user facilities
- Integrated node management software for on-line configuration and logging
- Dial-up terminal access over the PSNs via the network PAD to a host HP 3000 computer system. Both character mode and HP VPlus applications are supported.
- Remote terminal cluster access via an HP 2334A PAD/Statistical Multiplexer using a single leased line over a PSN to a host HP 3000 computer system. Both character mode and VPlus applications are supported.
- HP printers supported on an HP2334A PAD/Statistical Multiplexer
- Both system-to-system and system-to-terminal communications are supported over a single X.25 link on the HP 3000.
- Implements the 1980 CCITT Recommendations for X.25/X.3/X.28/X.29

NS X.25 3000/XL Server

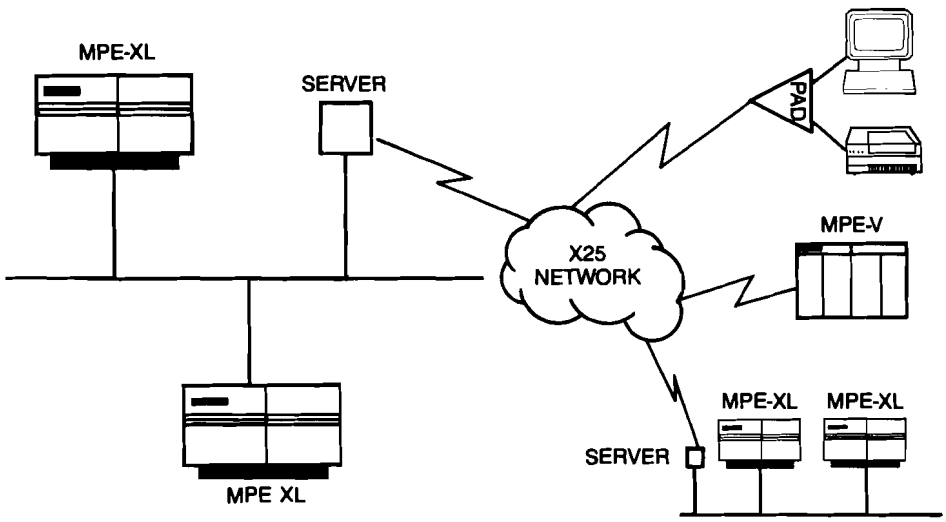


Figure 6-8. NS X.25 3000/XL Server

The NS X.25 3000/XL Server is an X.25 gateway which provides wide area networking for system-to-system (such as HPDesk) and terminal-to-system (PAD) communications for HP 3000 Series 900 systems. The Server can be used

to connect Series 900 systems to public packet switched network (PSN) or to private X.25 networks such as HP's Private Packet Network. It is accessed over an 802.3 local area network and can be shared by all the Series 900 systems attached to the same LAN. The Server provides the same functionality as MPE V systems today with the NS X.25/V Network Link (P/N 24405A) with the exception of level III access.

Features of the NS X.25 3000/XL Server include:

- Full support of NS 3000/XL Network Services to provide access to higher level services, such as Network File Transfer (NFT), Virtual Terminal (VT) and Remote Database Access (RDBA) in LAN configurations
- Packet routing and gateway capabilities for transparent access over multiple nodes and between LAN and X.25 networks for NS based nodes
- Provides X.25 user facilities such as flow control and throughput class negotiation, closed user groups and one-way/two-way virtual circuits
- Implements DTE/DCE modes for connection over public and private X.25 networks, leased and direct hardwired lines
- Implements the 1980 CCITT Recommendations for X.25/X.3/X.28/X.29
- Support for remote terminals and printers using PAD services
- Compliance with U.S. Defense Data Network TCP/IP protocol
- Certified on major public X.25 networks in the U.S. and Europe
- Built on an OSI layered architecture
- Capability to be shared by multiple Series 900 hosts on the same LAN

HP Asynchronous Serial Network Link

The HP Asynchronous Serial Network Link (HP ASNL) provides a remote asynchronous connection for MPE V-based HP 3000s and Vectra and IBM PCs to communicate with MPE V-based HP 3000 systems. The communication link is made through the standard ATP. For system-to-system communication, the HP ASNL provides all software for a complete network connection for an HP 3000 minicomputer or can be used in conjunction with NS3000 if more network services are required. For a PC-to-system connection, the HP Serial Network User link software for PCs and the HP Serial Network PC Configuration and Diagnostics Software and License for HP 3000s must be purchased.

The features of the HP Asynchronous Serial Network Link include:

- Full support for PC and HP 3000 remote links
- Uses standard HP 3000 ATP hardware
- Supports Hayes-compatible auto-dial modems and HP 2334 stat muxs
- Supports NS3000/V Transport and Services
- Supports Office Productivity Services for PC remote links
- Provides virtual terminal access
- Supports 1200 and 2400 baud connections on PC and HP 3000; 9600 baud on HP 3000 only

Intelligent Network Processor

The Intelligent Network Processor (INP) is a communication card that allows HP 3000 MPE V-based systems to be linked to other computers in a distributed data processing environment. It also supports multipoint terminals.

The significant features of the Intelligent Network Processor are:

- 16-bit microprocessor
- Data communication protocol handling
- Character handling and 32 Kb buffer storage
- Modem and hardwired interfaces up to 56 Kbits per second
- Full- and half-duplex asynchronous modem support
- Bisync and HDLC/SDLC protocol compatible
- RS-232C, RS-422, CCITT V.24 and V.35 interfacing
- Direct memory access for data
- Auto-dial capability

The protocol driver can be dynamically changed. This allows the INP to be reconfigured easily from one data link protocol to another and permits several subsystems to use a single INP. An auto-dial capability allows a remote dial-up connection to be made without the intervention of an operator.

Programmable Serial Interface

The Programmable Serial Interface (PSI) card, which connects to the Central Bus (CTB), allows HP 3000 900 Series systems to be linked to other computers in a distributed data processing environment. Significant features of the PSI are:

- 10-MHz 68000 microprocessor
- Data rates to 64 Kbits per second
- Full- and half-duplex EIA RS-232C, RS-422, RS-423, RS-449, and RS-366A CCITT V.28, V.24, V.10, V.11, V.35, and X.21
- NRZ, NRZI, or FM data encoding/decoding
- SDLC and LAP-8 protocol compatible
- On-board self-test
- Direct Memory Access for data
- Auto-dial capability

The PSI provides the physical interface and data link protocol management for both HP-to-HP and HP-to-non-HP remote communication. Auto-dial capability is included with the PSI, allowing remote connections to be made in a dial-up environment without the intervention of an operator.

HP 3000-to-IBM Mainframe Communication

An HP 3000 or a subnet of HP 3000s can communicate in either batch or interactive mode with an IBM mainframe. In addition, the HP 3000 can communicate to the IBM host in either an SNA or BSC environment, and can send and receive electronic mail to PROFS and/or DISOSS residing on the IBM mainframe.

SNA Communication

For SNA communication, there are gateway or stand-alone solutions available. The SNA standalone products (i.e., non-gateway products) are SNA Interactive Mainframe Facility (IMF) for interactive communication, SNA Network Remote Job Entry (NRJE) for batch communication, and HP LU6.2 Application Programming Interface (API) for program-to-program communication. Both SNA IMF and SNA NRJE are available for all HP 3000 systems. These products work in conjunction with SNA Link, which provides the physical interface and lower layer SNA software for SNA network communication.

SNA IMF allows access to 3270 applications on the IBM mainframe such as TSO, CICS and IMS via programmatic or PassThru mode. In programmatic mode, application programs on the HP 3000 emulate IBM 3270 terminals and printers, exchanging data with the host via intrinsics (user-callable procedures). In PassThru mode, users of HP terminals and printers can access 3270 applications on the host as if they were using IBM 3270 devices.

SNA NRJE allows HP 3000 users to submit large batch jobs and transfer files between the IBM mainframe and the HP 3000 system. In addition, SNA NRJE allows routing of the job output from the IBM host to any standard output device on the HP 3000, such as tape units, discs, and printers. Similarly, jobs can be input through any standard input device such as terminals, card readers, or disc. Reverse NRJE allows a user connected to an IBM mainframe to start a job on the HP 3000. SNA NRJE emulates an IBM 8100 DPPX/RJE workstation.

LU6.2 API will allow third parties and end-users to develop HP 3000 applications that use the LU6.2 protocol to communicate program-to-program with LU6.2 applications running on IBM systems elsewhere in the SNA network.

The HP 3000 can also act as a gateway for an HP 3000 network to an SNA network. SNA Server allows a single MPE V-based system in a network to act as a transparent gateway for SNA IMF and SNA NRJE communication for all HP 3000 users on a LAN.

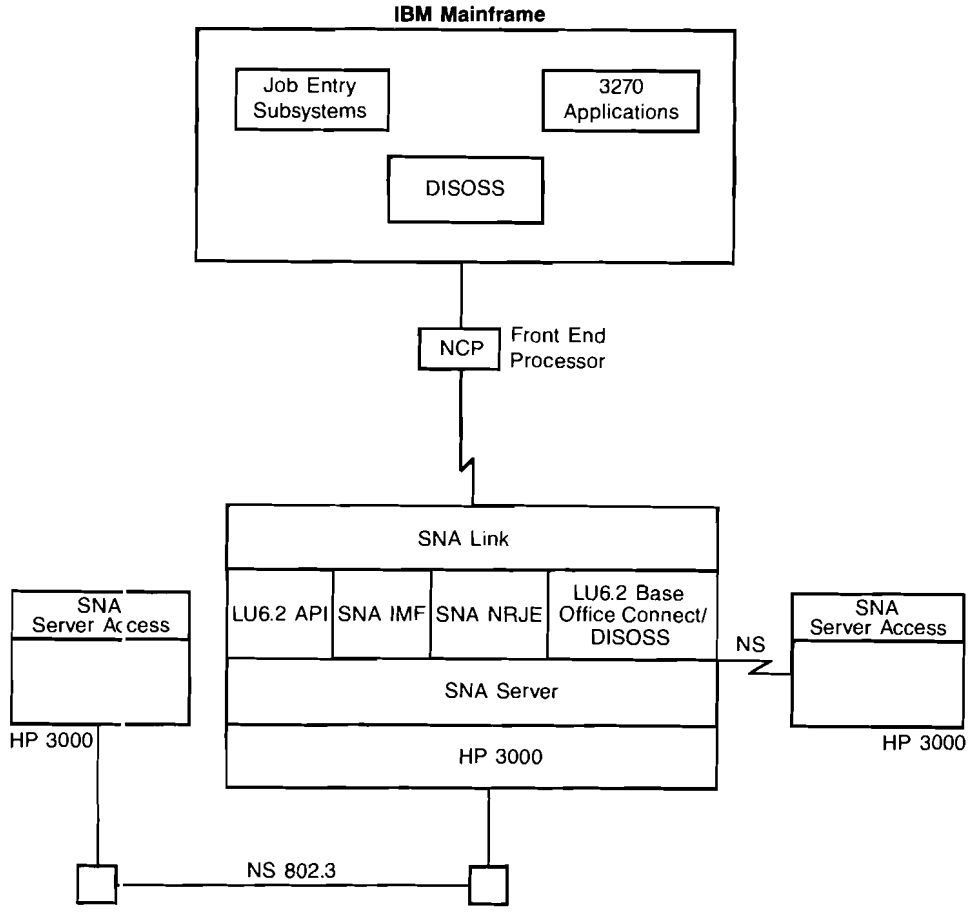


Figure 6-9. SNA Communication

It appears to users connected to each processor on the LAN as if SNA NRJE and SNA IMF reside directly on their processor, when these products actually reside on just one HP 3000 MPE V processor connected to the LAN. HP SNA Server Access allows you to transparently transmit input to, and receive output from, an IBM mainframe through the MPE V-based HP 3000 systems installed with SNA Server.

E-Mail Office Communication

HP Office Connect to X.400, HP Office Connect to DISOSS and HP Office Connect to PROFS all allow multiple HP DeskManager users on different HP 3000s in an HP DeskManager network to exchange, file, and convert electronic mail between their HP 3000 system and an IBM mainframe running DISOSS or PROFS.

BSC Communication

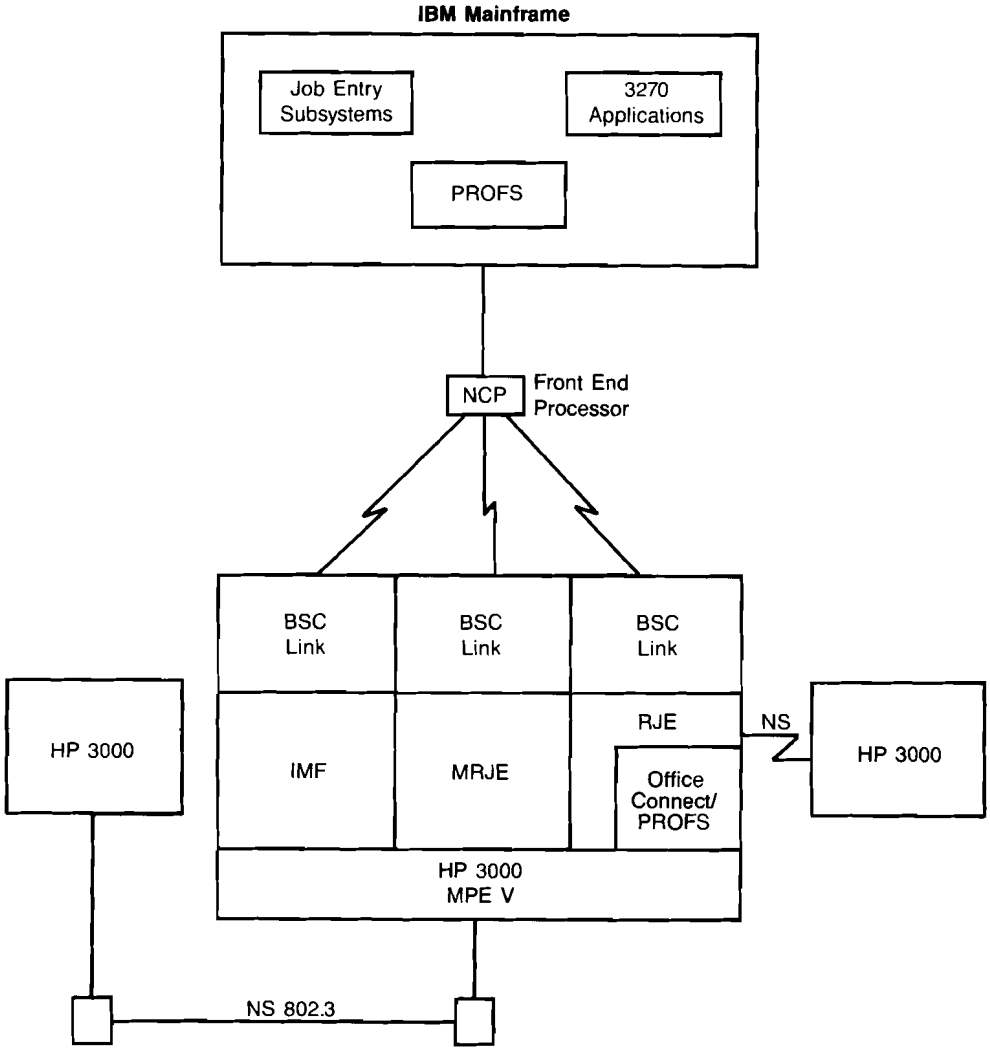


Figure 6-10. BSC Communication

HP also provides interactive and batch products for the bisynchronous IBM network. (See Figure 6-9 on the following page.) These products include Remote Job Entry (RJE) for single-user remote job entry using 2780/3780 BSC protocol, Multileaving Remote Job Entry (MRJE) for multiuser remote job entry using HASP multileaving BSC protocol, and IMF for interactive communication using 3270 BSC protocol. All of these bisynchronous networking products run on an MPE V-based HP 3000 and can be accessed from a system on the same HP 3000 LAN. (Note that the BSC product may run on the same HP 3000 gateway running SNA Server or SNA Link.) In the future, BSC batch emulation will also be available for standalone use on the 900 Series.

Future Directions

Hewlett-Packard currently has an entire research and development facility working on the development of new products that will enable you to communicate within IBM environments. Among these products are:

- In addition to existing value-added solutions, a software-only, enhanced reverse pass-through product allowing IBM terminal users to access HP applications on an HP 3000.
- SNA-to-X.25 conversion software allowing SNA communication between the 900 Series system and the IBM mainframe over an X.25 network.

Other committed future directions include support of IBM's Network Management Architecture in all SNA HP-to-IBM products, coexistence with Token Ring Network environments, and support for Physical Unit 2.1 (PU2.1).

HP Network Management

Network Management is the ability to monitor, diagnose and control each component of a network. ISO has identified five network management functions:

- Fault management: the ability to detect, diagnose, and resolve problems throughout the network and to restore components that have failed.
- Performance management: the ability to optimize network performance through the collection and analysis of network data.
- Accounting management: tracking network resource utilization and traffic in order to manage costs and accurately bill for network use.
- Configuration management: controlling local and remote configurations of network components.
- Security management: safeguarding network components from access by unauthorized parties.

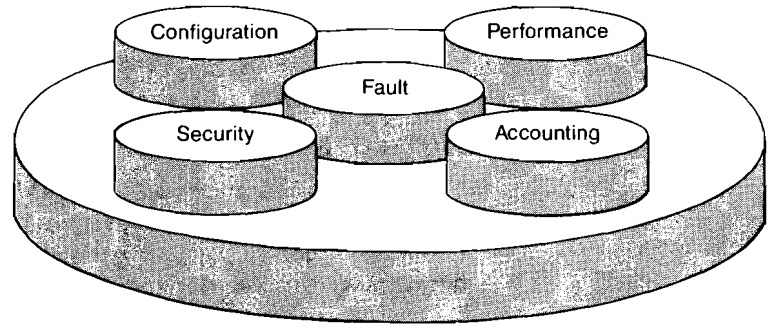


Figure 6-11. Network Management

The objective of HP's Network Management is to provide network customers with the tools to create and manage private data networks through all phases of the network life cycle.

Remote Console Operations

INCS/3000

An HP special product, Integrated Network Console Support (INCS/3000), provides the capability for centralized management of multiple HP 3000 computers in a network. INCS can be used in a local, remote, or mixed network environment. In a local environment, such as a data center, INCS eliminates the need for multiple system consoles. In a distributed network environment, the central hub, or management node, controls and monitors all remote HP 3000 systems and can obviate the need for operators at remote sites.

INCS gives an authorized user on the management node the ability to operate and monitor all nodes in the network through centralized operation of the remote nodes' system console functions.

Presently, HP is investigating ways to increase the functionality of INCS. A regular product based on INCS is also currently under development for future release.

NetCI

NetCI, a remote command interpreter which is integrated into NS3000, centralizes operator functions and improves productivity. NetCI allows a single operator to execute commands on any remote system accessible to NS3000 without having to manually establish a remote session. By reducing the need for remote operators, companies can reduce costs.

Remote command execution can be interactive, or it can be controlled by script files complete with variables and conditional branching. The output from the command execution may be stored in log files, if desired, for later analysis.

While NetCI is not specifically a tool for troubleshooting the network, it allows you to reduce troubleshooting time and effort by helping to quickly isolate some network problems from one terminal.

Performance Management

OPT/3000 is a system management tool that is used to improve performance. It tracks the system workload through measurements of CPU and main memory utilization, I/O traffic, process activity, and system table usage. OPT/3000 can be used interactively to tune system and program parameters.

Network Configuration Management

The NMS configuration manager (NMMGR) is a menu-driven configuration utility that is used to create and enter information into a configuration file. The information in the configuration file is then used by the data communication products on the network to determine their operating characteristics.

Network Diagnostics

The LAN Node Diagnostic (LANDIAG) is an on-line diagnostic tool that verifies the LANIC components by running the LANIC self-test as well as a series of diagnostics to test the Attachment Unit Interface (AUI) and the Medium Attachment Unit (MAU). LANDIAG extends diagnosis as far into the LAN as possible, dependent upon the equipment connected to the LANIC. LANDIAG testing includes a Remote Node Test which sends and receives test frames between nodes.

Security Management

HP Security Monitor/V is a fully integrated system security program that protects both system resources and sensitive data from unauthorized access.

Information Distribution

NetDelivery/V

NetDelivery/V is an application development product which enables the reliable transfer of messages and files either locally or across a network in an HP 3000 environment. The product enables the delivery of data between two HP 3000 systems which are not directly connected and without requiring a synchronous connection between the systems.

NetDelivery consists of a set of intrinsics which a programmer would use to develop distributed applications. At the same time, it is a transport service which delivers data from one application to another.

NetDelivery/V can be used to send large amounts of data from one location to another. For example, sales information from remote offices can be consolidated at a regional office before being sent to a corporate location for final analysis. NetDelivery will insure that the information arrives at the intended destination, even if a system is unavailable or the link between systems is down

NetDelivery can effectively handle system unavailability and link failure because data is stored on disc before being transmitted throughout a network. The product will periodically attempt to deliver the data when the system or link becomes available.

With NetDelivery, you can specify when message transfers will take place. And because NetDelivery is an asynchronous or background service, applications using the product are not forced to wait for data transfer to complete before processing additional information.

NetDelivery is currently available on HP 3000 MPE V systems. Future releases of the product will be available on MPE XL operating systems. For multivendor connectivity, Hewlett-Packard will offer a NetDelivery/X.400 connection.

HP DeskManager

HP DeskManager, together with optional products HP AdvanceMail, HP File/Library, and HP Schedule, provide PC and terminal users with versatile communication and information distribution capabilities. These communication services permit the easy exchange of documents and messages, shared filing,

complete time management, resource scheduling, and application integration, all in a customizable environment.

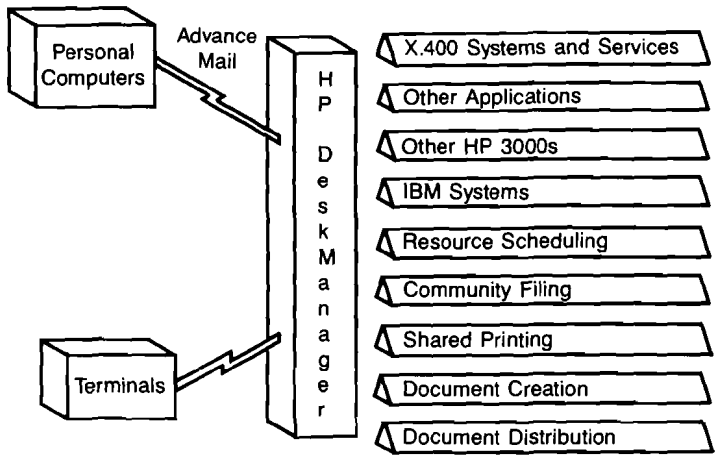


Figure 6-12. HP DeskManager

Office Connect to X.400

Office Connect to X.400 uses OSI standards to provide multivendor connectivity fo HP DeskManager. This allows HP DeskManager users to exchange electronic mail messages with users of other electronic mail systems and services which support the X.400 standard. Office Connect to X.400 handles all the required X.400 addressing and conversions transparently, allow HP DeskManager users easy access to the X.400 environment without additional training.

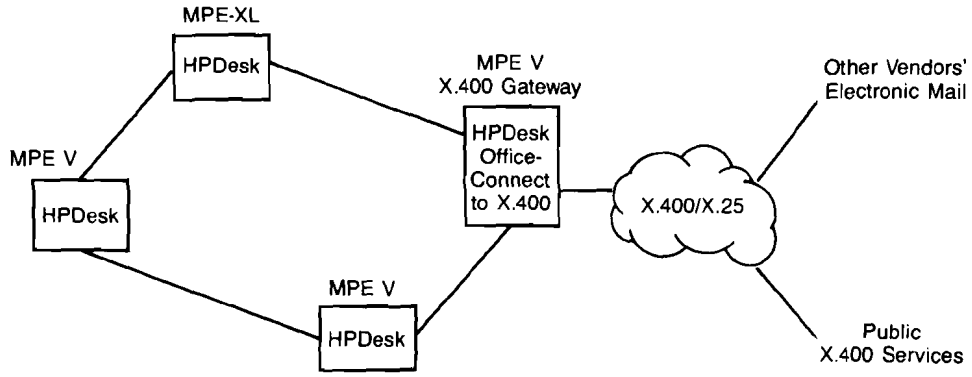


Figure 6-13. Office Connect to X.400

Office Connect to X.400 is currently available for MPE V systems, and this product offers X.400 access indirectly (through an MPE V X.400 gateway) to MPE XL systems on the same HP DeskManager network.

Office Connect to X.400 includes not only X.400 but also all of the required supporting OSI networking layers (Session, Transport and X.25). Office Connect to X.400 will be available on MPE XL systems in a future release.

HP Office Connect to DISOSS and HP Office Connect to PROFS allow multiple users on different HP 3000s in an HP DeskManager network to exchange, file, and convert electronic mail between their HP 3000 system and an IBM mainframe running DISOSS and PROFS, respectively.

Network Management

The size, complexity and importance of information networks are ever growing. Most companies are becoming increasingly dependent on data communications to operate their businesses, from local-area networks used in factories and offices to wide-area corporate networks spanning the globe.

As networks become more complex and geographically dispersed, organizations face a growing need for effective network management. To meet this need, Hewlett-Packard has created OpenView, a complete family of network management tools for local- and wide-area multivendor networks.

The objective of Hewlett-Packard's OpenView is to provide network customers with the tools to create and manage information networks through all phases of the network life cycle.

The OpenView Family

OpenView refers to a comprehensive family of network management products and services. These can be grouped into three areas:

- Software applications
- Network-independent tools
- Network management services

Most of the HP OpenView products are integrated under a common graphical user interface called HP OpenView Windows.

A Truly Open System

HP's OpenView Windows Developer's Kit allows anyone to quickly and easily write network management applications integrated under a common user interface. No other vendor gives third parties the ability to fully integrate -- not NetView, not AT&T, not DEC. The key difference is that OpenView offers all applications full management functionality. Because OpenView is based on international standards, it is the only system that can provide complete multivendor integration.

Flexible Structure

Because network managers have different needs depending on the types of networks they manage or the companies they work for, OpenView gives network managers the ability to customize the system to fit their own needs. By purchasing only the applications the manager needs, OpenView can be tailored to fit each organization. In this way, OpenView can manage everything from international wide area networks to small office LAN's -- from one location or several.

Integrated Console

Every network manager knows that in today's multivendor environment, each system has its own console and its own user interface. This situation makes it tough for a single person to learn the whole system or to effectively manage it.

OpenView solves that problem by putting the network management tools into a single workstation with one user interface. This shortens learning time and greatly simplifies network management. The end result is lowered costs through reduced training time and decreased staffing needs.

Standards-based Approach

In keeping with the entire AdvanceNet strategy, OpenView is fully committed to international and industry standards. This approach assures the greatest interoperability with other vendors' equipment and offers customers the greatest value and freedom of choice. Network management standards are not just a far-off wish; HP is implementing them today through its work in national and international standards bodies and the OSI Network Management Forum, a cooperative organization comprised of more than 20 major networking vendors. As the standards become better defined, any changes will be incorporated into the underlying system with no differences visible to the end user. This transparent migration is possible thanks to the OpenView Windows user interface technology.

Modular Design

Each application can be plugged-in individually under the user interface, so you by only what you need and get full value for your networking investment.

Graphical, Menu-based User Interface

OpenView Windows provides an easy-to-learn and easy-to-use environment that is the same for all OpenView applications. The user of color graphics and an intuitive menu-driven interface greatly simplifies the task of network management. Now there is no longer any need for a network manager to spend time learning complex command sequences. OpenView Windows lets you focus on managing the network, not on learning the network management system.

Distributed Network Management

Unlike the systems offered by other vendors, OpenView distributes network management computing across the network. Because you don't need a new computer just for network management, this means low-cost entry. As your network management needs grow, you can increase your network management investment financial commitment gradually.

Supports Multivendor Networks

Quite rare are networks where only one vendor is present. As the need for powerful, cost-effective networks grows, your networking environment will become increasingly mixed. Through OpenView, HP offers true multivendor network management capability.

7

Peripheral Devices

Hewlett-Packard designs and manufactures a very broad range of computer peripherals to meet the needs of all HP computers. HP has long had a reputation in the electronics industry for excellence in computer peripheral products.

HP is a leader in printers that use laser-scanning technology. These microprocessor-controlled printers provide advanced printing capabilities such as electronic forms, multiple fonts per page, high resolution, and type size variations. A wide range of impact printers are also available.

HP's personal computers -- the Portable PLUS and the IBM-compatible Vectra family -- provide a broad range of personal computing solutions and extend the power of the HP 3000. HP's terminals combine quality ergonomic design with high-productivity features such as forms caching and block-mode operation.

HP has combined thin-film technology for heads and media with seven generations of disc drive design and manufacturing to produce a series of disc drives with superior performance, very low-cost per-megabyte storage, and industry-leading reliability. High-density data storage and compact size provide the ideal storage systems for a wide range of multiuser computer systems.

HP's open-reel and cartridge tape drives offer ideal backup solutions for systems of all sizes. In addition to providing secure data storage, they save valuable floor space and improve operator efficiency.

Figure 7-1 is a guide to the suggested use of peripherals for each HP 3000 system.

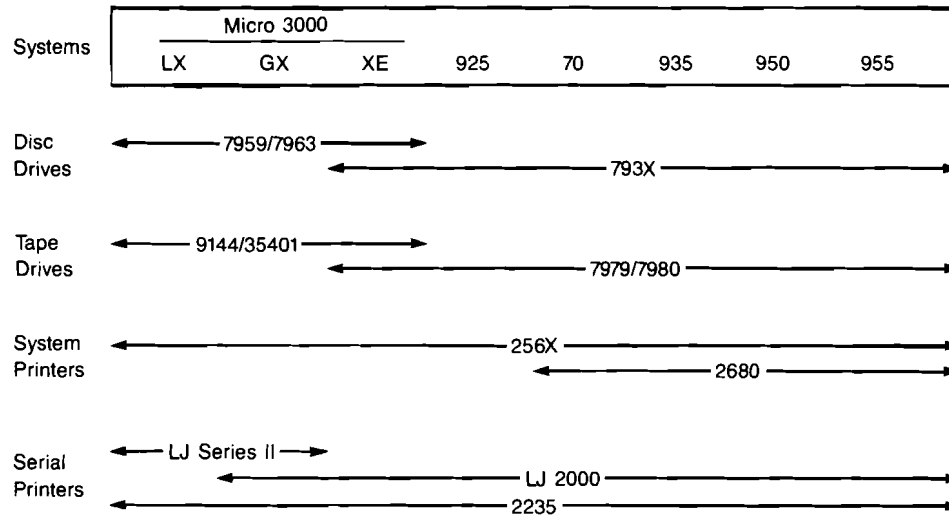


Figure 7-1. HP's Peripheral Family

Peripheral Connections

HP-IB Channels

Disc drives, tape drives, and system printers are connected to the systems via the Hewlett-Packard Interface Bus (HP-IB). HP-IB is Hewlett-Packard's implementation of the IEEE standard 488-1975 interface.

HP-IB is a cost-effective solution that allows customers to continue using many of the peripheral devices they already have when upgrading from one HP system to another.

An HP-IB Channel consists of an HP-IB cable connected to an HP-IB interface card. The interface card, which is connected to the system's backplane, performs protocol translation between the CPU and HP-IB. Up to six devices can be connected to a single HP-IB Channel.

HP-IB is an 8-bit wide, asynchronous bus. Each HP-IB has eight data lines and eight control lines. HP-IB can support sustained data transfer rates of up to 1 Mb per second.

HP-FL Channels

On 900 Series systems, customers have the option to connect discs via HP Fiber-Optic Link (HP-FL). HP-FL is the preferred solution for new systems.

Besides offering a fast, 5-Mb per second data transfer rate, HP-FL allows disc configurations beyond those supported by HP-IB. HP-FL also supports cable lengths of up to 500 m, allowing greater flexibility in disc placement.

The HP-FL interface is a CPU-resident card providing an interface between the fiber-optic cable and the CIO backplane on 900 Series systems. The cable between the CPU and disc drive is the fiber-optic portion of the HP-FL architecture. A wire Pbus cable, which also operates at 5 Mb per second, is used to connect subsequent drives to the fiber-optic cable. A total of up to eight 7936/37FL disc drives can share one HP-FL interface via Pbus cables.

Workstation Connections

The Advanced Terminal Processor (ATP) is used to connect workstations to MPE V-based HP 3000 systems in a point-to-point configuration. On the 900 Series, asynchronous terminals and serial printers are connected through Distributed Terminal Controllers (DTCs). For a detailed discussion of each of these products, refer to Chapter 6: Networks.

Disc Drives

HP 7936 and HP 7937 Disc Drives

The HP 7936 and HP 7937 disc drives, using thin-film media, combine compact size with high-density data storage to provide the ideal storage system for a wide range of multiuser computer systems.

The HP 7937 provides 571 Mb of formatted data storage on seven 8-inch platters and is an ideal product for high-end mass storage. The HP 7936 uses four platters for 307 Mb of storage and is well suited as an entry-level disc drive for

smaller systems. These capacities provide very low-cost per-megabyte storage for HP 3000 systems.

The compact size of the drives allows up to eight drives to be stacked in a single cabinet. (A two-drive cabinet is also available.) In addition, it is possible to rack-mount two 7936 or 7937 drives in the Series 925 or 935 cabinet. Modular design offers great flexibility in rack mount and cabinet configuration to help you optimize the use of floor space. Low power consumption and a wide tolerance for ambient conditions make the disc drives suitable for installation in a variety of environments, including the factory floor, the data center, and the typical business environment.

A sophisticated dual servo system in each drive provides fast head positioning with the precise accuracy required by high track densities. Variable-length frequency modulation is used to take full advantage of the high bit density available with HP designed and manufactured thin-film media.

Technical details:

- 571 Mb (formatted), HP 7937
- 307 Mb (formatted), HP 7936
- 2.35 Mb per second internal burst data transfer rate
- 20.5 ms average seek time
- High reliability (Mean Time Between Failures (MTBF) greater than 70,000 hours)
- Efficient use of floor space
- Low power consumption

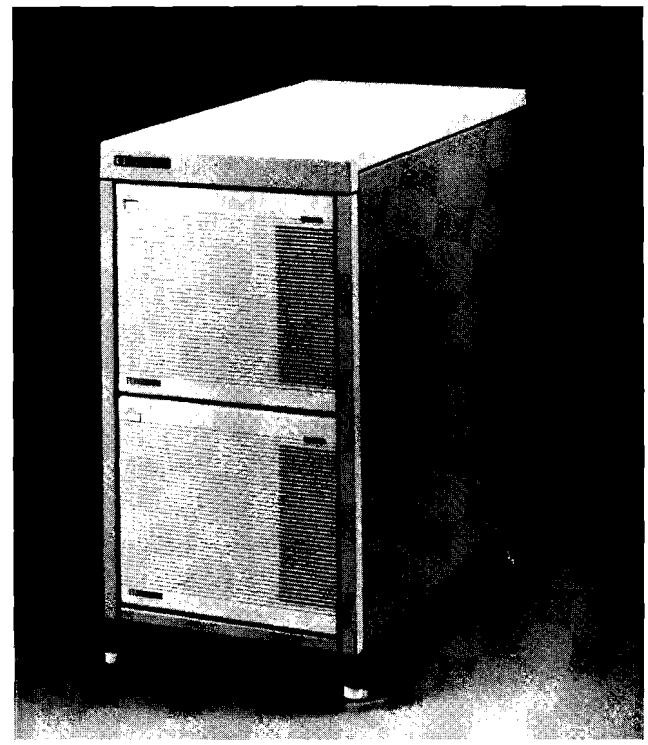


Figure 7-2. The HP 7937 Disc Drive

HP 7959B and 7963B Disc Drives

The HP 7959B and 7963B Disc Drives are high-performance 5 1/4-inch disc drives that use thin-film heads and media and are packaged with an intelligent controller and power supply in a compact box. These new disc drives are based on an HP designed and manufactured head/disc assembly that features an average seek time of 17 ms and a burst data transfer rate of 1.25 Mb per second.

When these leading-edge disc mechanisms are combined with HP's low-overhead HP-IB controller, the result is products that have the capacity and performance tailored for Hewlett-Packard's entry-level HP 3000 systems. Currently these new disc drives are supported only on MPE V-based systems. In the future, they will also be supported on 900 Series systems.

The HP 7959B and 7963B products are designed to offer Hewlett-Packard customers industry-leading reliability and ease of support. The reliability of these products is based on seven generations of disc drive design and manufacturing experience at Hewlett-Packard. The drives feature a unique track positioning system, using embedded servo code, that essentially eliminates seek errors and provides greater read/write accuracy over the entire operating temperature range. Product serviceability is enhanced by extensive self-test capabilities and error-logging, as well as a package design that allows quick access to all replaceable assemblies.

The 7959B and 7963B use the same basic disc mechanism. The only difference between them is that the HP 7963B is designed for growth. The 7963B package accommodates two additional disc mechanisms, which allows a configuration of 304 Mb to 912 Mb in one package. A 304-Mb upgrade kit (97963B) provides a total solution that is lower in price than two equivalent but separately packaged drives.

The HP 7959B and 7963B products are supplied with all the necessary accessories and are fully configured and ready to operate after being configured into the HP 3000 system. Besides being ideal for desktop use, the products fit into HP's mobile mini-rack cabinets.

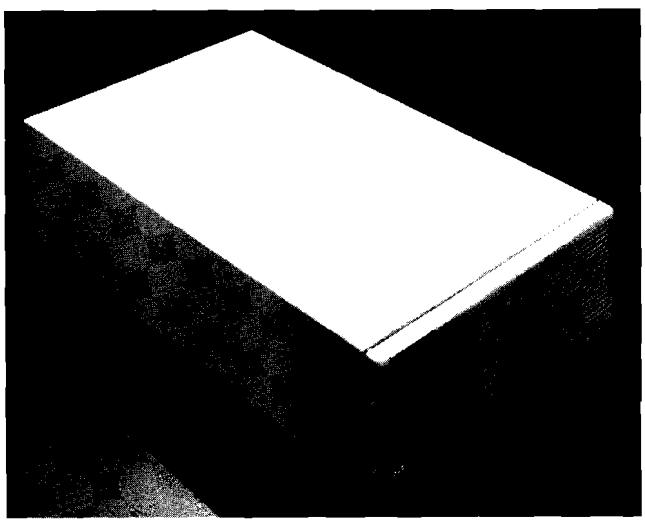


Figure 7-3. The HP 7963 Disc Drive

Technical details:

- Supported by MPE V-based systems
- 304 Mb (formatted) -- HP 7959B, HP 7963B
- Add-in drive for 7963B, 304 Mb (formatted) -- HP 97963B
- 17 ms average seek time (includes settling)
- 1.25 Mb per second burst rate
- Quiet operation
- Normal office environmental specifications
- High reliability
- Compact size (7959B: 132 mm high, 325 mm wide, 285 mm deep. 7963B: 132 mm high, 325 mm wide, 554 mm deep.)
- Low power consumption

Magnetic Tape Drives

HP 7979A/7980A 1/2-inch Tape Drives

The HP 7979A and 7980A 1/2-inch tape drives are designed to save valuable floor space and improve operator efficiency for mid-range and high-end systems.

The HP 7980A is the perfect backup solution for systems with 400 Mb or more of disc space. This high-performance drive operates at both 6250 characters per inch (cpi) and 1600 cpi.

The HP 7979A follows the same design as the HP 7980A but offers 1600 cpi density only. It is best suited for systems with 100 to 500 Mb of disc storage. When your system grows, you can upgrade your HP 7979A on-site to an HP 7980A with a field upgrade kit.

Save floor space by mounting two tape drives -- or one tape drive and one 7936/7 disc drive -- in a single cabinet. These tape drives can even be mounted inside the Series 925 and 935 system cabinet.

Both drives have the same autoload feature that accepts any standard reel from 6 to 10 1/2 inches. The operator simply places the reel in the slot and closes the door. The drive does all the positioning and threading.

A tape speed of 125 inches per second, a 512-Kb buffer, and HP Immediate Response and Read-Ahead software maximize streaming performance.

Technical details:

- Density: 1600/6250 cpi (HP 7980A); 1600 cpi (HP 7979A)
- Format: GCR/PE (HP 7980A); PE (HP 7979A)
- Capacity: 140/40 Mb (HP 7980A); 40 Mb (HP 7979A)
- Operating mode: Streaming or start/stop emulation
- Tape speed (inches per second): Read/write, 125 ips; rewind, 320 ips average
- Burst transfer rate (bytes per second): 781 Kbps (6250 cpi); 200 Kbps (1600 cpi)
- Two-track error detection and correction (6250 cpi)

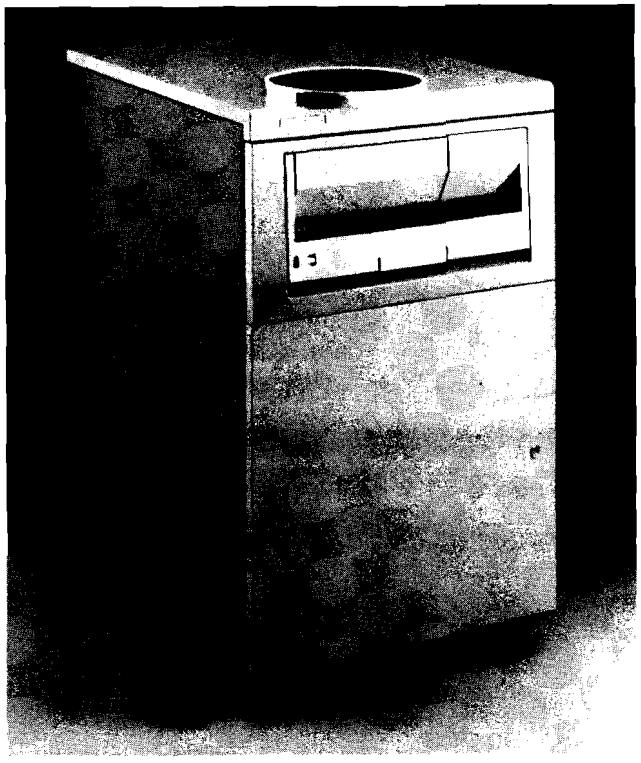


Figure 7-4. The HP 7980 Tape Drive

HP 9144A 1/4-inch Cartridge Tape Drive

The HP 9144A 1/4-inch cartridge tape drive is the low-cost, convenient backup solution for MICRO 3000 systems with up to 132 Mb of disc storage. This stand-alone drive accepts 16- and 67-Mb-capacity cartridges. It features immediate READ-after-WRITE, automatic error correction on READ, and a 2 Mb per minute transfer rate.

Technical details:

- Supported by MPE V-based systems
- Backup 67 Mb in 45 minutes
- HP-IB interface/CS80 protocol
- 2 Mb per minute transfer rate with Immediate Response (system dependent)
- Streaming device with gentle tape handling

HP 35401A Autochanger 1/4-inch Cartridge Tape Drive

The HP 35401A Autochanger 1/4-inch cartridge tape drive provides cost-effective, unattended backup for MICRO 3000 systems with up to 536 Mb of data. Media and format are compatible with the HP 9144A 1/4-inch cartridge tape drive, so you can move up to the HP 35401A when your backup needs grow without losing archived data or having to change media.

Technical details:

- Supported by MPE V-based systems
- 2 Mb per minute transfer rate
- Design Plus cabinet, stand-alone, or 19-in EIA rack mount
- Autochanger handles up to eight cartridges
- Sequential and selective modes of operation
- Immediate READ-while-WRITE and automatic error correction on READ.

System Printers

HP 256XB Family of Dot Matrix Printers

The HP 256XB family of dot matrix line printers is designed for a wide variety of printing applications and offers many special printing capabilities, such as raster graphics, compressed print, double-size and block characters, OCR characters, bar code printing, and math and multinational character sets. Other convenience features include paper-out and paper-jam detection, a 16-channel downloadable vertical forms control, and easy forms alignment. In addition, this family features:

- High reliability
- Excellent print quality
- Interfacing flexibility

The HP 256X family is composed of the:

- HP 2563B -- a 300-lpm printer that comes standard as a 55-dBA unit with quietized cabinet, sound enclosure, and passive paper stacker. A 65-dBA desktop model is also available without the cabinet, sound enclosure, and passive paper stacker.

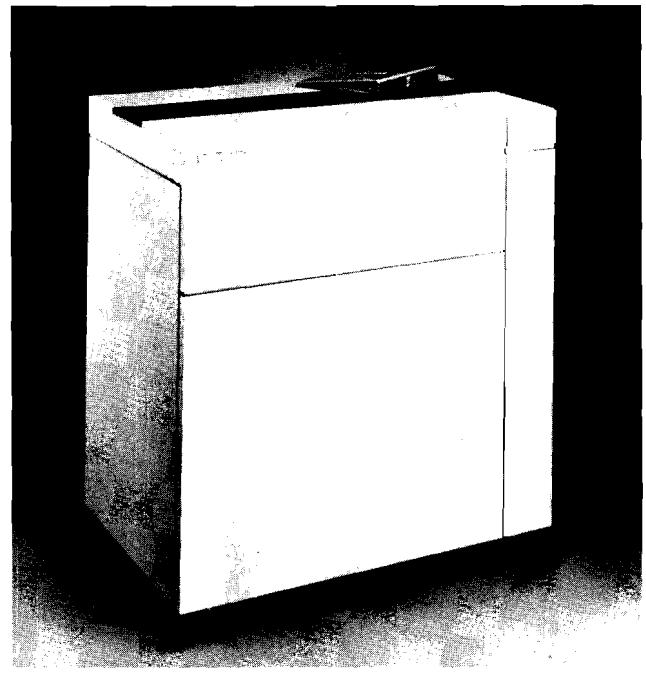


Figure 7-5. The HP 2566 Line Printer

- HP 2564B -- a 600-lpm printer that comes standard as a 55-dBA unit with quietized cabinet, sound enclosure, and passive paper stacker. A 65-dBA cabinet model is also available without the sound enclosure and passive paper stacker.
- HP 2566B -- A 900-lpm printer.
- HP 2567B -- a 1200-lpm printer. The speed of this printer can be increased to 1600 lpm with an optional sparse character set.

Also available for each of these printers is the HP Label Card, which adds versatile forms, graphics, and labeling capabilities. This option greatly expands the types, sizes, and shapes of printed characters and also generates forms, lines and bar codes. It provides the ability to create and print labels, minimizing the need for preprinted labels. It utilizes the powerful and easy to use QMS Magnum programming language.

In addition to being HP-IB devices, the 256X family can also be connected serially through an RS-232 or RS-422 interface.

HP 2680A Laser Page Printer

The HP 2680A laser page printer offers advanced laser scanning technology and printing capabilities.

The HP 2680A prints 45 pages per minute and is designed for the high-volume EDP environment. It provides 180 dots per inch resolution and uses continuous-feed paper in a variety of sizes including 8 1/2 by 11 inches. The HP 2680A is designed to print 300,000 to 800,000 pages per month. Bar code and OCR-A/B character sets are optionally available.

Besides its speed and laser-technology reliability, this printer does jobs that traditionally have required retyping, cut-and-paste work, reformatting, and photo reduction. As a result, it provides significant cost savings and productivity improvement.

The 2680A is also available as a 2685C, which can be used as a remote printer over long-haul and short-haul data communication lines. The 2685C is bundled with a disc drive, tape drive, terminal and SPU (HP MICRO 3000LX, GX, or XE).

Technical details:

- High-quality output
- More than 200 predefined character sets
- More than 60 predefined forms
- Forms Design software (PSP) lets users create their own electronic forms
- Up to 32 fonts on any page
- Portrait or landscape orientation
- 2:1 and 4:1 reduction
- Capability to merge graphics and text in printed output
- Microprocessor controlled
- Sophisticated self-diagnostic hardware
- Prints on label stock

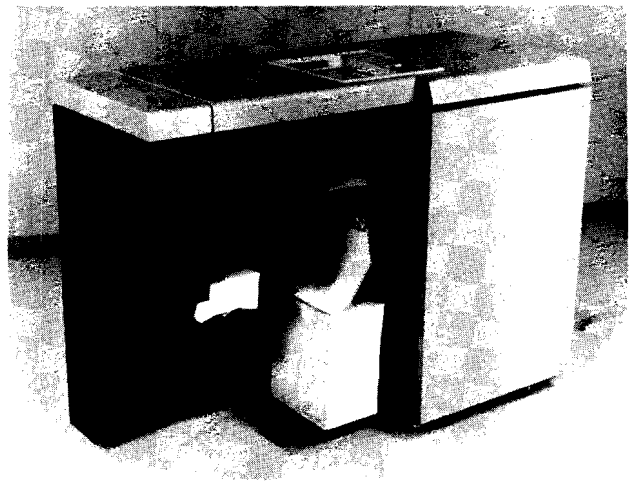


Figure 7-6. The HP 2680 Laser Printer

Printers Connected Serially

HP LaserJet Series II

The HP LaserJet Series II printer is the second-generation personal laser printer from Hewlett-Packard. The LaserJet Series II prints 8 pages per minute at up to 300 dots per inch (dpi) resolution.

The LaserJet Series II comes with 6 internal fonts, 23 symbol sets, and an easy-to-use front control panel. It has 2 font cartridge slots and can store up to 32 disc-based soft fonts in sizes from 6 to 48 points. The printer is completely compatible with the LaserJet Plus, so all software, font cartridges, and soft fonts that work with the original LaserJet Plus printer will work with the LaserJet Series II.

Technical details:

- 512 Kb memory standard, expandable to 4.5 Mb in 1, 2 or 4 Mb increments
- Parallel and RS-232C/RS-422 interface
- Toner cartridge with integral drum prints about 4000 pages of normal text
- 200-sheet input tray, 100-sheet output tray. Pages stacked in correct order
- Prints on letter, legal, executive and A-4 single-sheet paper. Envelopes and heavier paper can be fed manually.

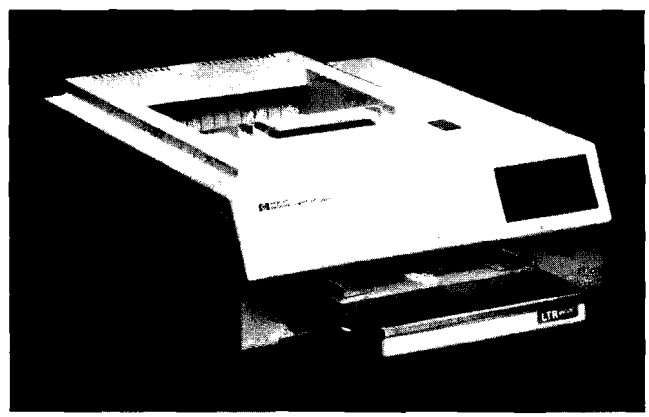


Figure 7-7. The HP LaserJet Series II

HP LaserJet 2000 Laser Printer

The HP LaserJet 2000 laser printer, designed to print up to 70,000 pages per month, is the top of the LaserJet printer line. Designed to meet the high-performance needs of the multiuser PC network and minicomputer environments, the LaserJet 2000 offers many features that make it ideally suited as a departmental printer.

The HP LaserJet 2000 prints up to 20 pages per minute, single-sided, on a wide range of paper sizes. Two-sided (duplex) printing is also available as an option. Two 250-sheet input trays are standard, and a 2000-sheet paper deck can be added. A 1500-sheet correct-order output tray is standard.

Technical details:

- Print resolution 300 by 300 dpi
- Full-page 300 dpi 8 1/2 by 11 inch graphics standard
- Designed to print up to 70,000 pages per month
- Fully compatible with LaserJet PLUS and LaserJet Series II font cartridges and downloadable soft fonts with automatic font rotation
- LaserJet PLUS software compatibility
- 1.5 Mb standard memory expandable to 5.5 Mb total
- Other features include user-definable macros, automatic font and graphics rotation, and many more.

HP 2235 RuggedWriter 480

The HP 2235 RuggedWriter 480 can be used as the primary printer on entry-level systems and as a local printer on high-end systems. At this time, the RuggedWriter 480 is supported only on MPE V-based systems. In the future, it will also be supported on 900 Series systems.

The RuggedWriter 480 is a wide-carriage, 24-wire, serial impact dot-matrix printer that prints 480 cps draft quality and 240 cps letter quality. It is designed to print 3000 pages per month.

Tractor feed is standard. The optional sheet feeder can be used without unloading the tractor-feed paper, and tractor feed can be used without removing the sheet feeder. Single sheets can also be hand-fed.

The RuggedWriter 480 offers built-in parallel and serial interfaces and works with HP, IBM, and IBM-compatible PCs. HP PCL III control and Epson LQ-1000 emulation ensure compatibility with HP system software and most popular independent PC software.

Technical details:

- RS-232 and HP-IB interfaces available
- Courier font standard (letter quality); other fonts available via handy plug-in cartridges
- Paper width up to 15 inches
- 36 x 24 character cell for high-resolution characters
- Full range of print pitches (including proportional spacing) and character attributes (bold, underline, italics, etc.)

Terminals

HP designs and manufactures high-quality terminals specifically for HP 3000 systems. These terminals offer superior system performance and increase user comfort and productivity. HP terminals offer ergonomic features such as anti-glare displays with high character definition and functional keyboard lay-outs. Many of HP's terminals provide display screen tilt and swivel.

HP 700/92 Display Terminal

The HP 700/92 display terminal combines a 14-inch screen, 8 pages of display memory, and an enhanced keyboard with tactile feedback to make your work easier and more productive. The display, with built-in tilt and swivel mechanism, can be switched from 80- to 132-column display and is available in soft white, amber, or green phosphor.

Technical details:

- Printer port standard
- Selectable 80- or 132-column display modes
- Detached adjustable keyboard with 8 shiftable function keys
- Block-mode operation

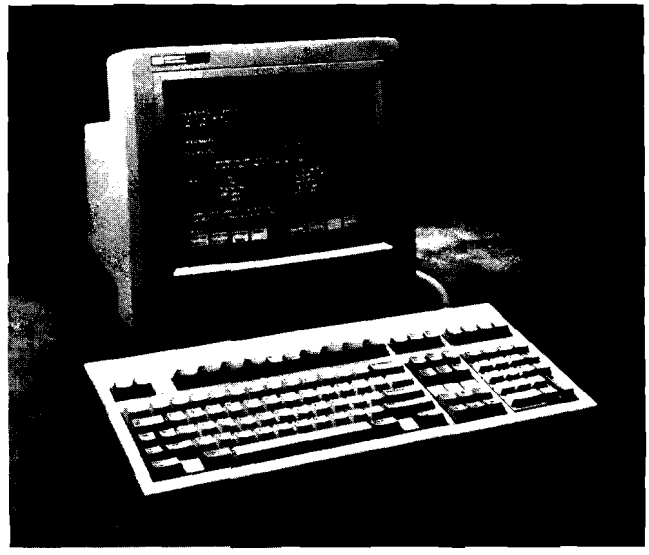


Figure 7-8. The HP 700/92 Display Terminal

HP 700/94 High-Performance Terminal

The HP 700/94 high-performance terminal incorporates advanced capabilities to help you make the most of your HP computer applications. The HP 700/94 provides forms cache for storing an average of 25 forms locally. Local edit checks, modified data tag, and 16 pages of display memory reduce costly host communication.

- Selectable 80- or 132-column display modes
- Printer port standard
- Detached adjustable keyboard with 8 shiftable function keys
- Block-mode operation

HP Personal Computers

HP's personal computers are easily integrated with HP 3000 systems. Users can take advantage of the rich functionality available in PC applications while utilizing the full range of HP 3000 resources. Processing power can then be focused on the PC, reducing the demand on the host system.

With HP Business System Plus, PCs are integrated into a complete departmental solution. Sophisticated mail systems electronically speed information such as documents, graphics and program code throughout your organization. Access to host database information for authorized PC users reduces the demand for specialized MIS reports.

Shared printers, plotters, and disc storage maximize return on peripheral investments. Backing up PC hard discs to the HP 3000 increases data security, and centralized distribution of PC applications increases MIS control.

The Vectra Personal Computers

HP's Vectra Personal Computers present a broad range of price/performance choices (illustrated in Figure 7-9) for the user who needs the local computing capability of PCs together with terminal access to the host computer.

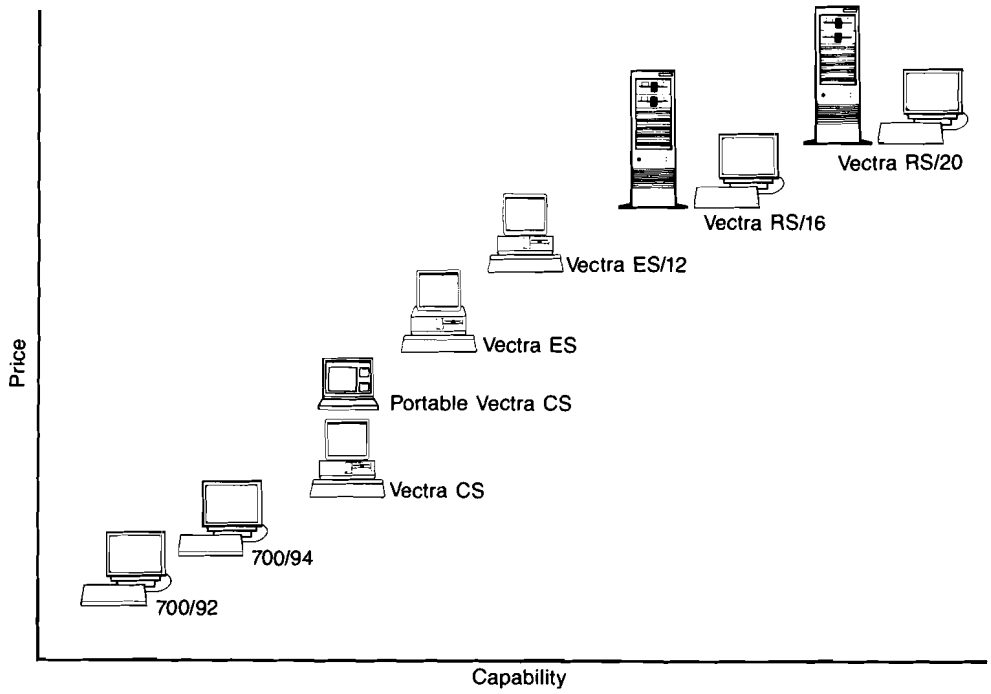


Figure 7-9. Workstation Family

Vectra PC's can be integrated with HP 3000 systems to take full advantage of HP 3000 data and peripherals while offering complete PC-based office functionality.

Each Vectra comes standard with terminal emulation software for accessing host-based DP applications. AdvanceLink and AdvancePrint software is available for file-transfer and shared printing/plotting with the HP 3000.

The HP Human Interface Link (HP-HIL) is supported on Vectra PCs. This allows you to use input devices such as HP Touch, HP Mouse, HP Bar Code Reader, and HP Graphics Tablet.

Vectra Personal Computers are compatible with the IBM PC/AT. This means thousands of software packages and accessories are available on Vectra PCs.

The HP Vectra CS

The HP Vectra CS is HP's least expensive PC. It offers excellent value and runs the thousands of available software packages written for DOS 3.2. The Vectra CS features a 7.16 MHz microprocessor (8086 compatible), 640 Kb of RAM memory, 7 accessory slots, 3 half-height mass storage shelves, a 360-Kb 5 1/4" flexible disc drive, and serial and parallel ports standard. Options include additional disc drives (360 Kb and 1.44 Mb flexible disc or 20 Mb hard disc), color and monochrome monitors.

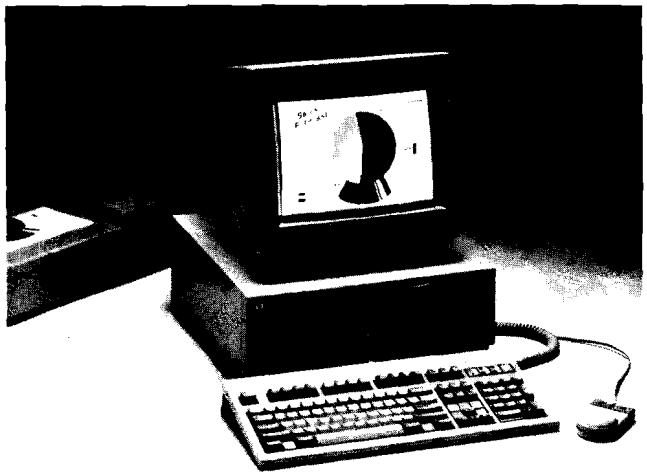


Figure 7-10. The HP Vectra CS

The HP Portable Vectra CS

The Vectra CS (shown in Figure 7-11) is also available in a portable version that offers performance and features similar to the desktop Vectra CS. The HP Portable Vectra CS includes two 1.44-Mb flexible disc drives and operates up to 10 hours on battery. The HP Portable Vectra CS Model 20 PC features one 20-Mb hard disc, one flexible disc drive, and up to four hours of battery life. Both models offer full software compatibility with the IBM PC/XT, which means there is a wide range of industry-standard software available.

The HP Vectra ES and ES/12

The Vectra ES/12 is the recommended 80286 PC workstation because of its superior price/performance. The Vectra ES offers most of the features of the ES/12, but at a lower price. Both are fully compatible with the IBM PC/AT.

The Vectra ES/12 features a 12-MHz Intel 80286 microprocessor, 7 accessory slots, 3 half-height mass storage shelves, 640 Kb of RAM, a 1.2-Mb flexible disc drive, and serial/parallel ports. Options include additional disc drives

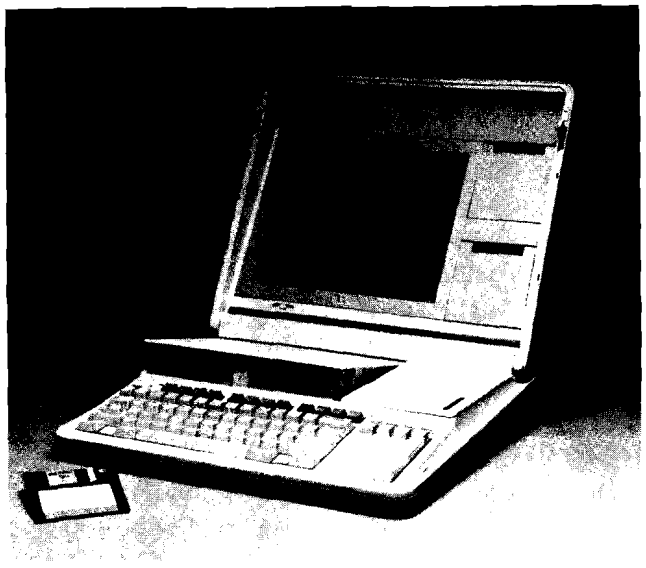


Figure 7-11. The HP Portable Vectra CS

(1.2 Mb flexible disc or 20 or 40 Mb hard disc), color and monochrome monitors, and expanded RAM up to a total of 8 Mb.

The Vectra ES offers all of the same features, but uses an 8 MHz Intel 80286 microprocessor. The ES can be upgraded to an ES/12.

The HP Vectra RS/16 and RS/20

The HP Vectra RS/16 and RS/20 offer premium PC performance and expandability. They are ideal for program development workstations and for running high-performance applications such as large spreadsheets and databases. The Vectra RS/20 features a 20-MHz Intel 80386 microprocessor; 8 accessory slots; 6 half-height mass storage shelves; 1 to 16 Mb of 32-bit memory; serial/parallel ports; 360-Kb, 1.2-Mb, and 1.44-Mb flexible disc drives; and up to 620 Mb of hard disc storage. The Vectra RS/16 offers the same features but uses a 16-MHz Intel 80386 microprocessor.

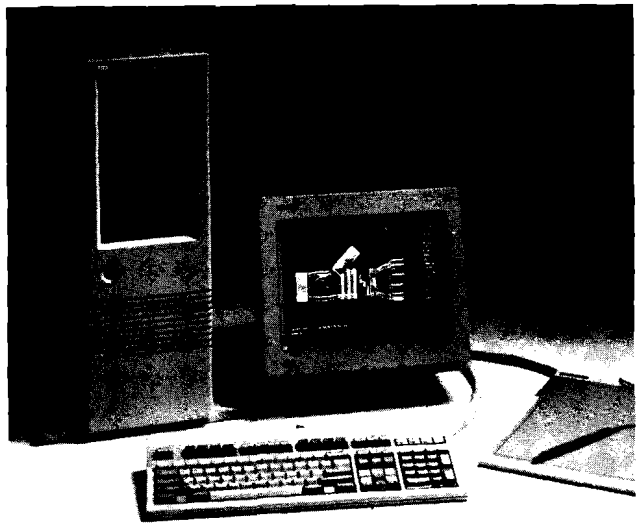


Figure 7-12. The HP Vectra RS/20

The HP Portable PLUS Computer

The Portable PLUS combines the power of a desktop computer with the convenience of portability. You can take it with you on business and personal trips or use it to work at home – anywhere your work schedule demands.

The Portable PLUS provides durability, reliability and full personal computer capabilities, and yet is small enough to fit inside a briefcase. It weighs less than 10 pounds. The keyboard is full size. It has a flat panel, anti-glare, enhanced liquid crystal display monitor with variable tilt and contrast.

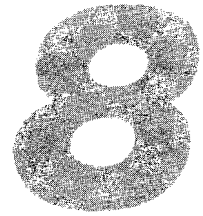
The Portable PLUS comes standard with 256 Kb or 512 Kb of RAM memory, expandable to 1.28 Mb. Another of the system's advanced features is its "disc on a chip" mass storage which is expandable to 1.2 Mb of RAM. Plug-in ROM memory is expandable to 3 Mb. Thus, you can run applications and store large amounts of data without having to carry mechanical discs when you travel.

For more data storage, a portable, 710 Kb, 3 1/2-inch flexible disc drive is available. Also, the Portable PLUS can be connected to the Vectra personal computers and can use their disc drives.

A rechargeable battery powers the system for up to 20 hours. The Portable PLUS alerts you when battery power drops to 20 percent. It automatically enters a protect mode at 5 percent of power which can preserve data for up to a week.

The Portable PLUS connects to an HP 3000 system via a 300/1200 bps internal modem. Terminal mode operation is provided by optional Reflection 1™ terminal emulation software (full block mode).

Many of the software applications are available for the Portable PLUS. These include Microsoft Word™, Lotus 1-2-3™, RBASE™, HP Memomaker, Multimate™ and Executive Card Manager.



Commitment to Your Success

Customer Support Services

Hewlett-Packard's Customer Support Services are designed to ensure long-term, productive use of HP 3000 systems. Support is available throughout the life of your system to meet the needs of your particular applications and working environment.

HP offers a complete spectrum of customer support services for the HP 3000. These services fall into four general categories:

- Hardware maintenance programs provide various levels of hardware support for systems and peripherals.
- A choice of software support programs provides you with the level of software support that best fits your needs.
- Standardized and custom consulting services allow you to develop tailored solutions to meet your application needs.
- Fundamental and advanced training courses speed your ability to take full advantage of your system's capabilities.

HP Customer Support is delivered by a world-wide network of Systems Engineers (SEs) and Customer Engineers (CEs). These extensively trained professionals work closely with both your HP Sales Representative and HP Response Centers to provide you with complete support for your HP 3000 products.

Hardware Maintenance Services

Hewlett-Packard offers a full range of system and peripheral maintenance services for the HP 3000 products. This broad range of contractual services lets you select the support program that best meets your needs.

Several important features are common to all of HP's hardware maintenance services for system products. For instance, on-site warranty for 90 days is included for each HP 3000 system and all HP computer products purchased with the system. After the warranty period, service is continued under an HP Support Agreement, and all HP hardware services include parts and labor for remedial maintenance.

When you purchase an HP System Support Agreement, a CE is assigned to your account to personally manage your maintenance program. Your CE will perform preventive maintenance on a regularly scheduled basis and, if necessary, will adjust or replace parts to ensure a continued high level of performance. Your CE also will install additional equipment, update your system with engineering improvements, monitor your site environment and maintain a current system log.

HP remote support is included with HP hardware support for your HP 3000 system. A communications link via phone line and an HP-provided Support Link modem enable specialists in our Response Centers to access your system in order to remotely run tests and diagnose functional problems.

HP's Predictive support is also included with hardware support for selected HP 3000 systems. Predictive support provides early warning and resolution of potential problems in HP disc drives, magnetic tape media, system memory, INPs, and laser printers. This results in increased system availability through scheduled maintenance and minimized downtime during a repair.

Should your system require troubleshooting, your CE has the training and materials to rapidly resolve most problems. The CE will stay on-site until your problem is solved, even if this involves working beyond your coverage hours. For very difficult problems, your CE can initiate an escalation plan that enlists all the HP resources necessary to provide a solution.

Features included in system support agreements are detailed in the System Hardware Maintenance Service Matrix.

	Standard System Maintenance Service	**Basic System Maintenance Service**
On-Site Response Time		
Within 100 miles[1]	Within 4 hours	Next day
101-200 miles[1]	Within 8 hours	Within 2 coverage days
201-300 miles[1]	Within 12 hours	Within 3 coverage days
Over 300 miles[1]	--- Established at time of order ---	
Coverage Hours Per Day		
Standard:	8 a.m.-9 p.m.	8 a.m.-5 p.m.
Extended Coverage		
Options:	8 a.m.-12 a.m.	
	8 a.m.-8 a.m.	
Coverage Days Per Week		
Standard:	Mon-Fri	Mon-Fri
Extended Coverage		
Options:	Mon-Sat	
	Mon-Sun	
r-Incident Out-of-Coverage		
Option	Yes	Yes
r-Incident Premium -hour		
Response Option	N/A	N/A
Hardware Maintenance Service Features		
Account-assigned CE and Backup		
Work-to-Completion		
Predictive Support[2]		
HP Remote Support		
Escalation Management Procedures		
Preventive Maintenance		
Installations of Add-Ons		
Engineering Improvements		
Site Environmental Surveys		
Warranty Enhancements		

[1] *From an HP Service Responsible Office (SRO)*
[2] *For selected HP 3000s*

Figure 8-1. System Hardware Maintenance Service Matrix

Standard System Maintenance Service

Standard System Maintenance Service (SSMS) provides the fastest response and most comprehensive hardware support for business and technical applications. This same-day service program provides on-site response within four coverage hours within 100 miles of a Service Responsible Office. Support coverage is from eight a.m. to nine p.m. every day of the standard workweek (ex-

cluding HP holidays). Extended coverage options are also available to provide service up to seven days a week, 24 hours a day.

Basic System Maintenance Service

If your business operates primarily during standard working hours and can tolerate a one-workday service response, then Basic System Maintenance Service (BSMS) is the economical choice for you. Coverage is from eight a.m. to five p.m., Monday through Friday (excluding HP holidays) within 100 miles of a Service Responsible Office. Longer response times are offered beyond 100 miles. Improved response time and extended coverage hours are also available on a per-incident basis.

Workstation Products Maintenance Service

Hewlett-Packard also offers a variety of cost-effective service options for your terminals, workstations, and peripherals. These specialized services provide a range of lower-cost maintenance alternatives specifically designed for the many different situations in which workstations are used. You can take advantage of these programs to:

- Save on maintenance costs for workstations with less critical applications
- Meet your fast-response needs for single units with critical applications

To determine the workstation maintenance service best suited to your needs, refer to the Workstation Service Selection Guide below.

	Priority On-site Service	**Next Day On-site Service**	**Scheduled On-site Service**	**Customer Return Service**
Environment	Production-critical applications	Standard applications	Multi-unit environment (>25 units)	Non-critical applications
Response Time	Four-hour response	Next workday response	Scheduled weekly visit	Three days at HP
Major Benefits	Quickest response time	On-site convenience	On-site convenience and lower cost	Most economical

Figure 8-2. Workstation Service Selection Guide

Software Support Services

HP software support services are designed to provide you with the level of support that best meets your individual needs. Software support services range from materials-only to personal assistance and give you the flexibility to adapt your support plan to meet changing requirements throughout your system's life cycle.

Account Management Support

Account Management Support (AMS) provides you with the opportunity to develop a long-term business partnership with Hewlett-Packard. Featuring a proactive approach to support, AMS provides you with a locally assigned Systems Engineer (SE) who understands your specific environment and helps

Figure 8-3. Software Support Program Structure

you plan for your future business needs. By providing you with the personalized attention and technical expertise of an HP SE, AMS offers you continuous improvements in productivity.

As HP's premier level of software support, AMS includes a complete set of services to help you optimize your available resources, as well as to anticipate changes to your environment. Through Support Management Reviews, Software Release Planning, System Growth Planning, and Personnel Development Planning, your Account SE recommends solutions to meet your changing needs. Through HPTREND reports, you will receive performance analysis information to help you manage your system resources more effectively.

In addition to these planning services, AMS also provides you with software maintenance. Via the HP Response Center, you will have access to technical resources dedicated to maximize your system availability. To keep you current with all enhancements to your HP software, you will receive a complete set of software materials, including the latest software and firmware releases and documentation updates.

Response Center Support

Response Center Support (RCS) is an intermediate level of support that offers telephone assistance from experienced HP system experts in our Response Centers. Using advanced support technology, these specialists provide prompt answers to your questions or advice on product use.

HP remote support and software problem verification are also included in RCS so HP can remotely diagnose your system and provide on-line assistance. In addition, RCS provides all of the software support materials necessary to stay current with HP software enhancements.

HP SupportLine

HP SupportLine is an electronic on-line support service that allows you to learn from others' experience. It provides a wide array of information for more timely usage assistance and problem resolution for many operating systems, subsystems, and application questions relating to the HP 3000. HP SupportLine also offers the most current support-related news from Hewlett-Packard's Response Centers and divisions. Users are also able to submit questions on-line for prompt response.

HP SupportLine is available to AMS and RCS customers at no extra charge. You access the HP SupportLine database directly, via a modem and terminal at your location.

Software Materials Subscription

Software Materials Subscription (SMS) ensures that you receive all of the materials and information you need in order to keep your HP software and documentation current.

In addition to the latest software and manual updates, under SMS, you will receive the "Software Status Bulletin" and the "Communicator/3000," HP publications that give you complete information on HP software enhancements.

Custom Support Plan

HP's Custom Support Plan (CSP) is designed for AMS customers who require additional, personalized assistance on a contractual basis. Developed by you and your Account SE, the CSP is an annual support plan that gives you the convenience of contractual billing. The plan is built around your specific requirements and will provide any extra support you need in specific areas of operation.

Since the CSP is unique to you, the services included depend entirely upon your needs. For example, you may need help coordinating implementation at multiple sites. Or, you may want performance consulting on a regular basis to enhance your system's operation.

Custom Support Plan availability is limited. Consult with your Sales Representative for availability in your area.

Startup Response Center Support

Startup Response Center Support (Startup RCS) is specifically designed to grow with you as your system software support needs change during the first year you own your HP 3000 system. It includes services to help you successfully implement your new system and to help you maximize system availability after implementation is complete.

With Startup RCS, you receive system implementation assistance and on-site problem resolution assistance during the first three months of support. In addition, Startup RCS provides you with complete RCS and SMS support.

Software Service Extensions

For maximum flexibility, HP offers a number of additional services which can be easily added to your support program:

- Additional system coverage extends your central system support coverage to additional HP 3000 systems.
- HPTREND reports may be purchased for additional systems and central systems with RCS support. More frequent reports are also available on central systems with AMS or CSP support.
- Additional Response Center Caller provides authorization for one additional person to call HP's Response Center.
- Extended Materials Subscription provides the right to make one copy of all central system support materials for use on one additional system.
- Software Update Installation Assistance provides assistance for one software update installation.

- Off-Hours Software Update Installation Assistance provides assistance for one software update installation within specified times outside of normal working hours.
- Manual Update Service provides one additional copy of the latest updates to your HP software manuals.
- Software Notification Service provides one additional copy of the "Software Status Bulletin" and "Communicator/3000."

Support Services	CSP	AMS	Startup RCS	RCS	SMS
Customized Support	X				
Account-Assigned SE	X	X			
Support Management Reviews	X	X			
Software Release Planning	X	X			
System Growth Planning	X	X			
Personnel Development Planning	X	X			
HPTREND	X	X			
Software Problem Reporting	X	X			
On-site Implementation Assistance	X	X	+		
On-site Problem Resolution	X	X	+		
Access to HP Response Center	X	X	X	X	
HP Remote Support	X	X	X	X	
Software Problem Verification	X	X	X	X	
Software Patches	X	X	X	X	
Software Updates	X	X	X	X	X
Software Status Bulletins	X	X	X	X	X
HP Communicator	X	X	X	X	X
Reference Manual Updates	X	X	X	X	X
90-Day Free Software Support Promotion	X	X	X	X	X
Software Service Extensions					
Additional System Coverage	o	o	o	o	
Additional HPTREND Reports	o	o	o	o	
Additional Response Center Caller	o	o	o	o	
Software Update Installation Assistance	X	X	o	o	o
Off-hours Software Update Installation	o	o	o	o	o
Manual Update Service	o	o	o	o	o
Extended Materials Subscription					o

X *Included within the service*
\+ *During first three months of support*
o *Optional service*

Figure 8-4. Software Support Features Matrix

Personal Computer Software Support

HP's Personal Computer Assistance services provide fast answers to questions about PC application software and hardware configurations. They give you unlimited access to experts at HP Response Centers 14 hours a day, 5 days a week.

HP supports the specific needs of small businesses and large corporations through a wide range of services. The software service guide shown below gives you a quick explanation of the features and benefits for each. For mid- to large-size companies with an internal support staff, HP's two Workgroup Coordinator services are appropriate. For a small business or single PC user, HP offers PC User Assistance and HelpLine.

	Workgroup Coordinator Assistance—Business Software	Workgroup Coordinator Assistance—Vectra Office	PC User Assistance	HelpLine
Environment	Internal coordinators supporting multiple HP PCs	Internal coordinators supporting multiple HP Vectras	Single HP PC user requiring frequent assistance	Single HP PC user requiring occasional assistance
Coverage	Unlimited calls on HP software plus selected third-party software	Unlimited calls on HP Vectra office software	Unlimited calls on HP software plus selected third-party software	Per-call service on HP software plus selected third-party software
Benefit	Increased effectiveness of internal support on multiple HP PCs or HP Vectras		Increased effectiveness of individual users with HP PCs	

Figure 8-5. Personal Computer Software Support Matrix

Consulting Services

HP offers a comprehensive set of consulting services to help you obtain the most productive use possible of your HP 3000 system throughout its life cycle. Consulting is available in standard service packages offering defined results and fixed prices, or on a Time-and-Materials Consulting basis.

Migration Consulting -- HP FastLane 3000

Migrating applications from your current MPE V-based HP 3000 system to a 900 Series system is straightforward, but proper planning is bound to accelerate the process. Proper planning will ensure that the migration is efficient and coordinate with your daily operations.

An HP consulting service that concentrates on planning, HP FastLane 3000 is a powerful yet cost-effective way to streamline the migration process and help you make the most effective use of your time and resources.

HP FastLane 3000 is delivered by a specially trained HP Systems Engineer who will work with your migration project team on the planning of your migration. The service, which is customized to fit your needs, consists of two components:

- System Planning provides a system-level migration perspective of your data processing environment and helps you develop an overall migration strategy.

- Application Planning guides your project team through the development of a complete migration plan for one of your applications.

The components of HP FastLane 3000 can be put together in many different ways -- and consultation on a Time-and-Materials basis can be added to HP FastLane 3000 -- to structure the service that perfectly fits all your needs.

Capacity Planning and Performance Analysis

To help optimize your system's performance, HP can analyze your current system performance and assist you in planning for your future growth.

HP CAPLAN enables you to accurately plan for system expansion and anticipated growth. An HP Systems Engineer, experienced in performance issues and equipped with advanced performance evaluating software tools, will analyze your system's workload. Recommendations will then be made for appropriate changes such as job mix, memory management, use of I/O devices and files, and subsystem configuration. In addition, HP can help forecast your machine performance and required capacity for future business needs. HP CAPLAN services can also provide performance projections for migration of MPE V-based applications to Compatibility Mode and Native Mode on a 900 Series system.

HP SNAPSHOT helps you identify performance bottlenecks and their causes and recommends a strategy for corrective action and future growth. The HP specialist uses advanced capacity planning software tools to perform this analysis and understand the profile of your system usage. As a result, you will be able to get increased productivity from your system and your system's users.

HP Disaster Recovery Services

HP Disaster Recovery Services consist of two services: HP Disaster Recovery Planning and HP Backup. The ability to survive a computer disaster increases in direct proportion to your advance preparation and contingency planning for disasters. HP Disaster Recovery Planning provides the knowledge and tools necessary to develop and maintain a complete disaster recovery plan designed for your HP 3000 environment. HP Backup provides you with access to a fully operational HP 3000 computer facility. Combining backup hardware with the support of Hewlett-Packard's worldwide resources, HP Backup enables you to continue your critical computer operations in the event of a disaster.

Custom Project Services

In order to meet individual needs not addressed by HP's standard services, HP offers Custom Project Services. Through a carefully defined project development and management methodology, HP application specialists can work with you to design a customized solution to your business needs.

Starting with requirements definitions and proceeding through software design and development, implementation assistance, and customer training, your HP team will manage a complete, customized solution that meets your business needs.

Time-and-Materials Assistance

When the content and duration of the assistance you need is difficult to determine, HP can provide consulting on a Time-and-Materials basis. This way, you

can take advantage of HP's consulting expertise in an ad hoc manner that best fits your needs.

Additionally, HP consulting on an ad hoc basis is available for new system installations. This gives you personalized help in customizing a new system for your needs and planning for long-term operational success.

Customer Education

Hewlett-Packard offers a full range of courses to meet your need to manage, operate, and develop applications on your HP 3000 system. Typical topics include system introduction, management, operations, application and systems programming, database administration, languages, and tools.

See Figure 8-6 for a diagram of customer training courses offered by HP.

All HP courses are taught by experienced professionals knowledgeable about our products. Training is available at 45 HP Education Centers around the world or, in many instances, at your site.

Course material is presented in a logical and professional manner so that students can quickly assimilate the new information. Typically, courses introduce key concepts and principles through illustrated study materials and lectures. Students then apply what they have learned with exercises and labs. In this way, principles are immediately reinforced through actual experience.

The training curriculum for the HP 3000 is designed to offer a flexible course path for all people involved in managing and using the system. The courses focus on the following user categories:

System Managers and Administrators -- Taken at the beginning of implementation, these courses provide the students with knowledge of operations, file management, system commands, security, diagnostics, and configurations.

Applications Programmers – HP offers a full complement of language courses to assist programmers in the development of applications. HP also offers comprehensive training on the tools and techniques needed to develop, debug, compile, and run applications on the HP 3000 systems.

Advanced Programmers -- System programmers or those with advanced skills can learn about the new, sophisticated debugging tools and special capabilities of the system.

Database Administration -- Whether you have IMAGE or HP SQL, HP offers courses that cover topics such as accessing, reporting on and maintaining data, transaction management, backup and recovery, programming basics, security and locking strategies, and much more.

Customer Documentation

HP has created comprehensive, high-quality documentation for HP 3000 hardware and software. Logically organized and fully indexed so that information is easy to find, the manuals are written from the users' point of view. They identify the actual tasks users perform, supply clear explanations, and make frequent use of examples and illustrations. The manuals have been extensively tested by users for appropriate content, organization, readability, and ease of use.

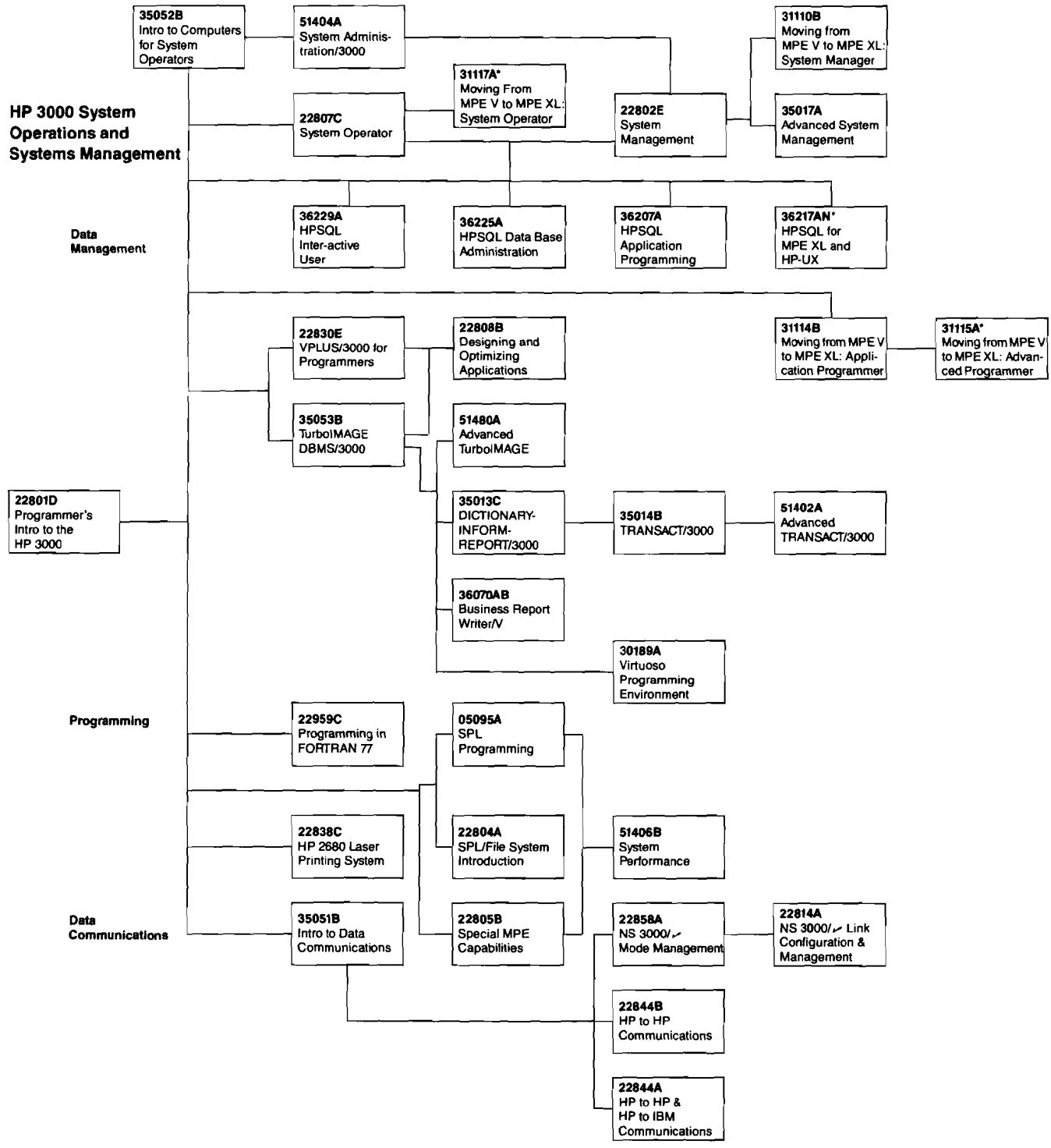


Figure 8-6. Customer Training

In addition, the manuals go beyond HP-specific information for further customer benefit. For instance, the manuals provide general discussions on database design and structured programming techniques.

The user documentation consists of series of manuals by subject area. Each series includes several or all of the following types of manuals:

- Introductory and overview manuals
- User guides and tutorial-style manuals
- Reference and encyclopedic manuals
- Quick-reference manuals and pocket guides

This approach provides appropriate levels of information for all users in a given subject area. The manuals range from explaining basic concepts to the new user to providing concise listings of syntax and parameters for the experienced user.

Several error message manuals are supplied that list error messages, explain probable causes of the errors, and recommend corrective actions.

HP LaserROM Subscription Services

HP LaserROM Subscription Services use compact disc read-only memory (CD-ROM) technology to complement other software support services and enhance your use of HP support documentation. HP LaserROM combines 600-Mb-capacity compact discs with full-text keyword retrieval software to allow you to instantly pinpoint exactly what you need within up to 200,000 pages of HP support documentation. This includes software and operational reference manuals and solutions to known problems. HP LaserROM Subscription Services are available for both MPE V- and MPE XL-based HP 3000s. HP LaserROM uses a CD-ROM drive that works on an HP Vectra or IBM PC AT personal computer.

Software Tools

HP LaserRX Performance Tool

HP LaserRX is a performance management software tool for HP 3000 systems. It provides system performance data essential to the proper maintenance, support, and growth of your systems. It is centralized on the System Manager's PC workstation to enhance your ability to provide adequate computing resources in a timely and efficient manner.

HP LaserRX includes graphical presentation of information on system resource usage, and transaction response and throughput, via powerful CD-ROM technology. It also uses the HP Vectra PC and Microsoft Windows™ for a flexible user interface.

HP Network Support

Tailored to Your Needs

The HP Network Support Program assured you of having support each step of the way, throughout the life of your network. Hewlett-Packard's network support services are flexible enough to be tailored to your specific business requirements and to accommodate networks of varying sizes and complexities.

HP Network Planning and Design

HP Network Planning and Design provides experienced HP Network Consultants to work closely with you to plan and design a network based on your business goals and strategies. It also documents the communications capability required to meet these goals. Part of Hewlett-Packard's design includes a plan for expanding your network so that it may grow with you.

HP Network Prepare

HP Network Prepare assists you in developing a network implementation plan to help you prepare for the smooth integration of the network into your business. The implementation plan covers project scheduling, resource and training requirements, and procedures for managing the network.

HP Network Startup

The HP support team works with you to plan and coordinate the configuration and installation of all network components under HP Network Startup. He works with you to thoroughly test the network to help ensure that it is operating properly.

HP NetAssure

With HP NetAssure, Hewlett-Packard becomes your major contact to isolate problems to a specific component on all supported connections of your network, whether its HP's equipment or another vendor's. This service simplifies problem resolution and reduces your network downtime by working directly with selected vendors under HP's joint support program.

HP Private Packet Network Operations Support

HP Private Packet Network (PPN) Operations helps eliminate the need for creating and training a staff of network operators and engineers to operate your HP PPN network. The tasks this group would normally perform can be performed by the HP Customer Network Center (CNC). The HP Network Operations service provides a level of product coverage above that provided by standard service products and NetAssure.

HP WireTest

HP WireTest evaluates the suitability of your existing twisted-pair cable for use with HP StarLAN. This service furnishes you with the information needed to make the important decision to use existing wiring for an HP StarLAN network in order to maximize the value of your existing wiring.

Index

E

F

G

H

I

J

K

W X Y Z

Notes