HEWLETT-PACKARD

900 Series

HP 3000 Computer Systems

General Information Manual

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900 Series
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General Information Manual

HEWLETT PACKARD

19111 Pruneridge Avenue
Cupertino, CA 95014
USA

Preface

Purpose of this Manual

The purpose of this manual is to present a broad overview of the 900 Series systems of the HP 3000 family. This includes information on HP software and peripherals for the 900 Series, as well as related topics such as support services.

This manual is intended for the reader who has a basic understanding of data processing in business environments and is interested in how the 900 Series of HP 3000 systems can meet business data processing needs.

Manual Organization

Chapter One summarizes the design and capabilities of the 900 Series systems It describes how the 900 Series systems fit into the HP 3000 family of compatible systems, and discusses in general how the HP 3000 systems can meet business needs.

Chapter Two is an overview of MPE XL, the operating system of the 900 Series systems.

Chapter Three describes the information management capabilities of the 900 Series.

Chapter Four introduces HP Precision Architecture, the new architecture upon which the 900 Series is based.

Chapter Five is an overview of the hardware features of the Series 930.

Chapter Six is a brief summary of the networking and communications capabilities of the 900 Series systems.

Chapter Seven describes some of the peripheral devices that are available for the Series 930.

Chapter Eight summarizes HP's support services and user documentation for the Series 930; it also introduces third-party and user group programs.

For More Information

Primers

For the less technically knowledgeable reader, HP offers a series of primers which explain the basic concepts of various technical subjects related to the 900 Series of HP 3000 systems and business data processing.

- "HP Precision Architecture — A New Perspective" (5954-6677)
- "Relational Technology — A Productivity Solution" (5954-6676)
- "Discovering Data Dictionaries — A Data Dictionary Primer" (5957-4680)
- "Touring Datacomm — A Data Communications Primer" (5957-4622)
- "Connecting to Your Computer — A Workstation to Computer Communications Primer" (5957-4625)
- "Making the LAN Connection — A Local Area Network Primer" (5957-4624)
- "Communicating With IBM — An HP-to-IBM Communications Primer" (5957-4623)

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 the 900 Series 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 the HP 3000 Series 930 or Series 950 Data Sheet"
- "Information Management Specifications Guide", a compilation of data sheets for the HP 3000 information management software products
- "HP Precision Architecture Data Sheet"
- "Series 930 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" (5953-7573) 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.

Reader Reply Forms

Please use the Reader Reply Forms at the end of this manual to send us any comments, suggestions or questions you might have regarding information in this manual.

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1 Introduction

Management Overview

The HP 3000 Series 930 and Series 950 are the first implementations of HP Precision Architecture. The 900 Series systems are high performance, high-end extensions of the HP 3000 processor family.

The HP 3000 computer systems are a compatible family of multi-purpose, business data processing systems. Well known for reliability and ease-of-use, HP 3000 systems are ideally suited for online, transaction-oriented applications and distributed data processing. Batch processing and IBM mainframe communications are also well supported by the HP 3000.

With an installed base of over 25,000 systems, HP 3000's are used in highly diverse settings: offices, factories, government and educational organizations, financial institutions, hospitals and many more. Office and manufacturing environments have benefited especially from the HP 3000.

To work with the HP 3000 family, HP provides comprehensive networking capabilities, high quality peripheral devices and workstations, HP's own personal computers, and a wide range of ready-to-run software. And because the HP 3000 has been well-established for more than a decade, there are numerous third party products available for the HP 3000.

Based on a new architecture that is in the forefront of computer technology, the 900 Series systems still retain the traditional HP 3000 qualities. They are outstanding systems for database-oriented, transaction-intensive applications in network environments. The 900 Series provides the highest performance and computation power ever offered in an HP 3000 system.

Because of their performance capabilities, the 900 Series systems bring more power to business processing needs and extend the HP 3000 family into even broader areas of use. For instance, the Series 930 can be equipped with a floating point coprocessor to enhance the performance of applications that require floating point calculations. This makes the Series 930 an ideal choice for customers who require in one system the capabilities to support not only transaction-oriented applications, but also compute-intensive applications such as financial modeling.

Although technologically innovative in many ways, the 900 Series systems are evolutionary extensions of the HP 3000 family. The 900 Series systems adhere to the strategy that has guided the development of the HP 3000 product line since its inception.

HP 3000 Strategy

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

1. **Software compatibility.** All members of the HP 3000 family share a common operating environment, MPE (Multiprogramming Executive). Programs written on earlier versions of MPE can run on the latest versions without modification. The same software can also run on any size system in the HP 3000 family without modification, thereby protecting customers' investment in application software.

2. **Expanding product line.** The HP 3000 family continues to expand, providing customers with a broad range of systems in terms of price and performance. This allows customers to choose a system according to the particular needs of each geographic site or functional department.
3. **Easy growth path to higher performance.** All HP 3000 systems are, and will continue to be, upgradable to higher performance systems. It is essential that a company's computer systems keep pace with the growth of its business. Software and peripheral compatibility, as well as generous trade-in allowances for upgrades to higher performance processors, make it easy for customers to adjust their computing power to meet growing workloads and new demands.
4. **Ease-of-use.** The HP 3000 has a well-deserved reputation as being easy to use by system operators and managers, end users and programmers. Customers cannot afford a small army of system administrators, operators and programmers dedicated only to maintaining each system. Compared to other computers, the HP 3000's require fewer personnel for system operation functions, and system management is easier to perform. HP is committed to software with user-friendly interfaces, and MPE provides a very friendly and productive environment for programmers.
5. **Comprehensive network solutions.** Offering comprehensive network solutions is critical to success in a distributed processing environment. The HP 3000 offers a wide variety of workstation to system, system to system, and IBM communications to provide customers the flexibility they need to tailor networks to their business needs.
6. **Lasting value.** The final element of the six-point strategy is really a summation of the previous elements. By protecting customer investment in software and hardware through compatibility and upgradability, and by ensuring maximum productivity of their people through easy-to-use systems, HP ensures that customers get a maximum return on their investment in HP 3000 solutions.

Foundation for the Future

The 900 Series systems meet every element of the HP 3000 strategy outlined above, including software compatibility with the rest of the family. Yet the 900 Series is based on a new architectural approach to computer design.

This new architecture, called **HP Precision Architecture,** will be the foundation for HP's computer development efforts through the rest of this century. All future 900 Series systems will be based on this architecture. Customers will find that this new architecture gives significant advantages in price and performance.

The advances capabilities of HP Precision Architecture are expolited by the system software for 900 Sereis systems. The **MPE XL** operating system and **ALLBASE/XL** database management system are integrated with the architecture to deliver high performance business processing solutions. MPE XL, ALLBASE/XL and associated software subsystems provide a comprehensive set of capabilities needed for business processing, from data management to program development to system operations.

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 overviews the support services, training and documentation for the 900 Series systems.

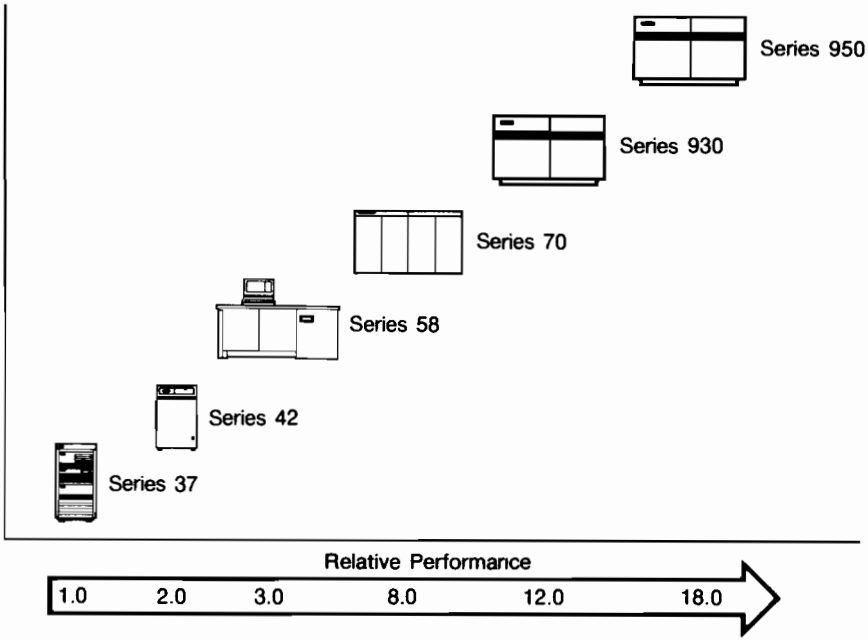


Figure 1-1. HP 3000 Systems: A Broad, Compatible Family

The 900 Series Systems

The Series 930

The newest high performance member of the HP 3000 family, the Series 930 is the first generation of the HP 3000 family to utilize HP Precision Architecture.

Built with reliable Schottky technology, the Series 930 delivers 4.5 MIPS (Millions of Instructions Per Second) processor performance. *That the Series 930 can produce this high level of performance using off-the-shelf logic technology reflects the high performance potential of HP Precision Architecture.*

A new, floating point coprocessor is also available to extend the performance of the Series 930 for companies using computationally intensive applications.

The Series 930 supports up to 400 users via a new distributed terminal controller connected over a local area network. Local area networking for terminal connections provides customers with reduced cabling costs and increased flexibility in workstation placement.

The Series 930 is preconfigured with 16MB (megabytes) of main memory, two HP-IB (Hewlett-Packard Interface Bus) I/O channels, and one LAN interface. Configuration maximums for the Series 930 include:

- Memory: 24MB
- Workstations: 400
- Disc Drives: 24
- Tape Drives: 8
- System Printers: 12
- LANs: 2
- Remote Printers: 32

The Series 930 can handle a full range of distributed data processing tasks through HP's AdvanceNet network services.

The HP Precision Architecture results in a simplified system design. This translates directly into lower cost of ownership and higher system uptime for the Series 930.

Because of its simplified design, the Series 930 is smaller, and consumes less power than typical systems in its performance class. Fewer system components allow the system to be housed in a compact, two-bay cabinet. The Series 930 requires less electrical power and a less elaborate cooling system than computers with more complex designs.

Also, simplified design enhances system reliability. The monthly maintenance cost for the Series 930 is much lower than that of other computers in its performance class.

The Series 950

The Series 950, the highest performance member of the HP 3000 family, is the first HP 3000 to utilize HP's proprietary NMOSIII VLSI technology. *Use of this state-of-the-art VLSI technology results in 6.7 MIPS processor performance.* The entire processor is contained on a single NMOSIII chip.

The Series 950 will provide an easy upgrade path from the HP 3000 Series 70 and Series 930 systems. The Series 950 will be placed on HP's price list at a later date.

HP Precision Architecture

The new HP Precision Architecture, which forms the basis of the Series 930 and Series 950 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. HP Precision Architecture represents a fundamental change in computer design. This new architecture is based on RISC (Reduced Instruction Set Computer) 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 HP Precision Architecture 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.

HP Precision Architecture 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 Series 930 and Series 950 allows users to expand their program sizes substantially without being limited by addressing capacity.

The new architecture includes multiprocessing capability, and provision for a variety of coprocessors to meet specific computing requirements (such as the Series 930's floating point coprocessor).

The architecture permits the implementation of multiprocessor systems. HP plans to add very high performance multiprocessor systems, based on this architecture, to the HP 3000 family in the future. This will provide mainframe levels of performance — at significantly lower costs — while retaining the compatibility and ease-of-use of the HP 3000 family.

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.

HP Precision Architecture 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 XL Operating System

MPE (Multiprogramming Executive) has been the only 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 the Series 37 through 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 the HP Precision Architecture. However, it retains the high compatibility standards of its predecessors. MPE XL is object-code and source-code compatible with MPE V. MPE XL has two run-time environments that are transparent to the user:

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

Other major features of MPE XL include:

- Multiprogramming: concurrent transaction processing, data communications, online 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; increases system performance for I/O intensive applications

- Concurrent multilingual capability: seven programming languages, including HP-extended versions of COBOL, RPG, FORTRAN, BASIC, and Pascal
- File system with file backup, user logging, security and interprocess communication
- Separate directories on each disc allow the system to continue in the event of a disc failure (except to discs required by the operating system)
- Comprehensive access security and complete accounting resources
- Powerful command language including user-defined commands, command files, conditional job control, extensive online 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

Commercial applications are primarily database applications. With IMAGE on the HP 3000, HP was the first in the industry to put a database management system on a minicomputer. Since that time, with more than 20,000 active installations of IMAGE, HP has achieved the largest installed base for a database management system in the industry. **ALLBASE/XL,** HP's new database management system for the 900 Series systems, continues this type of leadership in database technology.

ALLBASE/XL combines both a network and relational interface to data in the same database management system. **HPIMAGE,** *the network interface, is an enhanced superset of the previous versions of IMAGE.* Network databases, with predefined data relationships, provide optimal performance for applications with high volume, repetitive transactions, such as production planning. HPIMAGE provides application compatibility with TurboIMAGE version of IMAGE so that customers can easily move their current database applications to the Series 930.

HPSQL, *the relational interface of ALLBASE/XL, is fully compatible with the de facto industry standard of SQL.* Relational access provides customers with increased flexibility and programmer productivity. In addition, HP plans to add a very important enhancement to ALLBASE/XL in the future: the ability to access HPIMAGE databases from the HPSQL interface. This will make ALLBASE/XL an even more powerful system.

ALLBASE/XL is complemented by and integrated with other tools that combine to form HP's *"Information Management Framework".* Programmers need a rich environment of programming languages and tools. Reporting and presentation tools are required to allow access to information without programming. And a common data dictionary can provide the integration necessary to tie the system into a unified whole.

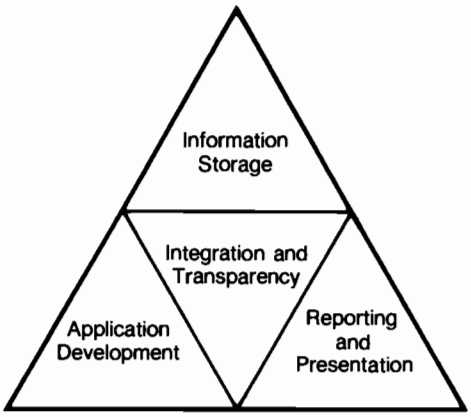


Figure 1-2. HP's Information Management Framework

HP offers products in all of these areas. **System Dictionary** aids programmers and system administrators by providing a single source for documenting all aspects of the system from data definitions to configuration information. This central source of information makes it easier to develop and maintain applications, as well as to manage system resources effectively. System Dictionary can be customized to meet user needs, and has a programmatic interface that allows easy integration with other software.

Business Report Writer allows development of sophisticated reports through easy-to-use menus, thereby freeing programming resources for other tasks. It allows users to combine data from several sources into a single report, and offers the power and flexibility needed to track a broad range of business details.

A new set of **optimizing compilers** for the 900 Series allows programmers to take advantage of the new system architecture. These compilers allow all programming on the systems to be performed in high level languages. The compilers are integrated with MPE XL to provide convenient access to ALLBASE/XL and other information management subsystems.

Programming productivity is increased by tools such as VPLUS and **HP Toolset. VPLUS** is an easy to use forms design and screen handling tool for programmers. HP Toolset provides a high-productivity, integrated environment for application development. It includes facilities for full screen editing, symbolic source-level debugging, and version management of source code.

HP also offers **Transact,** a high level programming language for transaction processing applications. A procedural language, Transact provides the functionality of third generation language such as COBOL combined with a comprehensive set of powerful verbs that can perform several functions in a single call.

Compatibility and Migration

Compatibility is the most important element in the HP 3000 strategy. HP has made a tremendous investment in resources 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.*

Customers can upgrade to the Series 930 as easily as they have upgraded to previous HP 3000 systems in the past. In addition, HP has provided tools so that migrating to the Series 930 can be performed in stages as the customer's schedule permits without interruption of operations.

- *Object Code Compatibility.* Customers can move MPE V applications and data to the Series 930 by a simple backup procedure. They store off the applications and data on a tape and restore the applications on the Series 930 without modifications. The applications and databases will run on the Series 930 in Compatibility Mode.
- *Source Code Compatibility.* To achieve the maximum performance for applications, they can be recompiled using HP's optimizing compilers to run in Native Mode. Maximum database performance can also be achieved by transforming existing databases into Native Mode. This can be easily done using software utilities supplied by HP.
- *Migration Flexibility.* Customers have ample flexibility in upgrading to the Series 930 since Native Mode applications can access Compatibility Mode databases, 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. Customers' investment in MPE V training is well protected.
- *Peripheral Compatibility.* Because of common I/O mechanisms, the Series 930 supports many of the same peripherals and workstations as the other HP 3000 systems. This protects customers' investment in peripheral devices when upgrading to the Series 930.
- *Cross System Development.* Compatibility Mode allows customers to develop applications on the Series 930 that will run on MPE V based systems, as well.

HP 3000 Naming Conventions

Hewlett-Packard has instituted a new naming convention scheme for HP 3000 software products. It consists of adding either the suffix "/V" or "/XL" to a product name.

Software products that previously had the suffix "/3000" now have the suffix "/V". For instance, IMAGE/3000 is now called IMAGE/V, and COBOL/3000 is now COBOL/V.

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 system

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 members of the HP 3000 family which operate under the MPE V operating system are referred to as *"MPE V based systems"*. The following HP 3000 members are "MPE V based systems": Series 37, Series 42, Series 58 and Series 70. Of course, older HP 3000 systems which operate under MPE V, such as the Series 68, are also MPE V based systems.

This naming convention scheme lets customers easily see which software product versions are most appropriate for the MPE V based systems and the 900 Series systems.

2

The MPE XL Operating System

Introduction

MPE XL (Multiprogramming Executive with Extended Large Addressing) is the operating system for the 900 Series of HP 3000 computers. A disc-based operating system, MPE XL manages all system resources and coordinates the execution of all programs running on the system.

Two versions of MPE are supported on the HP 3000. MPE V is supported on the HP 3000 Series 37 through 70. *MPE XL is a major new version of MPE, and is upwardly compatible with MPE V.*

MPE XL offers exceptional capabilities and performance for transaction-oriented and I/O-intensive applications. This is because MPE XL is designed to take full advantage of the HP Precision Architecture and provides state-of-the-art facilities for virtual memory and file access.

In addition, MPE XL provides increased reliability with improved error detection and handling. The result is that an operating system that was already well know for its reliability is now even more reliable.

For all its power and sophistication, MPE XL retains the commitment to ease-of-use that has been characteristic of every version of MPE.

Multiprogramming

MPE XL provides multiprogramming, that is, the concurrent execution of multiple programs. All system resources are provided to users as if each were the only user on the system. While one program is waiting for input, control of the CPU is shifted to the next highest program in the queue. This allows, for example, transaction processing, online program development, interactive data entry, data communications, and batch processing all to be performed concurrently.

Code sharing is inherent in multiprogramming, multi-user systems. For example, when multiple users access the BASIC interpreter, a separate process is created for each user. They all use the same code (there is only one BASIC interpreter on the system), but each user has a unique environment created by MPE. MPE XL provides complete protection against one program interfering with another.

Interactive and Batch Processing

MPE XL provides both interactive and batch processing. In interactive processing, users 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 direct dialogue with the computer is preferred.

Batch processing lets users 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.

Advanced Features

MPE XL provides many technically advanced features, including:

- Extended large addressing: 48-bit virtual addressing
- Demand paged virtual memory: Transparently manages virtual memory and eliminates need for program segmentation
- Mapped files: An extension of disc caching that improves I/O performance and eliminates file system buffering
- Powerful, interactive debug facility: window-oriented approach lets user see many aspects of the tested program simultaneously; supports breakpoints, single stepping and calculation of expressions

And, of course, MPE XL also provides features that have been perfected through the evolution of the MPE operating system, including:

- Comprehensive system security features
- Automatic accounting of system resource usage
- Powerful command language including user-defined commands, command files, conditional job control, extensive online HELP facility and meaningful error messages
- Complete file system with file backup, user logging, security and interprocess communication
- Device and file independence for simplified application development and maintenance
- Complete, automatic terminal management for both local and remote terminals
- Input and output conveniences such as spooling of input and output; tape labeling facility
- Power fail/automatic restart

Protecting Your Investment

A vital aspect of MPE XL is the degree to which it protects your investment in the software that you have and will develop, and in the training of your personnel in systems operations.

HP has always provided upward compatibility with each new version of MPE. *MPE XL is compatible, both in object code and source code, with MPE V/E.* (MPE V/E is an extension of the MPE V version of MPE.) Software compatibility is discussed in more detail in the "Native Mode and Compatibility Mode" section of this chapter.

MPE XL provides a superset of MPE V functionality, yet the user interface and system management operations are nearly identical. Consequently, system managers, operators and users who are familiar with MPE V will require little training to take advantage of the additional features and functionality of MPE XL.

MPE XL is an operating system with a long future ahead of it. It will support all future 900 Series systems. For instance, later 900 Series models will provide multiprocessing capabilities, and MPE XL has been designed so that multiprocessor support can be added in the future. The virtual memory capabilities of MPE XL will support virtual addressing needs throughout the rest of this century and beyond.

MPE XL is designed to support all low-end and high-end implementations of HP Precision Architecture: from desktop computers to large scale systems. And MPE XL is very scalable in terms of the number of users and attached devices it can support. *As new systems are added to the 900 Series product line, customers are assured of software and operational compatibility through MPE XL.*

User Interface

MPE XL's friendly user interface includes a command language, online HELP facility, user defined commands and command files.

Command Language

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

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

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

Actions you can perform through MPE XL 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 is 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.

User Defined Commands and Command Files

MPE XL gives users additional flexibility by allowing them to define their own commands and create command files. To create your own command, you simply combine the MPE XL commands you want (with whatever parameters, constants and variables you want to use) into a procedure, and then give the procedure a name. The name of the procedure can then be used as a command. User defined commands can be placed in individual command files. User defined commands and command files can be executed interactively, programmatically and in batch jobs.

Online HELP Facility

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

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

```
:HELP REDO EXAMPLE
```

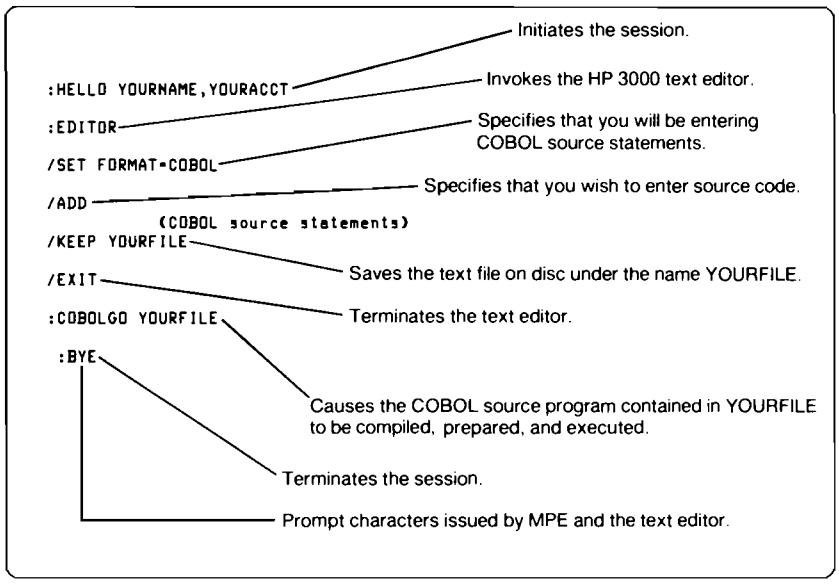


Figure 2-1. Sample MPE XL Session

In response to the above request, the HELP subsystem will display an annotated example of the REDO command. Users 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 users 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 XL's Online HELP Facility

System Management and Security

MPE XL is designed for optimum ease of use and can be tailored to meet your specific system security requirements.

Operational Ease of Use

The system management commands and utilities provided by MPE XL simplify system maintenance operations. Compared to other computers of similar power, the 900 Series models require significantly less time and effort for system administration and operations.

Provided are a complete set of operator commands and utilities that simplify typical operational tasks such as system configuration, startup, modification, backup and recovery. Operator commands and utilities also simplify spooling and tape labeling functions.

System Startup
MPE XL allows the system manager to specify a series of commands to be executed each time the system is restarted. When the system is started, these commands can be initiated automatically, eliminating the need for operator intervention.

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 systems operations.

System Backup
With MPE XL, 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 XL 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.

Programmatic Creation of Sessions
Programmatic Creation of Sessions allows terminals to log on automatically into application environments. When users arrive, they can begin working without having to log on or interact with the operating system. This feature helps to make the system easy to use for inexperienced users and provides an additional level of security.

System Logging
MPE XL 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 and can be used to detect problems before they interfere significantly with overall system operation.

Spooling Facility
MPE XL provides a flexible spooling facility for output devices and batch job input. (SPOOL is an acronym for Simultaneous Peripheral Operations OnLine.)

The MPE XL Spooling Facility permits the concurrent use of output devices that would otherwise be nonshareable, such as tape drives and line printers. For instance, if multiple 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 dynamically changed by the system operator.

Similarly, MPE XL permits multiple batch jobs to be submitted concurrently. The jobs are spooled to disc and executed according to the priority level specified by its submitter (in the JOB command). The system operator can specify the maximum number of jobs that can be executed concurrently and can dynamically alter a job's priority as needed. For instance, if a job must be executed as soon as possible, the system console operator can alter its priority to move the job to the head of the queue.

Automatic Scheduling of Jobs
Job scheduling allows MPE XL users to specify a particular time and date when their 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 executed automatically without requiring operator intervention. Automatic job scheduling can be used to automate many daily operation routines such as backup.

Online Diagnostics for Peripherals
HP's Customer Engineers now are equipped with online diagnostic tools for many of HP's peripherals. Should diagnostics be required for these peripherals, an HP Customer Engineer can run the diagnostics without having to shut down the system. These diagnostics can be run remotely.

Disc Failure Tolerance
MPE XL allows any system disc, except those which are critical to the operating system, to go offline without affecting the system. (Of course, users will not be able to access files on discs that are offline.)

Automatic Power Fail Recovery
Automatic power fail recovery is provided by MPE XL in conjunction with the 900 Series hardware. Should a power fail occur, the system initiates a power fail procedure that preserves the operating environment prior to complete loss of power. A battery pack (supplied standard with each 900 Series 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 fail occurred, and jobs continue from where they were interrupted.

System Account Structure

In MPE XL, users and their files are grouped in accounts and groups. System managers can devise a structure of accounts and users which reflects the functional organization of the people who use the system.

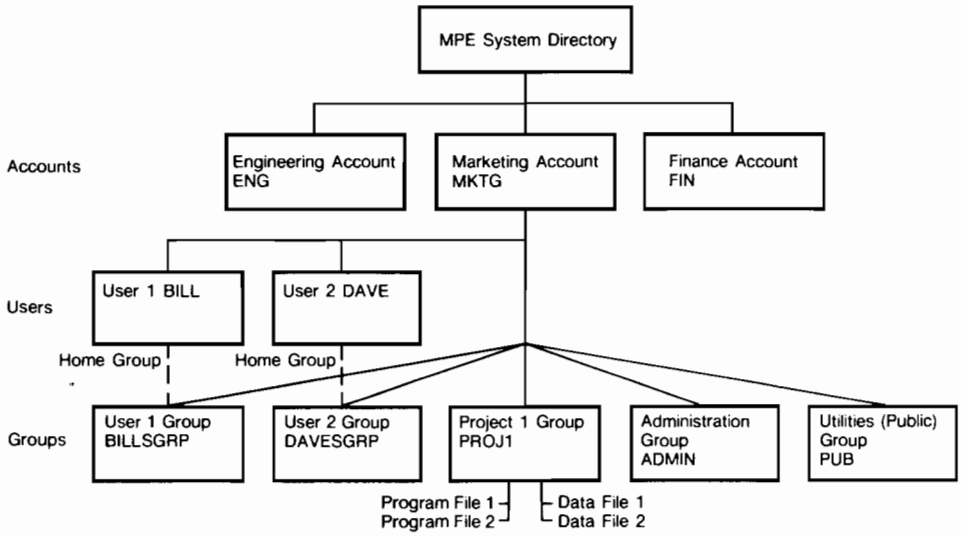


Figure 2-3. MPE XL System Account Structure

- Accounts are collections of users and groups. Each account has a unique name on the system.
- 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 its account.
- Users are individuals who access the system. Each user is assigned to an account and has a unique user name within that account.

Every user is associated with a "home" or default group in his or her account. User access to the system in general and to files in other groups and other accounts depends on the security measures that are used, as described on the next page.

Programs and applications that should be available to all users of the system can reside for convenience in PUB.SYS, that is, the public group of the system account.

MPE XL automatically maintains running totals on the amount of system resources consumed by each account, group and user on the system. This includes the amount of 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 accounting and billing purposes.

System Security

So that your system can be protected from unwanted tampering and interference, MPE XL provides ample means for system security. *MPE XL is designed so that the user capabilities, the account structure and system security measures are intertwined.*

User Capabilities
User capability sets define what users can do on the system.

- The most powerful capability set is "System Manager". The System Manager (that is, a user with System Manager capability) manages the overall system by creating accounts and defining resource-use limits. The System Manager assigns "Account Manager" and "System Supervisor" capabilities to specific users.
- A user with "Account Manager" capability has the same power over his or her account as the System Manager has over the entire system. For instance, an Account Manager can create new users and groups for the account, and monitor system resource usage by groups and users in the account.
- A user with "System Supervisor" capability normally is responsible for managing the system on a day-to-day basis. For instance, the System Supervisor is responsible for system logging and is able to retrieve information and change parameters regarding scheduling queues.

In a small installation, a single user may perform all the functions listed above. In larger installations, the capabilities may be divided among several users at each administrative level.

Other capability sets include "Account Librarian" and "Group Librarian", which provide special access capabilities for the maintenance of files throughout an account and for specific groups in an account.

The majority of users will be classified as "Standard Users" (such as programmers and end users). The System Manager and Account Managers specify exactly what capabilities are given to each standard user. For ease of use, MPE XL provides default Standard User capabilities that can be easily changed by the System Manager or Account Managers.

Restricting User Access
Passwords can be assigned for each account as well as each group in an account. Further, passwords can be assigned to each user name. *Thus, to log on to the system, a user can be required to provide up to three passwords.*

To illustrate, suppose a user knows the password for his user name and account. This user would be able to log on to the system and access files in his home group, but would be unable to access other groups in the account whose passwords are unknown to him.

Once a user is logged on to the system, what the user is able to do can be restricted in a number of ways. For example, a user can be restricted from saving files or using nonshareable devices such as tape drives or line printers. Users can be limited regarding the amount of CPU time and disc space they can consume. Also, users can be restricted from accessing system tables, utilizing system resources such as process management and logging, and using data communication subsystems. Users can even be restricted to either interactive or batch access, although normally both are allowed.

File lockwords, similar in effect to passwords, can be assigned to files. When a file is protected by a lockword, a user 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, users can be restricted from any or all of the following: reading, locking, appending, writing and saving files and executing program files. In addition, users cannot access files that are not in their account (except for files meant for general usage in PUB.SYS) unless the given file has been released.

In summary, MPE XL provides comprehensive, flexible means for system security that can be tailored to your specific needs.

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 providing programmers with the appearance that the available memory space is 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 HP Precision Architecture's extremely large addressing potential.*

MPE XL provides a virtual address space that consists of 65,000 individual spaces, each 4GB (four 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.

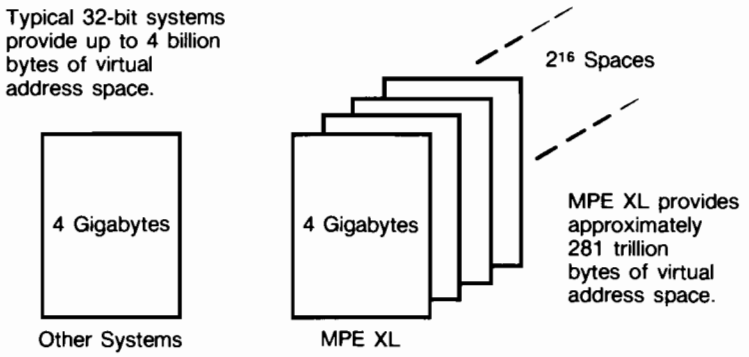


Figure 2-4. MPE XL's Extremely Large Virtual Address Space

Every virtual space is subdivided into fixed size blocks called pages, each of which is 2KB in size. 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 1GB in size. Access to multiple 4GB data areas is provided through mapped files.

A Productive Programming Environment

MPE has long been regarded as a friendly, productive operating system for programming, and the MPE XL version of MPE continues and improves upon this tradition. With a comprehensive offering of programming languages and tools available, MPE XL's features offer programmers a highly productive programming environment.

MPE XL supports programming in a wide variety of languages, including HP versions of COBOL, FORTRAN, Pascal, BASIC and RPG. Supported also are two languages developed by HP: Transact and SPL (Systems Programming Language).

For increased programmer productivity, HP offer's **Toolset/XL,** an integrated programming facility. Refer to the "Information Management" chapter of this manual for more information regarding Toolset/XL and the languages that are supported by MPE XL.

Program Development

Programs can be coded online using **Edit/V,** the text editor supplied with MPE XL. *Online coding* also is possible using **TDP/V,** an advanced text and document processor which can be purchased separately. **Toolset/XL** and **HP Business BASIC/V** also include integrated text editors for online coding.

MPE XL's file system provides *device independence.* Programmers can access devices by device name or class without having to specify characteristics of the device in their program.

MPE XL also provides *file independence.* This means data files are sharable among all the HP programming languages. For instance, an HP Pascal/XL program can read data files created by any of the other languages.

Programmers have access to MPE XL's system intrinsics — system service routines that can be called by a program. For example, the FOPEN intrinsic opens an MPE XL file. *Thus, many complex, internal operations are performed by the intrinsics instead of having to be coded into programs.*

Similarly, programmers can create their own libraries of commonly used subroutines which can be called by a program at run-time. Individual system intrinsics and subroutines can be shared by multiple programs executing concurrently. Also, subroutines are callable across languages. For instance, a COBOL II/XL program can call an HP Pascal/XL subroutine.

Data can be defined externally from a program by using one of HP's data dictionaries: **System Dictionary/XL** or **Dictionary/V.** This eliminates having to define data within each program, facilitates consistent definitions, and minimizes program maintenance when data definitions have to be changed.

MPE XL's demand paged virtual memory and mapped files greatly simplify programmers' work and increase programmer productivity. *Because of these features, programmers do not have to segment their programs or provide extra data segments or overlays.*

In MPE XL, there are essentially two steps required to taking a program from source code to an executable state. These are compiling the program and linking it to called intrinsics and subroutines. Linking can be performed automatically by MPE XL, or you can specify how you want linking to be accomplished.

The MPE XL commands used for compiling, linking and running programs are consistent for all the HP programming languages. One type of command compiles a program, another compiles and links, and a third does all three functions (compile, link and run). Thus, programmers don't have to learn different commands for each language they use.

Once a program has been compiled and linked, it can be executed at any time using the RUN command. The RUN command automatically invokes a load utility that allocates virtual memory and disc space for executing the specified program.

Debugging Facilities

HP's **Toolset/XL** program development package contains a symbolic debug facility for COBOL II/XL, HP FORTRAN 77/XL and HP Pascal/XL programs. *This powerful, interactive debugger performs debugging at the source code level.*

Debug/XL is the debug facility supplied with MPE XL. An interactive facility, *Debug/XL provides debug information at the machine instruction (object code) level.* It can be used to debug programs written in any of the supported languages, in both Native Mode and Compatibility Mode.

For increased ease-of-use, Debug/XL offers a powerful and efficient set of screen windows that allow dynamic visual monitoring of the program environment. The windows provide information about different aspects of the program under test, including register and memory values and the program's code. For Compatibility Mode programs, information such as the current stack frame and top of stack is also provided. Multiple windows can be displayed simultaneously on the terminal screen so that the user can see at once a wide range of information about the program. An example of one of the Debug/XL windows is shown below.

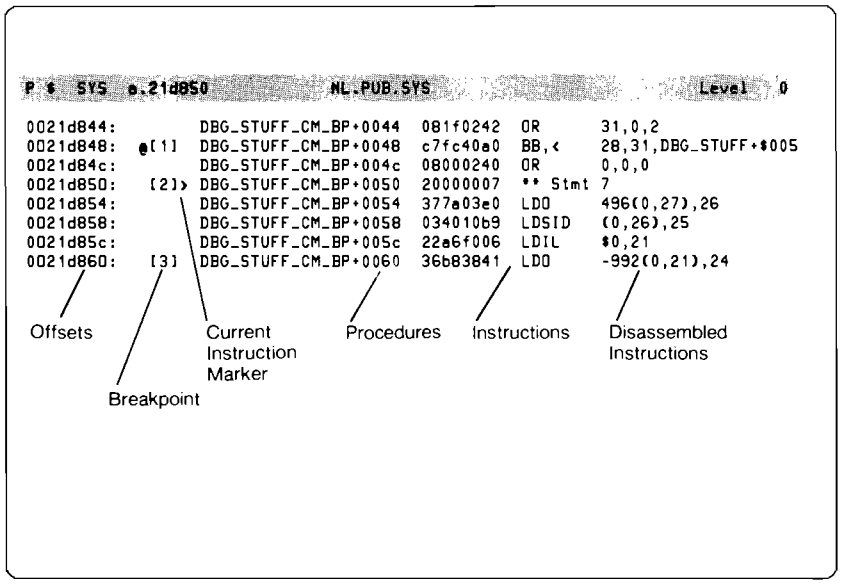


Figure 2-5. Example of a Debug/XL Window

Both the Toolset/XL symbolic debugger and Debug/XL allow users to set, list and clear breakpoints in a program. The program will execute until a breakpoint is reached, then stop and pass control to the user. Users can also modify data item values and trace program flow.

Native Language Support

MPE XL 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.

System Performance

MPE XL provides exceptional performance through a combination of innovative techniques.

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.

Mapped files significantly improves I/O performance without imposing additional CPU overhead or sacrificing data integrity and protection. Also, the mapped files technique 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 made possible because of 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.

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

If the required pages are not in memory, MPE XL's Memory Manager fetches them from disc directly into the user's area in memory. Typically, pages are fetched in groups (prefetching). This means that not only the specific page requested is fetched, but also the pages around it. Since the processor is likely to require pages that are located close to one another, prefetching further reduces the amount of physical disc I/O.

In addition, the mapped files 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 (see Figure 7). The benefit of this are two-fold: an additional increase in system performance due to the elimination of unnecessary data movement within memory, and optimization of memory space usage.

MPE XL's File System access intrinsics are built upon the mapped files technique. Thus, programs using the file access methods supported by MPE file types and intrinsics realize all the benefits of mapped files without the user having to make any changes.

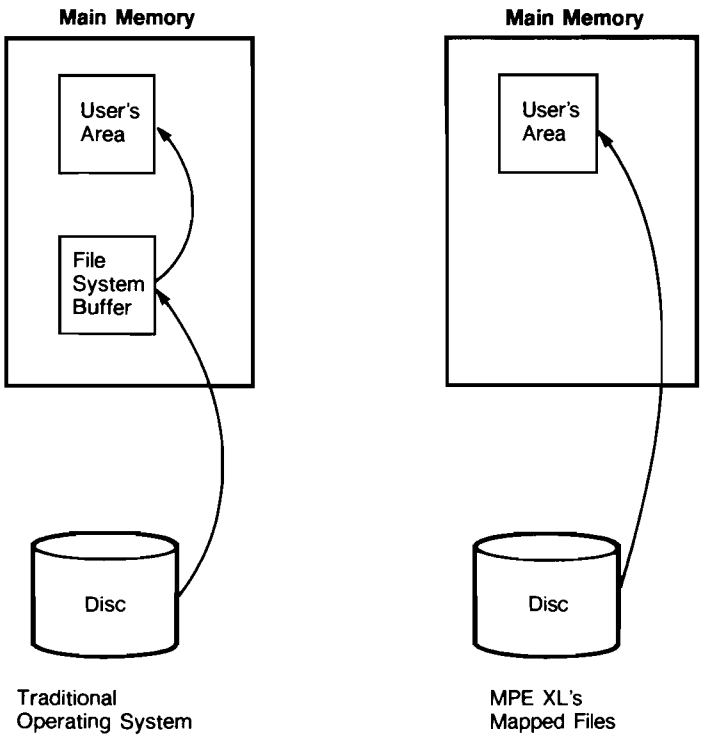


Figure 2-6. MPE XL's Mapped Files

In addition, programmers using languages with pointers can access mapped files directly. Instead of having to call File System intrinsics for disc reading and writing, these programmers can write their programs by addressing files through virtual memory. The file interface provides opens and closes of user mapped files with normal naming and security, but with the additional benefit of LOAD and STORE speed on file references. Data protection is enforced by the hardware. Thus, for access on array type structures, or for the development of specialized access methods, the programmer gains the advantages of file system naming and protection without the overhead of unnecessarily using the file access intrinsics.

Concurrent Directories

In some operating systems, the system directory is centralized on one disc, and access to directory services for files on any disc must go through the system directory one at a time. This can create a bottleneck at times of peak system usage due to the physical contention of one disc and the logical contention of one directory user at a time. MPE XL solves this problem by using concurrent directories. *This feature provides faster file access by eliminating the physical or logical serialization of a centralized directory.*

In MPE XL, each disc attached to the system contains its own directory of files on that disc. This allows users' requests to go directly to the disc that contains their files. In addition, MPE XL further improves performance by allowing multiple users to access the directory simultaneously.

Performance Measurement

For MPE XL, HP offers a system performance and management tool called **SMT (System Measurement Tool).** *SMT is an interactive software package that enables system analysts to isolate system bottlenecks and observe how system resources are being utilized.* SMT provides information regarding:

- Current system workload
- CPU utilization
- Memory management activity
- I/O activity
- Program and process activity
- Disc free space information
- System table usage
- Configuration information

SMT can give snapshot statistics of current system activity as well as running averages of system performance over specified time periods. The information can be presented in charts, graphs, or summary reports, and can be printed offline or displayed on a terminal screen. Although intended primarily for interactive use, SMT also can be run in batch mode.

System Performance Consulting Services

HP offers two consulting services for 900 Series system performance: HPSNAPSHOT and HPCAPLAN.

HPSNAPSHOT is a performance consulting service available 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.

HPCAPLAN is a capacity planning service performed by HP Performance Specialists. This service answers a customer's "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 online terminals), and how to best plan for capacity increases. HPCAPLAN 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.

System Utilities

The following utility subsystems are supplied with MPE XL.

- **EDIT/V,** a text editor.
- **FCOPY/V,** a program for general purpose file copying. It also allows movement of files between groups and accounts or from one peripheral type to another.
- **SORT-MERGE/XL,** a utility for ordering records in a file and merging sorted files. This utility can sort any character sequence using any data type.

Special purpose utilities are provided for system administration tasks. For instance, the MPE XL *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 Mode and Compatibility Mode

MPE XL Provides two run-time execution environments: Native Mode and Compatibility Mode. MPE XL doesn't operate strictly in one mode or the other. Rather, MPE XL dynamically and transparently blends and coordinates these two run-time environments as required by your applications.

Native Mode

Native Mode is the native run-time environment of MPE XL. In Native Mode, source code has been compiled into the native instruction set of the 900 Series.

Native Mode is the preferred environment because it fully realizes the high performance of the 900 Series systems. And Native Mode provides all the benefits of MPE XL described in this chapter, such as demand paged virtual memory and mapped files.

Compatibility Mode

Compatibility Mode provides object code compatibility between MPE V based systems and the 900 Series. Compatibility Mode allows current HP 3000 customers to move their applications and data to the 900 Series systems without changes or recompilation.

MPE XL is a compatible superset of MPE V/E. (MPE V/E is an extension to MPE V). Compatibility Mode provides a working MPE V/E environment including MPE V/E code and stack structures, and callable MPE V/E system intrinsics.

MPE XL Switches Modes Transparently

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.

900 Series Migration Flexibility

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

Because of the high degree of object code compatibility, customers can simply store an MPE V based application object code program, restore it on a 900 Series system, and it will run in Compatibility Mode. This applies to applications written in any language supported by MPE V. Customers can move their databases to the 900 Series in the same way.

For improved performance of MPE V object code, MPE XL provides an *MPE V Object Code Translator* which translates MPE V object code into the native instructions of the 900 Series.

To take full advantage of the 900 Series performance and the benefits of MPE XL, customers can recompile their 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.

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

For best database performance, customers can move to ALLBASE/XL, the Native Mode database management system for the 900 Series. HP supplies utilities for converting to ALLBASE/XL from TurboIMAGE/V.

Figure 2-7 illustrates the flexibility of migrating to the 900 Series. Customers can move some applications to Native Mode, while leaving others in Compatibility Mode. As illustrated, both types of applications can access the same database, whether it's in Compatibility Mode or Native Mode.

The total effect is that customers can immediately move their applications and databases to Compatibility Mode, and can migrate to Native Mode as best fits their scheduling needs.

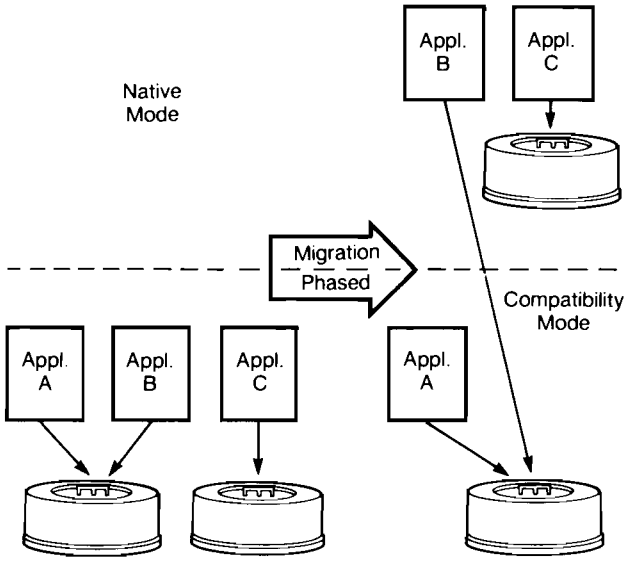


Figure 2-7. Migration Flexibility

Exceptions

Naturally, there are some minor restrictions in migrating MPE V based applications to the 900 Series. *For example, applications which 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.*

Programs written in **SPL/V,** the systems programming language for MPE V based systems, can run in Compatibility Mode on the 900 Series systems, but cannot be migrated to Native Mode. This is due to SPL's close dependence on the MPE V based HP 3000 architecture. However, the Compatibility Mode performance of SPL/V applications easily can be improved by using the MPE V Object Code Translator.

If Native Mode performance is required, these applications should be written in **HP Pascal/XL.** HP plans to offer a **C/XL** compiler in the future that will be suitable for this purpose, as well.

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.

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

Cross Family Application Development

Customers can develop applications on a 900 Series system for use on other HP 3000 systems, allowing the use of a 900 Series system 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 compiled to run on MPE V based systems.

Similarly, the same source code written in **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, as well. The MPE V Segmenter is supplied with MPE XL to facilitate cross family development in these languages.

Structural Overview

This section is a brief overview of the structure and basic concepts of MPE XL.

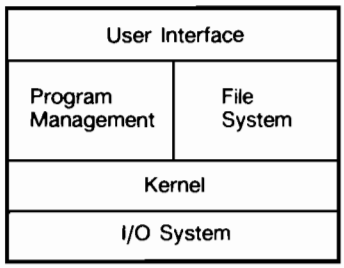


Figure 2-8. MPE XL Structural Overview

I/O System

The I/O system manages all I/O devices connected to the system. It carries information between the CPU/memory complex and the I/O devices. The I/O system provides parallel I/O paths so that a large number of I/O operations can be performed concurrently.

The Kernel

At the heart of MPE XL is the Kernel which is responsible for the overall control of processing and memory management. Its major modules and concepts are summarized below.

- Virtual Memory Management: Manages the entire virtual address space of the computer. Allocates virtual memory on disc. To the programmer, virtual and disc storage locations appear to be in main memory Provides complete protection of users' data and code.
- Memory Management: Manages main (real) memory. Allocates space in main memory. Uses virtual space addresses to swap pages of code and data between main memory and disc as needed.
- Pages: A page is set of 2048 contiguous bytes used as the basic unit for memory mapping and protection. The concept of paging, and the 2KB page size, are dictated by the HP Precision Architecture. All swapping is done in multiples of pages.
- Separation of code and data: Each page can contain either code or data but not a combination of both. Active code pages can be shared by concurrent processes but cannot be overwritten.

- Dispatcher: Automatically schedules and dispatches processes to the CPU on a priority basis. A process is the basic executable entity in MPE XL, consisting of the unique execution of a program by a user or by another program. MPE XL allows jobs and sessions (from which processes emanate) to be run in different priority classes. This allows the system manager to ensure that the most time-critical jobs and sessions have highest priority for CPU resources.
- Spooling Services: Provides spoolfiles for output devices. Users can assign priority levels to spoolfiles so that the more time-critical spoolfiles can have highest output priority.

The File System

MPE XL's File System consists of callable intrinsics (routines) for file manipulation. The File System provides device-independence and directory services. To access a file, users need specify only the file's name, not its explicit address. Access security is provided by user capability sets and assignable file access restrictions. Major new features of the File System include mapped files and concurrent directories on multiple discs.

Program Management

Program management is simpler in MPE XL than in previous versions of MPE because the very large Virtual Address space eliminates program segmentation. The Linker subsystem is used to resolve a compiled program's external references, such as calls to system intrinsics and user subroutines. The Loader subsystem allocates virtual memory and disc space for run-time execution. Commands for these functions are the same for all the MPE XL programming languages.

User Interface

MPE XL provides a friendly, powerful command language. The commands have easy to learn names, consistent syntax, and meaningful error messages. Users can define their own commands and create conditional job control statements. A comprehensive, online HELP facility is included.

3

Information Management

Introduction

Every company faces the challenge of managing information as effectively as possible. How well a company meets this challenge is a critical factor in its ability to operate successfully.

Information management involves collecting and storing data, transforming data into meaningful information, and making this information readily available when, where and how it can be of most use.

Effective information management requires four basic categories of functionality. HP's Information Management Framework, shown below, illustrates these categories.

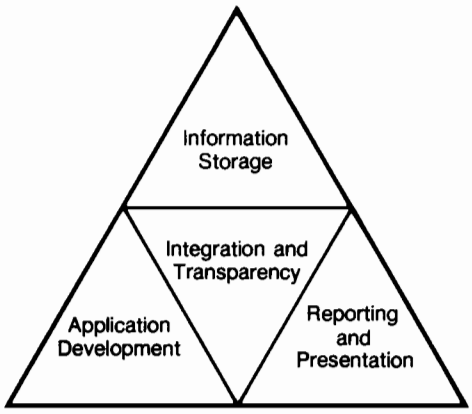


Figure 3-1. HP's Information Management Framework

Information Storage: A sound foundation is required to ensure that data integrity is scrupulously maintained while providing flexible data access by applications and users. The optimal foundation is a relational DBMS (database management system) for some applications, a network model DBMS for others, and keyed sequential files for still others.

Application Development: The programmer needs a rich environment of tools to productively generate and maintain business applications. A fourth generation language allows applications to be quickly brought into production. Third generation languages such as COBOL are required when run-time performance is critical or where industry standard languages are important.

Reporting and Presentation: A successful business system requires that managers have access to information on their terms — presented in the format they want, available when they want. This need will be met in some cases by a programmer using a powerful report writer to quickly create frequently used reports. In other cases, the need will be met by a user-friendly query facility which allows managers and other users to directly access the information required to support a split second decision.

Integration and Transparency: As every successful MIS manager knows, a key ingredient to effective business systems is the behind the scenes integration which frees the end user and the programmer from the need to specify endless details when requesting information or developing programs. A sophisticated data dictionary plays a critical role in unifying all the other components of the business system. This need for integration extends to distributed data processing, which allows the coordination of information management at different physical locations.

HP traditionally has excelled in providing these capabilities on the HP 3000. We have added even more functionality, power, integration and ease-of-use for information management on the 900 Series.

This chapter summarizes the offerings available on the 900 Series in each of the four basic information management areas. For more detailed information, ask your HP sales representative for HP's "Information Management Specifications Guide".

Product Name Suffixes

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

Information Storage

For the 900 Series, HP offers the following information storage products:

- **ALLBASE/XL**
- **TurboIMAGE/V**
- **TurboWindow/XL**
- **TurboIMAGE DBchange/V**
- **TurboIMAGE Profiler/V**
- **KSAM/V**

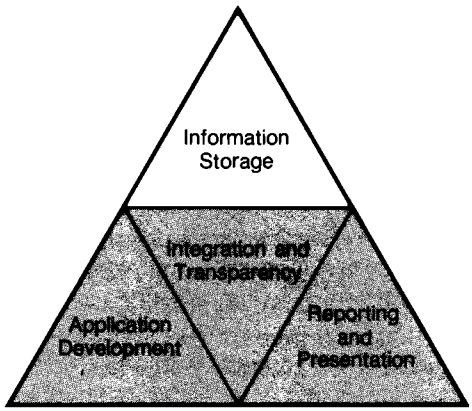


Figure 3-2. Information Storage

ALLBASE/XL is HP's new DBMS system designed specifically for the 900 Series. ALLBASE/XL makes it easy for you to "have it all", as it is truly two systems in one: relational and network. ALLBASE/XL will be the main DBMS system for the 900 Series for years to come, and will be scalable to all future 900 Series systems.

The other products help facilitate phased migration to the 900 Series from MPE V based systems, as well as the development of information storage applications for common use across all HP 3000 systems.

ALLBASE/XL

An Integrated Relational/Network DBMS

For the 900 Series systems, HP offers a new, state-of-the-art DBMS system entitled ALLBASE/XL. ALLBASE/XL is on the leading edge of DBMS technology. *It consists of both relational and network interfaces integrated upon a common internal core.*

This integration of relational and network models gives you the flexibility to choose the database model that best suits your application needs and personnel.

The relational model interface of ALLBASE/XL is entitled **HPSQL.** HPSQL is a complete relational DBMS which features a full implementation of the de facto industry standard SQL (Structured Query Language) relational language for data definition and manipulation.

The network model interface of ALLBASE/XL is entitled **HPIMAGE.** A complete network model DBMS, HPIMAGE continues the tradition of the DATAPRO award winning IMAGE family of DBMS systems. HPIMAGE is compatible with TurboIMAGE/V while providing important functional enhancements.

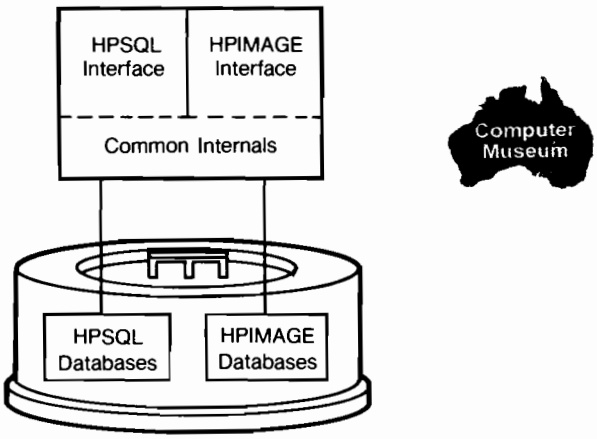


Figure 3-3. ALLBASE/XL

In the near future, HP will provide an exceptionally powerful enhancement to ALLBASE/XL. This will be the ability of HPSQL to access HPIMAGE databases.

ALLBASE/XL Features

Some of the most important features common to both HPSQL and HPIMAGE databases are listed below. Features specific to each interface are listed later in this chapter.

- Coexisting relational model interface and network model interface allow the optimal data model to be chosen on an application by application basis.
- Data may be accessed directly from a terminal or via application programs written in common programming languages.
- Interactive query facilities included for database design, testing and maintenance.
- Security is maintained by allowing specification of appropriate levels of access privileges to individual users or groups of users. These powerful security measures are easy to implement, monitor and change.
- Concurrent access allows multiple users to access data simultaneously.
- Data independence allows major changes to be made to the database structure without requiring that applications be modified.

- User controlled transactions ensure that data is always in a consistent state.
- Automatic locking ensures data integrity in a multi-user environment by preventing access to data while it is still being updated.
- Automatic rollback recovery guarantees logical data integrity in the event of a soft failure.
- The rollback capability also may be invoked in a program to allow erroneous data to be purged before the transaction is completed.
- Rollforward recovery guarantees logical and physical data integrity in the event of a hard failure.
- Fast data access is supported through B-tree indices (HPSQL and HPIMAGE) and hashing (HPIMAGE only).

Relational vs. Network
ALLBASE/XL gives you the flexibility of running some applications against HPSQL databases, and other applications against HPIMAGE databases. You're not locked into one model that is appropriate for some, but not all of your needs.

The traditional view of relational model DBMS systems is that they pose a tradeoff: greater ease-of-use but slower performance. HPSQL does offer greatly increased productivity compared to non-relational systems, yet it also provides exceptional performance for a relational DBMS, sufficient for all but the most performance critical applications. If performance is the overriding objective, HPIMAGE should be used for the application.

Any application can be based on the relational or network model. Still, there are general considerations in which one model may be preferable over the other.

HPSQL may be preferable:

- When development time is limited. HPSQL is a non-procedural language; data relationships are determined at access time, not predefined.
- If the database may need frequent restructuring. HPSQL databases can be restructured dynamically while they are being accessed.
- For data analysis and modeling applications.
- For prototyping.

HPIMAGE may be preferable:

- If you are migrating TurboIMAGE/V applications to a 900 Series system.
- When performance is the most critical application requirement. The types of applications where performance can be critical are those which serve a large number of users with a very high transaction volume.

ALLBASE/XL offers your organization the flexibility to use whichever model your analysts and programmers prefer, and which best matches the needs of the application.

ALLBASE/XL: HPIMAGE Interface

HPIMAGE databases consist of data sets (files) related in predefined paths. Each data set consists of data items (fields) and data entries (records).

In addition to the features common to both interfaces of ALLBASE/XL, the following features are specific to HPIMAGE.

HPIMAGE Features

- Network data structure allows fast access to complex relationships among data.
- Multiple level relationships allow hierarchical data structures to be easily modeled. Up to 199 levels are supported.

- *IQUERY/XL* provides the programmer and database administrator with a powerful facility for interactive queries and maintenance of the database.
- TurboWindow/XL (a software utility supplied with ALLBASE/XL) facilitates a smooth migration of TurboIMAGE/V applications and databases to HPIMAGE.
- TurboWindow/XL also allows the development of database applications (with the same source code) that can be shared across the entire HP 3000 family of systems.
- High level intrinsics allow applications written in **COBOL II/XL, HP FORTRAN 77/XL, HP Pascal/XL** (and **Transact/V** via TurboWindow/XL) to easily access the database.
- Dynamic capacity expansion and security modification allow data set capacities to be expanded and security designations to be modified without unloading and reloading the database.
- Generic search allows records to be located by specifying only a portion of the value in the field.
- Referential integrity can be maintained through definition of parent/child relationships.
- Four access methods are available: calculated, direct, chained and serial.

ALLBASE/XL: HPSQL Interface

SQL (Structured Query Language), which is fully implemented in the **HPSQL** interface of ALLBASE/XL, is a non-procedural language for both defining and manipulating data. Because SQL is non-procedural, it requires less application code for database access operations. This, in turn, simplifies the development and maintenance of database applications.

In HPSQL, data is organized in two dimensional tables (sometimes referred to as relations in strict relational terminology). Tables consist of columns (attributes) and rows (tuples). The intersection of a column and row is a field; the field values across a row constitute a data record.

In contrast to HPIMAGE databases, in which the relationships (paths) between data sets are defined as part of the database structure, data relationships are not predefined in HPSQL databases. Rather, data relationships are established by HPSQL when the database is accessed by a user or program.

HPSQL determines the fastest way to perform the operation that has been requested. Because HPSQL, not the application program, determines how to navigate through the database, changes to the database structure can be made without affecting the application program. This is another reason why HPSQL is so flexible and easy to use.

In addition to the features common to both interfaces of ALLBASE/XL, the following features are specific to HPSQL.

HPSQL Features

- Relational model allows the user to specify only what data is required without specifying how to retrieve it.
- Database creation, maintenance and manipulation can be done interactively, through *ISQL (Interactive SQL).*
- Language preprocessors allow the same SQL statements which are used for a direct query via a terminal to be embedded in COBOL II/XL and HP Pascal/XL application programs.
- A sophisticated query optimizer relieves the programmer of the details of query planning without sacrificing performance.

- Dynamic restructuring allows the database structure, table capacities, and security designations to be changed without unloading and reloading the database.
- Views can be defined which 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 use of fields which are relevant to some, but not all records in a table.

Other Data Storage Facilities

TurboIMAGE/V, the standard database system on MPE V based systems, is included in the **Fundamental Operating Software (FOS)** for the 900 Series systems for migration and information storage flexibility.

Another data storage facility included in FOS is **KSAM/V.** KSAM/V is an indexed file subsystem that speeds entry and retrieval of data by using the *Keyed Sequential Access Method.* It provides random and sequential record access and an efficient generic search capability. Existing KSAM/V files on MPE V based systems can easily be restored into KSAM/V files on a 900 Series system. KSAM/V is a useful data storage facility for applications that do not require database capabilities.

Database Compatibility and Migration

There is a very high degree of compatibility between HP's database products for MPE V based systems and the 900 Series. HP has made sure that TurboIMAGE/V databases and applications can be migrated smoothly and quickly to the 900 Series.

- Without any modification, existing TurboIMAGE applications and databases can be restored from an MPE V based system to a 900 Series system and run in Compatibility Mode.
- Migration is made easier by **TurboWindow/XL,** a software interface supplied with ALLBASE/XL. It allows TurboIMAGE/V applications to access both HPIMAGE and TurboIMAGE/V databases.
- To take advantage of the increased performance and functionality of HPIMAGE, HP supplies tools that let you easily convert TurboIMAGE/V databases into HPIMAGE databases.
- For optimum HPIMAGE performance, TurboIMAGE/V applications can be modified to use only HPIMAGE intrinsics. These applications then become HPIMAGE applications and access HPIMAGE directly.
- **HPSQL/V** is compatible with the HPSQL interface of ALLBASE/XL. As such, HPSQL/V databases can be easily migrated to the HPSQL side of ALLBASE/XL.

For customers who want to operate TurboIMAGE/V databases on 900 Series systems, HP provides two software tools for maintaining and tuning TurboIMAGE/V databases on all HP 3000 systems.

- **TurboIMAGE DBchange/V** is a new, interactive utility that allows dynamic restructuring and capacity expansion of TurboIMAGE/V databases. Database changes are entered using a menu format and executed either online or in batch. DBchange/V lets the user rename databases, copy databases, change database security, restructure databases, print schemas, and change set capacity and blocking factors. These changes can be made dynamically without having to unload and reload the database. An online Help facility is included.
- **TurboIMAGE Profiler/V** is a software utility to aid the programmer and database administrator in the design and fine tuning of TurboIMAGE/V databases. Profiler provides performance and usage statistics (for instance, regarding transaction performance, lock conflicts, and data path efficiency) that can help determine the optimal design of TurboIMAGE/V databases.

Application Development

For application development on the 900 Series, HP offers:

- **A wide range of programming languages and capabilities**
- **Toolset/XL:** an integrated application development environment
- **VPLUS/V:** a comprehensive tool to aid programmers in forms design and screen handling

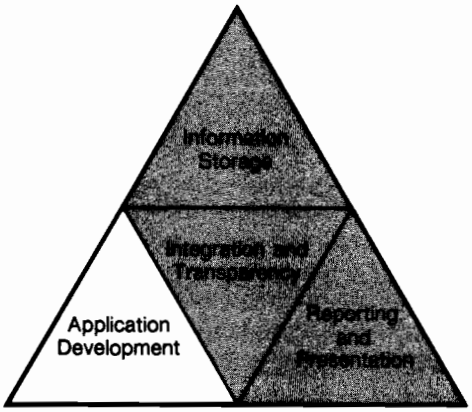


Figure 3-4. Application Development

Programming Environment Overview

Seven programming languages are available from HP for the 900 Series:

- **COBOL II/XL** – implements the X3.23-1985 ANSI COBOL standard with extended features.
- **HP Pascal/XL** – implements 770X.397-1983 ANSI Pascal standard with extended features for systems level programming for the 900 Series systems.
- **HP FORTRAN 77/XL** – implements X3.9-1978 ANSI FORTRAN standard with MIL-STD-1753 and HP language extensions.
- **RPG/V** – highly compatible with industry standard RPG.
- **HP Business BASIC/V** – extends far beyond the 1978 ANSI BASIC standard; includes both an interpreter and a compiler.
- **SPL/V** – the systems programming language for MPE V based systems.
- **Transact/V** – a high-productivity programming language designed for the development of transaction processing applications.

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.

The MPE XL operating system provides a very productive programming environment, including device independence, file independence, and the ability to call MPE XL intrinsics from any program. Refer to the MPE XL chapter of this manual for more information about the MPE XL programming environment. Programmer productivity is also enhanced by use of Toolset/XL and VPLUS/V.

Debugging Facilities

Toolset/XL *contains a symbolic, source level debugger* for programs written in COBOL II/XL, HP Pascal/XL and HP FORTRAN 77/XL. *MPE XL includes an assembly level debugging facility* that can be used for programs written in any of the supported HP programming languages. Also, HP Business Basic/V contains its own powerful debugging facility.

Native Mode and Compatibility Mode Compilers
The languages with the /XL suffix provide Native Mode compilers. Native Mode is the native run-time environment of MPE XL. In Native Mode, source code has been compiled into the native instruction set of the 900 Series.

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

In the future, HP will offer Native Mode compilers for HP Business BASIC, RPG, C and Transact, as well as Compatibility Mode compilers for HP FORTRAN 77, FORTRAN 66, COBOL II, BASIC and Pascal.

Compile Optimization
The Native Mode compilers — COBOL II/XL, HP FORTRAN 77/XL, HP Pascal /XL — are optimizing compilers. *They are very sophisticated compilers that maximize a program's run-time performance while minimizing its memory requirements.*

Reduced complexity architectures are ideal for optimizing compilers, and, conversely, compiler optimization provides the highest performance on such machines. HP developed these powerful compilers to take full advantage of the features, simplicity and uniformity of the machine instruction set of HP Precision Architecture.

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 so that memory references are minimized. In addition these compilers can compensate for some inefficiencies 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. Even in the case of COBOL/V (an older version of COBOL II/V), run-time library support is provided.

COBOL II/XL

COBOL II/XL, the primary commercial language for the 900 Series, is especially oriented toward data processing for business applications. Such processing can be done in batch and online modes, and typically involves manipulation of large volumes of data.

The COBOL II/XL compiler provides dual entry points which allow the user to choose between compiling under the X3.23-1974 ANSI COBOL or the X3.23-1985 ANSI COBOL Standards. COBOL II/XL offers the Intermediate Level of the 11 modules defined by the 1985 ANSI COBOL Standard.

Features of the 1985 ANSI COBOL Standard allow you to write more structured programs. Some examples of structured programming features supported in COBOL II/XL are:

- The EVALUATE verb which allows the testing of multiple conditions and indicates the specific action to be taken.
- In-line PERFORM allows the repeated execution of a set of statements until a specified condition is met.
- Scope-delimiters such as END-IF, END-READ and END-ADD allow nested conditional statements to be written with greater clarity.

- The CONTINUE statement which acts as a no-op, and transfers control to the next executable statement; can be used in control constructs to write structured code more easily.
- The NOT phrase can be used to negate all conditional clauses providing greater structured symmetry.

COBOL II/XL also provides HP extensions in addition to the 1985 ANSI features. These allow COBOL II/XL programs to interface to various subsystems offering symbolic debug environment (Toolset/XL), forms management (VPLUS/V), database management (ALLBASE/XL and TurboIMAGE/V), and the KSAM/V file system.

HP Pascal/XL

HP Pascal/XL offers all the advantages of programming in Pascal, including high readability of programs and ease of development resulting in lower maintenance costs. *In addition, HP has added extensions that allow system level level applications to be written in HP Pascal/XL.* This has enabled HP Pascal/XL to be used extensively within HP for the development of system software.

HP Pascal/XL is a superset of the ANSI/IEEE 770X3.97-1983 and ISO/DIS level one standards and conforms to the HP Standard for Pascal. Its system programming extensions form the major area of addition. These extensions permit the programmer a very high degree of flexibility for data manipulation, an essential requirement for systems programming. Some of the salient features for data manipulation are:

- Type coercion offers the flexibility to override Pascal's type checking for a particular manipulation.
- ANYPTR type and pointer arithmetic functions allow great ease in manipulation of pointers.
- Extended addressing allows access to the entire available address space.
- The TRY-RECOVER statement allows programs to handle run-time exceptions.

Other extensions of HP Pascal/XL over the ANSI standard include:

- Manipulation of character string data is facilitated by the STRING data type and associated functions.
- Direct Access and other I/O extensions provide improved I/O handling.
- Conformant Array parameter type offers greater flexibility in parameter passing.

HP Pascal/XL also provides the ability to break programs into separate modules, each of which can be compiled individually.

HP FORTRAN 77/XL

HP FORTRAN 77/XL is a superset of ANSI FORTRAN 77. It includes the MIL-STD-1753 extensions and other frequently offered extensions. In addition, it is highly compatible with FORTRAN 66/V (formerly known as FORTRAN/3000). Key features of HP FORTRAN 77/XL include:

- IF-THEN-ELSE, Block, DO, and DO-WHILE statements provide support for structured programming.
- Multiple ENTRY subprograms permit controlled sharing of private data.
- CHARACTER data type and operations provide convenient management of string data.
- DOUBLE PRECISION and DOUBLE COMPLEX data types and operations offer additional precision computation.

- Generalized I/O statements, including error handling, provide control and management of sequential or direct access, formatted or unformatted I/O.
- INCLUDE statement allows inclusion of program text (for instance, COMMON declarations) from other files.
- Compiler directives provide conditional compilation.

HP FORTRAN 77/XL provides procedural access to all /XL subsystems and to other /XL languages.

RPG/V

HP's RPG/V is highly compatible with the RPG II languages offered by other vendors. Minimal effort is required to upgrade RPG II programs from other vendors' systems to the HP 3000. In addition, HP's RPG/V compiler helps detect errors at the source code level with extensive diagnostic messages.

HP's RPG/V offers several extensions to the de facto industry standard for RPG II. These extensions include:

- Passing of parameters in external subroutine calls, which facilitates inter-language interaction.
- Increased flexibility in handling run-time errors.
- Direct access to databases from the language.
- Provision of compile-time or pre-execution time arrays and tables which may be stored on separate disc files; this allows them to be used by several programs without the need to specify them each time.
- Automatic conversion of EBCDIC data into ASCII format.
- RPG Interactive System Environment (RISE) provides an aid to program development.
- The compiler can supply a cross reference listing for fields, indicators and files.

HP Business BASIC/V

HP Business BASIC/V extends far beyond the 1978 ANSI BASIC standard. It provides an interpreter that is easy to work with and a fast, efficient compiler.

HP Business BASIC/V's interpretive environment provides immediate feedback on the effect of program modifications as well as indicating syntax errors as the program lines are entered. Extensive debugging tools also simplify application development. All or part of a program can be compiled, resulting in significant performance improvements for most types of applications.

Extended features of HP Business BASIC/V include:

- Statements and constructs to support structured programming include IF-THEN-ELSE, WHILE-ENDWHILE, REPEAT-UNTIL, SELECT-CASE, LOOP-ENDLOOP, FOR-NEXT and GOSUB.
- 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 BASIC commands and statements.
- Long identifier names and alphanumeric labels improve program maintenance. Keywords can be used as identifiers.
- Online HELP facility provides immediate help information.
- Seven data types and arrays of up to six dimensions allow flexibility and efficiency in structure design.

SPL/V

SPL/V is the System Programming Language for MPE V based HP 3000 systems. SPL/V is potentially the most efficient language for MPE V based systems because it is dependent upon and integrated with the stack architecture of the MPE V based systems. For MPE V based systems, SPL combines the efficiency of a machine-dependent language with the simple structure of a high level language.

Because SPL/V is so integrated with MPE V based systems, it cannot compile into the 900 Series' Native Mode of run-time execution. SPL programs run in Compatibility Mode on the 900 Series.

Transact/V

Transact/V *is a procedural, high-level language that combines the power of traditional programming languages, such as COBOL, with a comprehensive set of powerful verbs that can perform several functions with a single statement.* Transact/V source code consists of very high-level statements in which the user can automatically specify what actions are to take place. A set of registers, automatically maintained by Transact/V provide a consistent and logical interface to various file structures. Data definitions and structures can be defined in the program or resolved from Dictionary/V.

Transact/V statements provide high-level functionality in these areas:

- Database and File Operation – From a single, consistent interface, Transact/V can access TurboIMAGE/V databases, MPE and KSAM/V files, and VPLUS/V forms for screen interaction.
- Data Entry and Display – Transact/V can accept data, validate and perform edit checking, or perform formatted output functions with a single statement.
- Assignment – Transact/V has the ability to move data between variables with automatic type conversion.
- Dictionary/V Interface – Transact/V data definitions can be handled by Dictionary/V providing data type and size consistency across all applications and freeing the programmer from defining the same data in multiple locations.

Transact/V is ideally suited for prototyping and developing transaction oriented applications. When used in conjunction with Dictionary/V, Transact/V can reduce coding by a factor of five to one compared to conventional languages.

Toolset/XL: An Integrated Environment

Toolset/XL is a powerful, integrated approach to maximizing programmer productivity in all phases of program development.

Toolset/XL provides an integrated programming environment for COBOL II/XL and HP Pascal/XL programming. Features of Toolset/XL include:

- *Full Screen Editor:* allows code to be entered and edited online.
- *Symbolic Debug Facility:* speeds interactive program debugging at the source code level. This powerful debugging facility locates run-time errors by using actual program variable and paragraph names rather than primitive level memory locations and code addresses. This alleviates the need for programmers to understand system internals in order to debug their programs.

  The debug facility lets programmers set and clear breakpoints, and edit a source file at a breakpoint. Programmers can also display and modify data item values, and trace program flow.

  Toolset/XL's symbolic debug facility can also be used to debug COBOL II/XL and HP Pascal 77/XL programs that were developed outside of the Toolset/XL environment. In addition, this symbolic debug facility can be used to debug programs written in *HP FORTRAN 77/XL.*

- *Code Generation Facility:* extracts data definitions from Dictionary/V and uses them to automatically generate data declarations in programs.
- *COBOL COPY Library Keys and Commands:* lets programmers easily create, edit and copy COBOL COPY libraries and list their contents.
- *Program Translation Manager:* allows programs to be prepared, compiled and run without leaving the Toolset/XL environment.
- *Version Management Assistance:* helps manage different versions of source code. Toolset/XL provides labeling documentation for each version of a source file, and can list changes between versions. Source file information can be shared by members of a programming team.
- *Workspace Management:* oversees all files needed for development of a program. For disc space optimization, only the differences between versions are stored, and the source files can be stored in a compressed format.

VPLUS/V

VPLUS/V *is a programmer's productivity tool designed to simplify forms design and screen handling for interactive applications.* Using VPLUS/V, formatted screens for data entry and retrieval are easily designed online. A high level library of intrinsics provides programmatic calls to utilize these screens in applications.

While the primary purpose of VPLUS/V is to aid programmers in the development and maintenance of screens for interactive applications, it also provides a complete stand-alone solution for simple source data entry requiring no programming.

VPLUS/V is included in the 900 Series' Fundamental Operating Software.

VPLUS includes the following modules:

- *Forms Design Facility.* This easy-to-use, menu-driven design facility lets programmers interactively create data entry screens and define the associated editing criteria. It is designed to be used both by programmers and trained nonprogrammers. Levels of screen design range from simple data collection and simple editing to full-field edits and advanced processing and formatting.
- *Programmatic Interface Facility.* This facility includes high level intrinsics for controlling VPLUS/V forms and the end-user's terminal screen. The VPLUS/V intrinsics can be called by all of the HP programming languages available on the 900 Series.
- *Source Data Entry and Reformatting Facilities.* For simple source data entry requirements, VPLUS/V provides a general purpose, stand-alone data entry program called ENTRY. ENTRY allows users to perform data entry and retrieval through forms that were created using the Forms Design Facility. No programming is required. The data is automatically stored in batch files. Another VPLUS/V facility allows users to reformat the data for subsequent use by other applications.

VPLUS/V supports all of HP's block mode workstations, including support for special features such as: HP Touch, labeling of user definable keys, display enhancements such as blinking and half-bright, local forms caching, and extended local edits.

Reporting and Presentation

HP offers the following reporting and presentation tools for the 900 Series systems.

- *Data Processing Professional Reporting Facility:*
  Business Report Writer/V
- *Programmer Reporting Facility:*
  Report/V
- *Database Query, Testing, Maintenance and Reporting Facilities:*
  ISQL/XL
  IQUERY/XL
- *End-User Ad Hoc Reporting:*
  Inform/V

Business Report Writer/V and Report/V are powerful report generation tools for creating and maintaining large, sophisticated reports. For instance, these two report writers can be used to meet the large scale reporting requirements of production and accounting applications. A Native Mode (/XL) version of Business Report Writer is planned for the future.

ISQL/XL and IQUERY/XL are interactive query and support tools for the HPSQL and HPIMAGE portions of ALLBASE/XL, respectively.

Inform/V lets end users easily generate their own ad hoc reports.

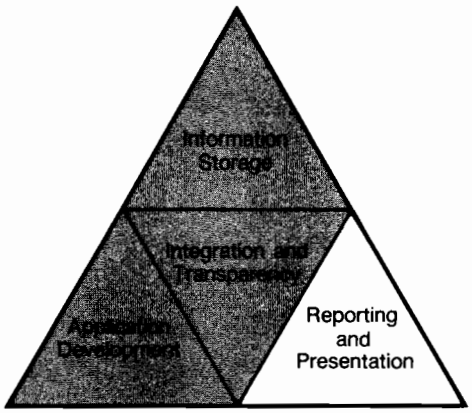


Figure 3-5. Reporting and Presentation

Business Report Writer/V

Business Report Writer/V is a powerful, high performance report writing system. It is designed to be used not only by programmers, but also by other data processing professionals such as system administrators and database administrators.

Business Report Writer/V has a menu-driven user interface. The menus and online help screens assist users in developing reports. An online report window lets users see the format of reports while they are being designed.

Reports created by Business Report Writer/V provide fast run time execution that is equivalent in many cases to reports written in COBOL.

Business Report Writer/V provides a powerful set of reporting features which include arithmetic operations, conditional statements, and exception reporting. Formatting features allow output to be printed on special forms such as checks and invoices.

Business Report Writer/V can access TurboIMAGE/V and HPIMAGE (via TurboWindow/XL) databases, KSAM/V files, and MPE XL files. Access to HPSQL databases will be provided in the future.

Business Report Writer/V reduces the time needed to generate sophisticated reports, and brings the reporting capability to more people in the MIS department.

Features of Business Report Writer/V include:

- "Fill in the box- see what you get" report specification menus that allow immediate design verification and reduce maintenance time.
- Relational views of data that offload the problem of how to get data and allow the designer to focus on report contents.
- Multi-pass reports allow the output file of a report to be queried directly by another Business Report Writer/V report or by other applications.
- Advanced reporting features deliver an analysis of information to facilitate decision making.
- Integration with Dictionary/V to transparently verify definitions, locate structures and access data.
- Performance tuning to optimize performance and conserve system resources.
- Security over report definition and execution to safeguard sensitive information.

Report/V

Report/V is a non-procedural, report writing language for programmers. It includes a high-level report definition language, a compiler, and a processor to execute the reports.

Report/V allows sophisticated reports to be developed in less time than would be possible using traditional languages such as COBOL. Its high level statements produce report formats, perform calculations, define selection criteria, and access the data. In conjunction with Dictionary/V, Report/V resolves data definitions, structures and access paths transparently.

For reporting flexibility, Report/V supports a wide range of formatting and grouping options. Also, this reporting system can perform advanced calculations, report statistical data and extract information based on logical conditions (IF-THEN ELSE).

Report/V can access TurboIMAGE/V and HPIMAGE (via TuboWindow/XL) databases, KSAM/V files and MPE XL files.

Transact/V, Inform/V and Report/V are integrated products. Transact/V programs can call compiled Report/V programs. Inform/V reports can be transformed into Report/V reports to provide more information.

To prevent unauthorized access of information, Report/V includes security provisions for report definitions and execution.

ISQL/XL

ISQL (Interactive Structured Query Language) is a database support tool integrated into HPSQL which features a powerful, non-procedural query facility. ISQL allows SQL queries to be executed directly from a terminal, giving programmers and frequent HPSQL users the ability to use this powerful language for ad hoc queries. Since the syntax of SQL queries is the same whether executed using ISQL or embedded in an application program, the programmer can reduce application development time by using ISQL to test database queries before embedding them in applications.

IQUERY/XL

IQUERY/XL is a database support tool included with ALLBASE/XL for use with HPIMAGE. IQUERY/XL features a powerful, command driven interface designed for application programmers and database administrators. It has extensive locating, reporting and updating commands that provide flexible data access on an ongoing basis and are particularly valuable in testing new database applications and structures.

Inform/V

Inform/V is an end user ad hoc query and report generation facility. It's easy to learn and use, yet provides powerful query functionality. *End users can utilize Inform/V to produce their own, tailor-made reports in minutes.*

Through Inform/V, end users can retrieve data from HPIMAGE (via TurboWindow/XL) and TurboIMAGE/V databases, and from KSAM/V and MPE XL files. Inform/V does not access HPSQL databases.

For maximum ease-of-use, Inform/V is designed to be used in conjunction with "Inform Groups", groups of logically related information. Your database administrator creates Inform Groups by specifying the data items and links that make up the group. The Inform Groups are stored in Dictionary/V. As a result, end users do not need to know how or where data is stored.

Inform/V presents the user with a series of menus and prompts that interactively guide the user through the query and report generation process. Users can specify the selection criteria that limits the amount of data reported. Data can be sorted in ascending or descending order. Summary functions include average, count, minimum, maximum and total values. New data items can be created by adding, subtracting, multiplying and dividing other data and constants.

Reports can be generated in default formats or users can specify their own page formatting. Report definitions can be saved for future use.

Integration and Transparency

Integration and transparency of information management for the 900 Series systems are facilitated by data dictionary and distributed data processing capabilities.

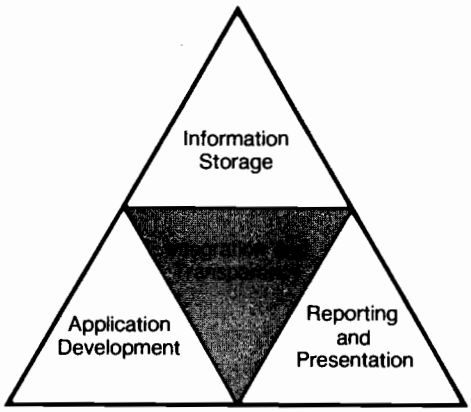


Figure 3-6. Integration and Transparency

Data dictionaries simplify the control and coordination of data. They store information about the data processing environment: data descriptions and definitions, as well as information about databases, files, programs, and security.

By providing a central source of information about the data processing environment, data dictionaries eliminate redundant data definitions, thereby helping ensure data consistency. Data dictionaries provide the means to enforce data standards and prevent naming conflicts. Program quality improves and debugging problems are reduced due to the consistent, reliable picture of the data processing environment.

Programmers can refer to data dictionaries to quickly resolve many design questions. From data dictionaries, programmers can easily learn what data is available, where the data is, its definition and structure, and who is responsible for the data.

Also, data definitions that otherwise would have to be supplied by a program can be retrieved from a data dictionary. And if a definition must be changed, it need be changed only once in the dictionary, not in every program that uses the definition.

HP offers two data dictionaries for the 900 Series: System Dictionary/XL and Dictionary/V.

System Dictionary/XL

System Dictionary/XL, which is included in the 900 Series' preconfigured package, will play a key integrating role in HP's information management solutions. System Dictionary/XL provides the stable programmatic interface, extensibility and powerful features required for its future role as the standard data dictionary for the HP 3000 family of computers.

System Dictionary/XL is organized according to the entity-relationship model. Entities represent all objects described in the dictionary: data, files, records, forms, documents, devices, users, etc. Relationships describe the ties between these objects. Attributes can be added to provide descriptive data for entities and relationships.

A core set of predefined entity and relationship types is provided which allows users to document TurboIMAGE/V databases, HPIMAGE and HPSQL databases, KSAM/V and MPE XL files, VPLUS/V forms, COBOL II/XL programs and network device configurations. This core set is extensible; that is, customers can add new entity types, relationship types, and attributes to further customize the dictionary to fit their needs.

System Dictionary/XL provides all the basic benefits of a data dictionary described earlier in this section. In addition, System Dictionary/XL provides other important features, including:

- Extensibility – Lets customers tailor the documentation structure of the dictionary to fit their needs.
- Programmatic Access – Allows customer-written programs to access and update the dictionary automatically.
- Domains – Provide the means to share global definitions throughout the dictionary while keeping application-specific definitions partitioned in different domains (areas) of the dictionary.
- Version Control – Allows different versions of dictionary definitions to be assigned "test", "production" and "archival" status, thereby helping to facilitate application development and maintenance.
- Synonyms and Aliases – Allows alternate names for the same entities in the dictionary so that users can access data by different names.
- Reports on Dictionary Contents – Permits item selection and report formatting using flexible, user-defined criteria. Report definitions can be saved for later use.
- Security Features – Provide means to define users capabilities regarding the dictionary and restrict user access to specific domains, entities and relationships.

- TurboIMAGE/V Utilities – Can create TurboIMAGE/V schemas and root files from the dictionary and produce dictionary definitions from an TurboIMAGE/V root file.
- VPLUS/V Forms Definition Loader – Loads information about VPLUS/V forms into the dictionary.
- COBOL Definition Extractor – Generates COBOL II/XL data definitions for COBOL Copylibs from definitions in the dictionary.
- Dictionary/V Conversion Utility – Automates the conversion of Dictionary/V dictionaries to System Dictionary/XL.

Dictionary/V

Dictionary/V is designed primarily to support HP's **RAPID** products: Transact/V, Report/V and Inform/V. It provides a consistent source of information to eliminate data definition redundancy. This dictionary can document TurboIMAGE/V databases, KSAM/V and MPE XL files, Inform/V groups, and VPLUS/V forms files.

Dictionary/V provides utilities which load TurboIMAGE/V schemas and VPLUS/V forms files into the dictionary, and generate TurboIMAGE/V schemas and root files. It can supply data definition source code for COBOL II/XL and Pascal/XL. The capability to generate reports of the dictionary contents is also provided by Dictionary/V.

Although it is closely integrated with the RAPID products, Dictionary/V is non-extensible and does not provide programmatic access, domains, or version control features.

Distributed Data Processing

The 900 Series systems can participate in distributed data processing through HP's new network services product, **NS 3000/XL (Network Services 3000/XL).** NS 3000/XL allows processing to be distributed either functionally or geographically in your organization.

NS 3000/XL gives you the flexibility to combine centralized and decentralized information management as best fits your needs. For instance, data can be gathered from networked systems for centralized storage, or stored on systems where the data is most frequently used. Users and applications from one system can access data stored on other systems in the network.

Distributed data processing provides the flexibility to coordinate and manage information in the way that you want to do business. It also facilitates data consistency and accuracy by reducing redundant storage of data. There is no need to try to maintain multiple copies of the same data on different systems.

One of the components of NS 3000/XL is *Remote Database Access* which allows transparent interactive and programmatic access to TurboIMAGE/V databases from any system on the network.

To facilitate transparent access, the database administrator can create a database access file that defines the location of target databases. Thus, the database location is handled by the database access file, not by the application. Applications then can access the remote database just as if the database resided on the local system. Databases can be relocated without affecting the applications.

Access to remote databases is subject to all the security measures of MPE XL and TurboIMAGE/V. In addition, the database administrator can specify in the database access file which users and applications can access each remote database.

For more information regarding distributed data processing, refer to the "Networks" chapter of this manual.

4

HP Precision Architecture

Foundation For The Next Generation HP 3000's

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

HP Precision Architecture maximizes the performance benefits that can be realized from a given semiconductor technology. This performance potential allows for development of high-performance systems which provide a cost effective, compatible growth path designed to meet growing performance requirements in commercial environments. And the inherent simplicity of Precision Architecture is ideal for fast, single-chip microprocessors which 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 900 Series HP 3000 systems.

Designed to Last

A key design objective of Precision Architecture 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, Precision Architecture 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, Precision Architecture 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% or more of the time is spent executing very simple instructions such as ADD, LOAD, BRANCH, and STORE. *Only about 20% 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.*

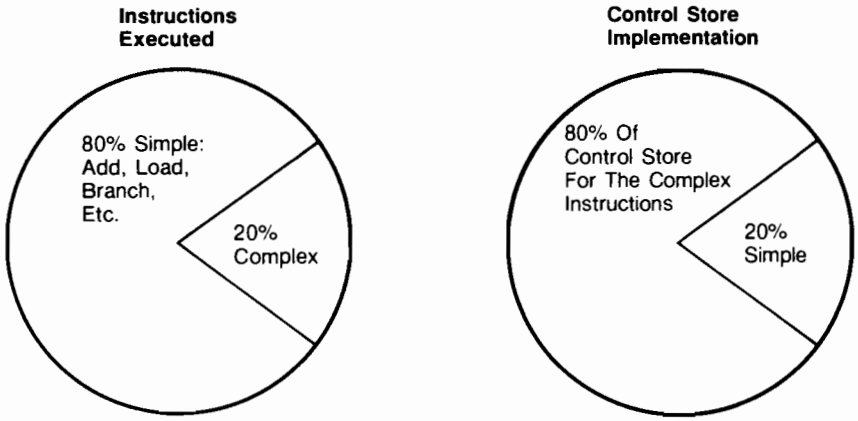


Figure 4-1. RISC Motivations

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. *HP Precision Architecture 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 Precision Architecture.

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 Precision Architecture 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 HP 3000 products, 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 HP 3000 system.

Lower Cost

Eliminating much of the hardware complexity associated with conventional computer systems directly translates into a reduced part count and a system which is easier to design, develop and manufacture. The result is a system that costs less to bring to market, and this cost savings is directly reflected in the superior price/performance of the 900 Series HP 3000 products as compared to competitive offerings.

Higher Performance Potential

With the 900 Series HP 3000 products, the performance potential of a wide variety of semiconductor technologies can be maximized. For example, the HP 3000 Series 930, implemented in off-the-shelf TTL, delivers performance that typically is achieved by conventional systems only via utilization of ECL semiconductors or expensive custom technology. *With Precision Architecture, a given level of performance can be achieved at a significantly lower cost than with conventional systems.*

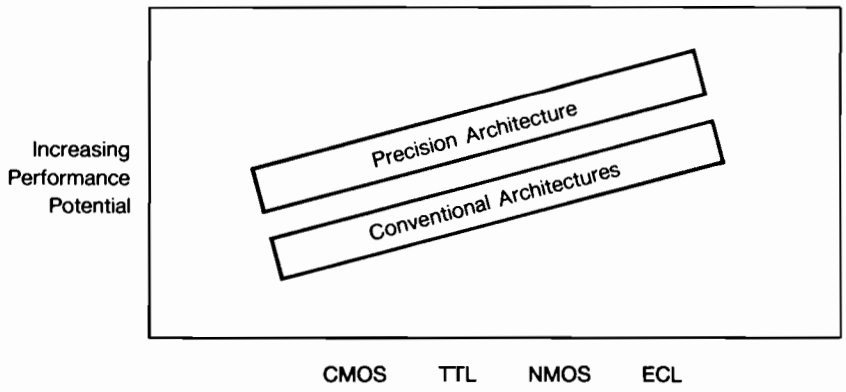


Figure 4-2. Higher Performance Potential

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 or workgroup computers. And at the high-end of the HP 3000 family, the performance advantage of Precision Architecture, coupled with support for multiprocessor systems, allows for development of products delivering very high performance HP 3000 solutions with the power of today's water-cooled mainframes.

Ideal for Advancing Technologies

The simplicity of Precision Architecture 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 HP 3000 products. 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, Precision Architecture systems provide increased processor reliability. In addition, Precision Architecture 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 in a multiprocessor system failed, another could automatically take its place allowing the system to continue operating without interruption.

RISC Attributes: Maximizing Processor Performance

The 900 Series HP 3000 systems are the first business computing systems which 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 these are discussed below. Note that the 900 Series HP 3000 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 Precision Architecture 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 HP Precision Architecture Instruction Set are fixed length, 32-bit quantities. 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 that calculations do not have to be slowed by accesses to relatively slow cache or main memory storage. By providing a relatively large number of these high-speed registers (32), 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 multi-cycle 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 for a program each time it 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 for only once, when the program is compiled. In this way, object code can be streamlined and optimized for performance so that the program can actually be run as quickly as possible.

HP Precision Architecture: Extending RISC

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

Expanded Addressability

Precision Architecture 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

Precision Architecture allows for the development of systems which utilize tightly coupled symmetric multiprocessors. Multiprocessors share the same memory and I/O busses and I/O devices. They can be used to enhance system performance via distribution of the system workload over several processors, or they can be configured redundantly to provide fault tolerance.

Floating Point Coprocessors

The modular design of Precision Architecture allows for the addition of special function coprocessors for accelerating execution of those complex functions which 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.

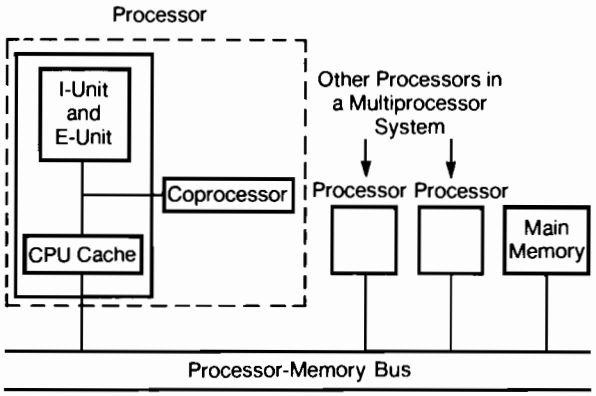


Figure 4-3. Coprocessor and Multiprocessor

Decimal Arithmetic Support

Decimal arithmetic is a data type commonly used in commercial applications, and Precision Architecture 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 HP 3000 systems than is required 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 Precision Architecture was to ensure a high level of data security and high throughput in I/O intensive database applications. The first step was providing a large virtual address space, which can be very effectively utilized by MPE XL's file mapping schemes. Furthermore, *HP Precision Architecture 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 Precision Architecture 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, all while the result of a calculation specified by a third instruction is being saved to a CPU register.* Such a pipeline organization is representative of the HP 3000 Series 930 and Series 950 systems. Fixed-length, fixed format instructions help streamline instruction pipelining. Additionally, Load/Store RISC-based machines are ideal for minimizing both the number of pipeline stages required for high performance, as well as ensuring that the time required to perform each stage is as short as possible.

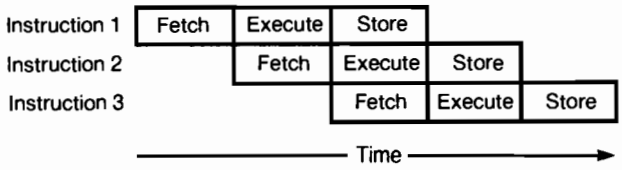


Figure 4-4. Instruction Pipeline

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" which is not utilized for useful processing. *On Precision Architecture 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.* As Branches constitute roughly one-sixth of typical instruction mixes, utilizing the available cycle after a branch results in increased performance with Precision Architecture systems.

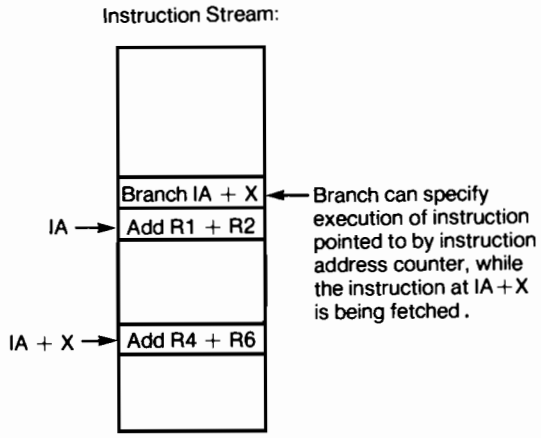


Figure 4-5. Delayed Branch Capability

Optimizing Compilers

Optimizing compilers ensure the best possible match between High Level Languages and Precision Architecture 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 HP 3000 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 by overlapping other instructions with Load instructions to ensure that even with storage accesses, effective instruction execution rates approaching one cycle per instruction are achieved.

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 Precision Architecture instructions which 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 Mechanisms

Precision Architecture specifies a four level privilege scheme for all code, data, and I/O accesses. This is supplemented by a 15-bit Protection Identifier which is assigned to each virtual page, and which is checked each time that 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 on Precision Architecture are provided below. For further information, refer to the "HP Precision Architecture Data Sheet".

Instruction Set

HP Precision Architecture defines 140 instructions. Each is 32-bits long and has a fixed format. So that complexity can be minimized and the the machine can be cycled as quickly as possible, the instruction set directly supports only simple functions. Although only simple functions are directly supported in the instruction set, some of the Precision Architecture instructions provide functions that typically would require multiple instructions on conventional systems. For example, the *Add* and *Branch* instruction performs a calculation and a conditional branch in a single cycle, whereas 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. Precision Architecture supports single-precision (32-bit), double-precision (64-bit) and quadruple-precision (128-bit) arithmetic operations. Floating point calculations can be performed in software via a sequence of integer calculations and conversions, or 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 Precision Architecture to provide high performance in applications which use floating point.

Data Types

HP Precision Architecture 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. Precision Architecture supports both packed and unpacked decimal data representations. Single, Double, and Quadruple-word floating point operands are represented in accordance with the ANSI/IEEE 7541985 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, and are used 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 4GB space which holds the next instruction. The Instruction Address Offset Register (IA Offset) points to the location, within that space, which 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 products is fully supported by the MPE XL operating system.

Virtual Memory is organized as a set of linear regions (called *spaces),* with each space 4GB in length. Spaces are further divided into fixed length 2KB *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.

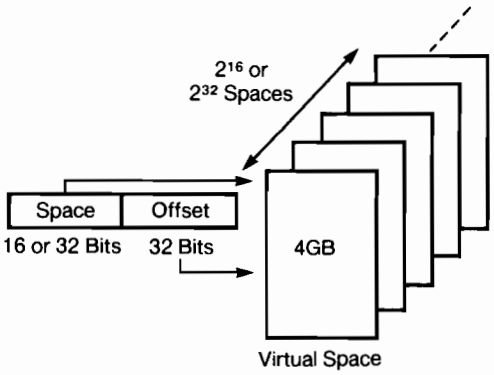


Figure 4-6. Virtual Memory Organization

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 to physical addresses using 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.

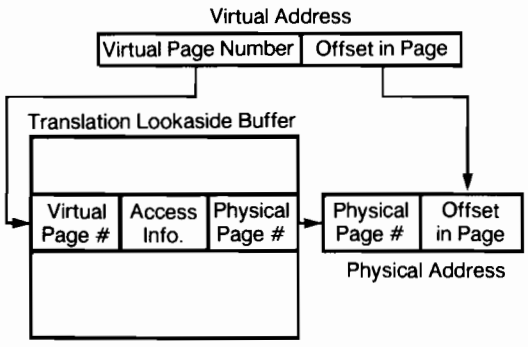


Figure 4-7. Virtual Address Translation

Virtual Memory Access Protection

The TLB hardware supports protection mechanisms to assure 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 are associated with each page, and these parameters define what privilege level is required to access that page, as well as 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 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
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

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
Divide Step
Compare and Clear
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

System Control Instructions

Break
Return From Interrupt
Set System Mask
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
Load Hash Address
Purge Instruction TLB
Purge Instruction TLB Entry
Purge Data TLB
Purge Data TLB Engry
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 Word
Coprocessor Store Indexed
Coprocessor Store Doubleword
Coprocessor Store Doubleword Indexed
Coprocessor Operation*

**Floating Point Operations Included*

5

Series 930 Hardware Overview

Introduction

The HP 3000 Series 930 is the first implementation of HP Precision Architecture. It represents a significant advance in performance over all previous HP 3000 models, while maintaining the HP 3000 tradition of ease-of-use and software compatibility with other members of the HP 3000 family.

The Series 930 is especially well-suited for business computing environments and distributed data processing. Utilizing the MPE XL operating system's file mapping facilities, the Series 930 is an excellent machine for transaction-oriented and I/O-intensive database applications.

The Series 930 also excels in computationally-intensive environments. And a floating point coprocessor can be added to the system to enhance the performance of applications (such as statistical analysis) that require floating point calculations.

The reduced complexity of HP Precision Architecture allows the high performance Series 930 to be implemented 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.

Through use of the Hewlett-Packard Interface Bus (HP-IB), and HP's new Distributed Terminal Controller, the Series 930 supports many of the same peripherals and workstations that are used on other HP 3000 systems.

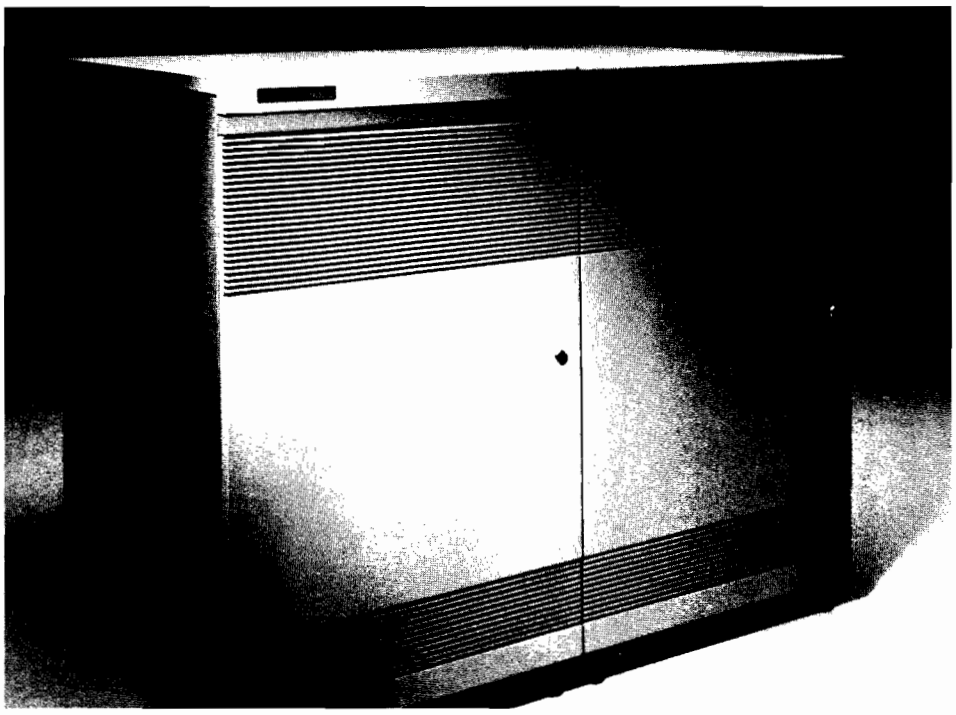


Figure 5-1. The HP 3000 Series 930

Features

- 4.5 MIPS CPU performance
- HP Precision Architecture
- 32-bit fixed format instructions
- 48-bit virtual addressing
- Single-cycle instruction execution
- All machine instructions hardwired; no microcode
- 125ns CPU cycle time
- Advanced instruction pipelining techniques
- 128KB high speed CPU cache
- Optional floating point coprocessor
- Two-bay, meter high packaging
- Low power and cooling requirements
- Battery backup and auto-restart standard

Configuration Maximums

- Main Memory: 16MB standard, expandable to 24MB in one 8MB increment
- Workstations: maximum of 400 per system
- Discs: supports 404MB disc drives; maximum of 24 discs per system for maximum of 9.7GB of disc storage
- Tape Drives: supports 1600/800 and 6250/1600 bpi tape drives, 1/2 inch; maximum of eight per system
- System Line Printers: supports 600 and 900 lpm printers; maximum of eight per system
- Intelligent Laser Page Printers: supports 12 and 45 ppm printers; maximum of four per system
- Serial Printers: Supports laser and dot matrix printers; maximum of 32 per system
- I/O Channel Multiplexers: Up to three channel I/O adapters per system

Central Processing Unit

The heart of the Series 930 is its Central Processing Unit (CPU), illustrated in simplified form below.

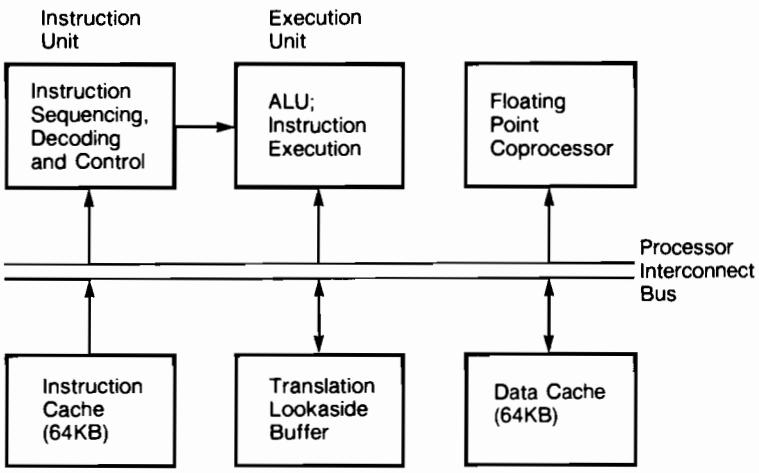


Figure 5-2. The Series 930 Central Processing Unit

The CPU of the Series 930 consists of five printed circuit boards and employs High Speed Schottky TTL logic. That the Series 930 is able to achieve high performance using this reliable, off-the-shelf technology reflects the high performance potential of HP Precision Architecture.

Instruction and Execution Units

Separate Instruction and Exeuction 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 (32Mhz).

The **Execution Unit** executes all instructions requiring data manipulation. It contains the ALU (Arithmetic Logic Unit) 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 930 employs a three-stage *instruction pipeline* so that up to three machine instructions can be operated on simultaneously. The instruction pipeline consists of three 125 nanosecond stages. Each stage is a CPU cycle. *While one instruction is fetched, another instruction is executed, and the result of a third instruction is stored.* Except for penalties such as cache misses (which occur infrequently), the net effect is that one instruction completes (exits the pipeline) every CPU cycle.

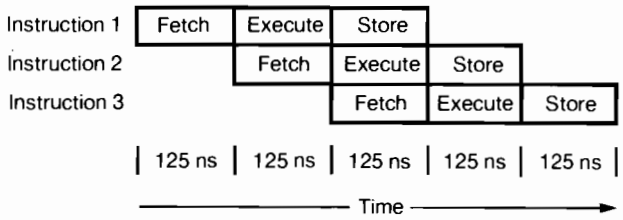


Figure 5-3. Instruction Pipeline Operation on the Series 930

High Speed CPU Caches

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 Series 930 maximizes the benefits of CPU cache in several ways. A large amount of CPU cache is provided, 128KB in total. The larger the CPU cache, the more likely it is that the required data and code will be in cache. Also, the Series 930 automatically moves into cache from main memory the code and data pages that are most likely to be required based upon a "locality" algorithm. As a result, the required code and data is found in cache almost all the time.

The total of 128KB cache is divided into two separate caches for instructions and data. Each is 64KB in size and implemented in high speed RAM. 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.* Data is transferred by Load and Store instructions between the general purpose registers of the Execution Unit and the Data Cache.

The Data Cache is a "write-to" cache, so that the main memory modules are updated only as required. This also serves to minimize main memory access.

If the instruction or data required by the CPU is not in cache, a "cache miss" occurs, and the required code or data is retrieved from the main memory modules.

Translation Lookaside Buffer

The processor generates 48-bit virtual addresses. Memory access is via 28-bit physical (real) addresses. Thus, virtual to physical address translation is required. *A high speed RAM buffer called the TLB (Translation Lookaside Buffer) optimizes this task.* The TLB can be considered to be a table that holds the most recently referenced virtual addresses and their corresponding physical address. It has 4096 entries: half for data, half for code. The needed address translation is found in the TLB more than 99% of the time.

If the translation is not in the TLB, a software scheme that involves hashing 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 is divided into 2KB 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.).

Floating Point Coprocessor

Scientific, engineering and statistical applications that utilize floating point numbers require high performance in floating point calculations. For such applications, HP offers a Floating Point Coproccesor that significantly accelerates floating point calculations.

The Series 930 Floating Point Coprocessor supports the floating point operands of the ANSI/IEEE 754-1985 standard. It supports single (32 bits) and double (64 bits) precision floating point operands.

The Floating Point Coprocessor is attached to the CPU's Processor Interconnect Bus. Included in the Floating Point Coprocessor are twelve 64-bit wide registers for operands, and three HP proprietary NMOS-III VLSI chips to perform the calculations.

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 calculation. This parallel operation helps provide a high level of performance for applications that use floating point calculations.

Main Memory

The Series 930 has 16MB of main memory standard, in two 8MB modules. Each Main Memory module includes an integrated memory array and controller. One additional 8MB memory module is optionally available, providing a maximum of 24MB of main memory. The memory modules utilize 256K-bit NMOS dynamic RAM chips.

ECC (Error Correcting Code) memory is standard on the Series 930. The internal memory word size is 39 bits: 32 bits for data and seven bits dedicated to error detection and correction. Single-bit errors are automatically detected and corrected ensuring data integrity. Multi-bit errors are automatically detected, resulting in a high priority interrupt to system software for appropriate action.

Data is transferred between the CPU caches and main memory via the Central Bus (as shown in the diagram on the next page). Data is transferred between CPU and main memory in four word blocks (16 bytes).

Bus Hierarchy

The Series 930 is based on a two-tier bus structure. As illustrated in Figure 5-4, the Central Bus is the higher level bus, and Channel I/O Buses are the lower level. Channel I/O Adapters interface the two bus levels.

The wide data paths and fast, synchronous clocking of the Series 930's 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 three adapters and low level buses).

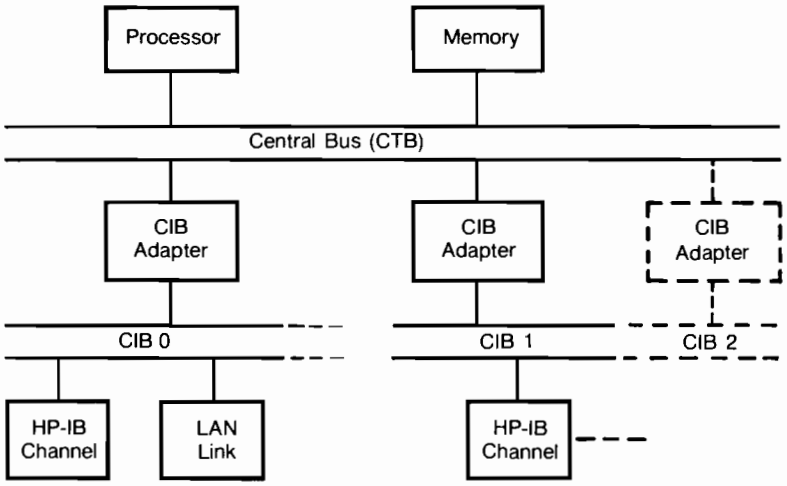


Figure 5-4. The Series 930 Bus Hierarchy and Main System Components

Central Bus

The *Central Bus (CTB)* is the communication path between the CPU, the Main Memory modules, and the Channel I/O Adapters. The Central Bus provides a 32-bit wide data path, and runs synchronously with an 8 Mhz clock. It supports sustained data transfer rates of 20MB/second.

The Central Bus consists of 56 lines: 36 time-multiplexed, bidirectional lines for addresses and data (includes parity), one clock line, and 19 lines for status and control information.

Channel I/O Adapters

The Series 930 *Channel Adapters* provide the interface between the Central Bus and the Channel I/O Buses. Each Channel I/O Adapter serves as a high performance channel multiplexer providing full DMA (direct memory access) for all HP-IB and LAN I/O channels and synchronizing the differing speeds and bandwidths of the Central Bus and the Channel I/O Buses. DMA allows large blocks of data to be transferred to and from main memory with minimal CPU intervention, thereby reducing CPU overhead. The Series 930 includes two Channel I/O Adapters standard, and a third may optionally be added.

Channel I/O Buses

The Series 930 supports up to three Channel I/O Buses (CIB's).

Each CIB provides a 16-bit wide, bi-directional data path which runs synchronously with a 250ns clock. There are 40 lines in each CIB: 16 for data, 4 for channel address, and 20 for status and control. Data is transferred in bursts ranging from 2 to 32 bytes in length. Each CIB can provide a sustained data throughput rate of up to five MB/second.

A significant benefit of having multiple Channel I/O Buses and Channel I/O Adapters is that this approach provides multiple concurrent paths to I/O devices. This further improves I/O performance by significantly alleviating any "bottleneck" effect in communications between the two levels of buses.

Peripheral Connections

Peripherals are connected to the Series 930 via HP-IB Channels and LAN's (Local Area Networks). Two HP-IB channels and one LAN channel are standard on the Series 930.

HP-IB Channels

Disc drives, tape drives, and system printers are connected to the Series 930 via HP-IB, the Hewlett-Packard Interface Bus. HP-IB is Hewlett-Packard's implementation of the IEEE standard 488-1975 interface.

HP-IB support on the Series 930 allows customers to continue using many of the peripheral devices they already have when upgrading from an MPE V based system to the Series 930.

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 up to one Megabyte per second.

Local Area Networks

Workstations (terminals, personal computers and serial printers) are connected to the Series 930 via an IEEE-802.3 standard Local Area Network (LAN). System to system communication is also via LAN.

Each LAN cable is connected to a LAN interface card on the system's backplane. The maximum data transfer rate over the LAN is 10Mbits/second. Workstations are attached to the LAN via HP's Distributed Terminal Controller. Individual workstation to system data transfer rate can be up to 19.2KB/second.

For more information regarding peripherals and LANs, refer to the "Peripheral Devices" and "Networks" chapters of this manual.

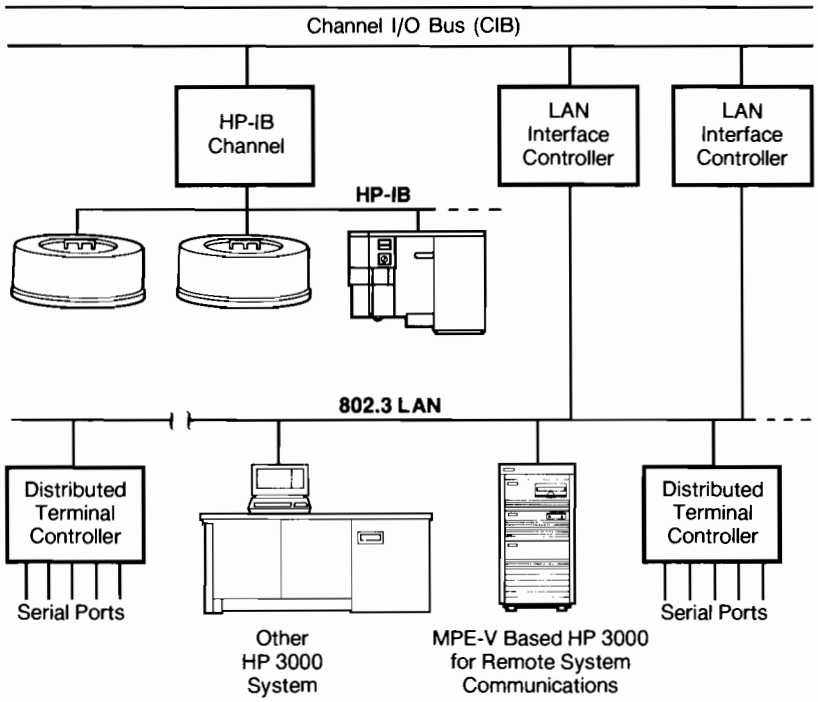


Figure 5-5. Series 930 I/O Attachments

Console and Diagnostics

An HP 2392 terminal is used as the system console for the Series 930. The system console is not attached to the system via HP-IB or LAN; rather, it has its own connection directly on the system backplane. A remote support modem is included with the system.

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

All the diagnostic functions are available remotely. By connecting a remote terminal to the system console via a modem, a remote console can operate in parallel with the system console. This allows HP Customer Engineers to diagnose hardware and run software troubleshooting tools from a remote site. Online diagnostics and remote support result in less system downtime and reduced maintenance costs.

Automatic Restart After Power Failure

Main memory battery backup and automatic restart after power failure are standard features on the Series 930. Thus, temporary power line interruptions can be tolerated with no data loss, and without having to restart the system.

The system includes a rechargeable battery pack for maintaining memory during power failures. The battery is capable of maintaining main memory and ensuring its validity for at least 15 minutes.

If A.C. power fails, the hardware generates a power fail warning (PFW) interrupt, and the system initiates a power fail procedure. All register contents are saved in main memory, critical system activities are completed, and the system conducts an orderly shutdown so that no data is lost.

The system restarts automatically if power returns while memory is maintained by the battery. All register values are restored and processing resumes. Jobs continue from the point at at which they were interrupted.

Environmental Specifications

Due to the simplicity of its design, the Series 930 is far less environmentally demanding than other computers in its performance range.

Compared to other computers of similar performance, the Series 930 is smaller, quieter, and has significantly lower requirements for input power and cooling. The Series 930 operates on single phase power.

The Series 930 environmental specifications:

- Physical dimensions:
  - Height: 1 meter (39 inches)
  - Width: 1.2 meter (46.8 inches)
  - Depth: 0.8 meter (31.2 inches)
  - Weight: 318 Kg. (700 lbs)
- AC Input Voltage: 200-240VAC, Single Phase
- Input Voltage Tolerance: 170/276VAC
- Input Voltage Frequency: 50Hz or 60Hz ±5%
- Line Current Rating: 13 Amps
- Heat Dissipation, Maximum: 7300 BTU/Hr.
- Relative Humidity, System (Operating): 40-60% (non-condensing)
- Operating Temperature: 20-25.5 degrees C (60-78 degrees F)

6 Networks

HP AdvanceNet

The data communications capabilities of the 900 Series, like all HP 3000 models, is under the umbrella of **HP AdvanceNet.** *HP AdvanceNet is a family of communications products, hardware and software, that enable HP systems to communicate with each other and with equipment made by other vendors.* HP AdvanceNet products adhere to industry standards for data communications. The International Standards Organization (ISO) seven layer Open Systems Interconnect (OSI) model is the basis of HP AdvanceNet product design. HP also offers products for batch and interactive communication to IBM mainframes in SNA and bisynchronous environments.

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 communications capabilities of the 900 Series. These products are grouped in three broad categories:

- Workstation to system
- System to system
- HP to IBM mainframe

Workstation to System Communications

By workstations, we refer to the terminals, personal computers and serial printers that are connected to a 900 Series system.

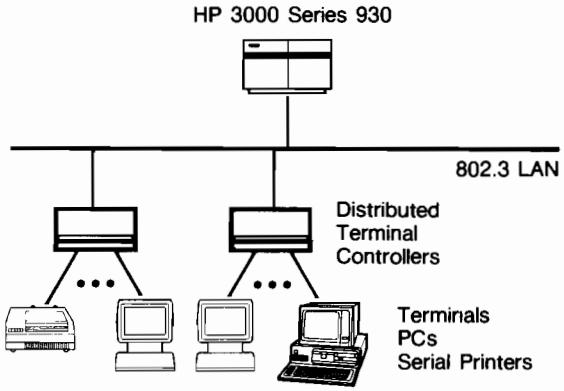


Figure 6-1. Workstation to System Communications

The system is connected to an IEEE 802.3 LAN (Local Area Network) by a LANIC (LAN Interface Controller) card on the system backplane. One LANIC card is included with each Series 930 or 950. Only one LANIC card is needed to support all workstation communication. Thus, backplane space is not a limiting factor in workstation configuration.

Distributed Terminal Controller

The key product for workstation communication on the 900 Series is HP's innovative, new **Distributed Terminal Controller (DTC).** The DTC is an intelligent controller with microprocessors to handle workstation connection preprocessing, and another microprocessor that handles communications with the system.

Benefits of the DTC include:

- Sophisticated data transmission capabilities
- Distributed placement of controllers to minimize cabling costs
- Compatibility with the Advanced Terminal Processor (ATP) used on other HP 3000 systems

The DTC (HP 2345A) is packaged in a small cabinet that is approximately 17 inches wide, 17.5 inches long and 9 inches high. (In metric units, it is 425 mm. wide, 440 mm. long and 22 mm. high.) Within the cabinet are slots for six HP Serial Interface Boards for either local or remote connections.

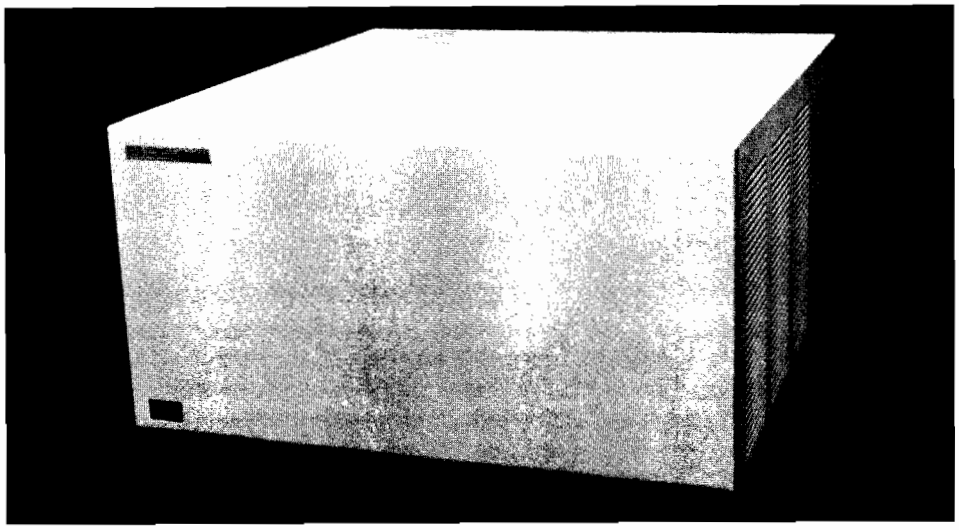


Figure 6-2. HP 2345A Distributed Terminal Controller

Each DTC can support up to 48 local workstations or 36 modem connections, or a combination of both.

The DTC supports:

▪ direct local connections:	RS-422 (5 pin) RS-232-C (3 pin)
▪ remote connections:	RS-232-C (25 pin; CCITT V.24) supports full duplex modems

Data Transmission Functions

The DTC works in conjunction with the *Asynchronous Serial Communications (ASC) software* that is included as part of the Fundamental Operating Software package for the Series 930 and 950. The DTC software necessary for operation is automatically downloaded from the system to each DTC.

Data transmission functions provided by the ASC software and the DTC include:

- Data transfer rate of up to 19.2Kbps
- Byte packing and unpacking
- Character and block mode support
- Message based operation that optimizes response time for block mode applications

The ASC software and DTC handle all handshaking between the host system and its asynchronous workstations, including character echoing, multiplexing, and input character buffering. *Because the DTC eliminates the need for character processing by the CPU, it significantly reduces CPU utilization.*

In addition, the DTC provides remote online diagnostics, and an easy-to-use, comprehensive configuration program.

Cabling Flexibility

One of the major benefits of the DTC is the tremendous flexibility it gives you in cabling your site. *DTC's can be placed in the computer room or distributed throughout your site in whatever way best minimizes cabling cost and complexity.*

If you are upgrading to the 900 Series, you can use your existing cabling with little or no modification. To free up more floor space and reduce cable clutter, you can place the DTC's in wiring closets or in the corners of the EDP room where wiring panels may be placed.

For the connection between the DTC's and the system, HP offers two types of LAN cables: "thick" and "thin".

Thick Cables: The thick cable (IEEE802.3 10BASE5) allows DTC's to be located up to 1500 meters from the system. The thicknet cable is connected to the system by an access cable that can be up to 48 meters in length. Thicknet cables require a *Media Access Unit* for each DTC. The use of thicknet cabling is most appropriate when the DTC's are distributed throughout the facility.

Thin Cables: The thin cable (IEEE802.3 10BASE2) allows DTC's to be up to 370 meters from the system. More flexible than the thick cable, the thin cable is appropriate when the DTC's are in close proximity to the system.

So that DTC's can be positioned even further from the system, thin and thick cables can be interconnected using the HP 92223A or HP 92223C Repeater Kits. In addition, workstations directly connected by RS-232 interface can be up to 15 meters from a DTC. Those connected by RS-422 interface can be up to 1200 meters from a DTC.

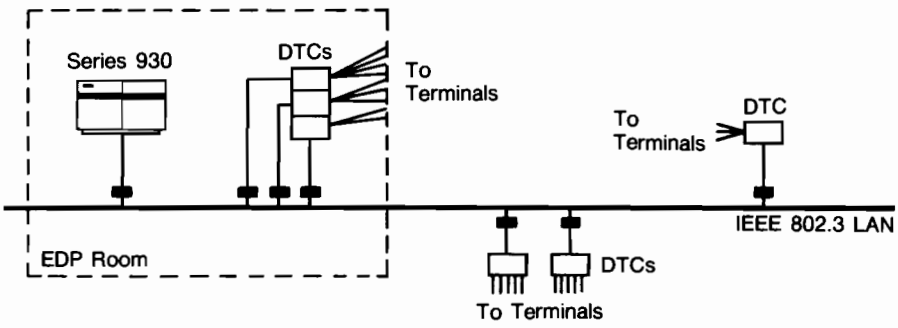


Figure 6-3. Cabling Flexibility

ATP Compatibility

The DTC is compatible with HP's Advanced Terminal Processor (ATP) which is used on MPE V based HP 3000's. This compatibility has two important benefits:

- The same cables used to connected workstations to an ATP can be used to connect to a DTC.
- Applications written for use with the ATP can use the DTC with little or no modification.

Your investment in applications and cabling is protected when upgrading from use of ATP's on MPE V based systems to the 900 Series.

X.25 PSN and PBX Support

Applications which serve multiple remote locations can benefit from the cost effective use of X.25 Packet Switched Networks (PSN). The 900 Series supports connections to workstations on X.25 Packet Switched Networks through the use of the HP 2334A X.25 Stat Mux. One HP 2334A Stat Mux located at a remote site can be connected to a maximum of 16 workstations. A corresponding Stat Mux is connected to the DTC ports.

In office settings, it can be beneficial to use Private Branch Exchange (PBX) facilities for integrated voice/data communications. Both telephone and workstation communications can occur simultaneously. HP has certified several PBX manufacturers' systems for use with MPE V based systems. Although not available at the present time, PBX communications for the 900 Series will be supported in the future as certification testing is completed.

System to System Communications

For the 900 Series, system to system networking is provided by two HP AdvanceNet products: **LAN3000/XL Link,** and **Network Services 3000/XL.** Through these products, a 900 Series system can be networked to other 900 Series systems or added quite easily to existing HP 3000 networks.

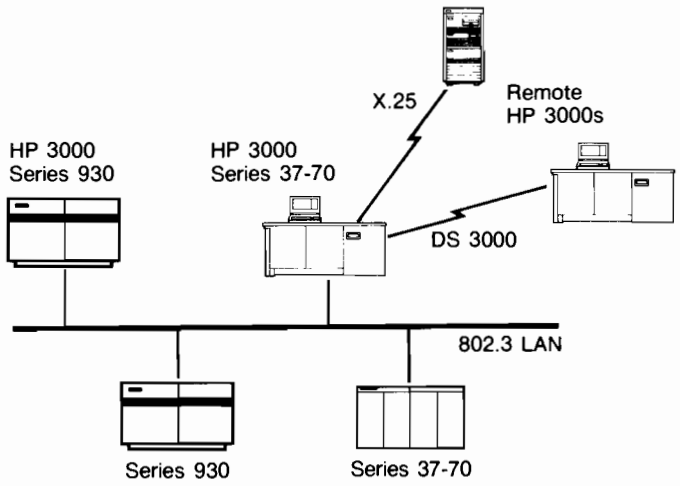


Figure 6-4. System to System Communications

LAN3000/XL Link

LAN3000/XL provides the hardware and communications software needed to connect 900 Series systems to a network for system to system communication. It includes a LANIC (Local Area Network Interface Controller) and transport software that perform the functions specified in layers 1-4 of the OSI reference model. LAN3000/XL is used in conjunction with NS3000/XL.

While one LANIC is included standard with each 900 Series model for workstation communication, a separate LANIC can be purchased for system to system communications.

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

Features of HP's LAN3000/XL Link include:

- Integrated node management software is provided for online 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 10Mbits per second, depending on the application.
- Transport level protocols are based on the DARPA TCP/IP protocols (Defense Advanced Research Project Agency and Transmission Control Protocol/Internet Protocol).

Network Services 3000/XL

NS3000/XL, which corresponds to OSI layers 5 through 7, provides powerful networking services. It is used in conjunction with the LAN3000/XL Link. The network services include:

Virtual Terminal — Virtual Terminal provides interactive access to other systems on the network. A terminal configured to one system is "virtually" connected to all the other systems on the network.

Virtual Terminal has two very important benefits. First of all, it allows users to log onto any system on the network as easily as logging onto their "home" system. Also, some applications that run on MPE V systems are not yet available on the 900 Series. Through Virtual Terminal, a 900 Series user can easily log onto an MPE V system and then run many of its native applications.

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

Remote File and Peripheral Access — This service gives users access to the files and peripherals of other systems in the network. Access can be interactive or programmatic. The MPE XL operating system contains intrinsics (procedures) for file manipulation. Since MPE XL treats peripherals similarly to files, the same intrinsics can be used for peripheral operations. NS3000/XL 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 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.

Security

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

Remote Communications

At present, system to system communications involving the 900 Series is accomplished on a Local Area Network. Connection to systems remote to a 900 Series system can be accomplished through a MPE V based HP 3000 system acting as a "server".

All of the major NS3000/XL capabilities, such as Virtual Terminal and Network File Transfer, are available between the 900 Series model and the remote system.

The server system (which can be any HP 3000 from Series 37 through Series 70) can be used concurrently for other applications subject to performance and system resource needs. The server system's communications can be shared by several HP 3000's on the LAN.

Direct connection to remote systems will be available for the 900 Series in the future.

The 900 Series systems cannot be connected directly to these early HP 3000 models: the Series II, III, 30 and 33. Connection to these early models must be through a MPE V based system.

900 Series to IBM Mainframe Communications

HP traditionally has provided powerful and easy to use products for HP 3000 to IBM mainframe communication. This tradition continues with the 900 Series.

Large IBM (and IBM plug compatible) mainframes are often used to process data that is collected and transmitted by distributed HP 3000's. HP AdvanceNet's products for HP to IBM communication provide capabilities for batch and interactive modes.

At present, communication between a 900 Series system and IBM mainframe system uses an MPE V based HP 3000 system acting as a server. Improvements in the price/performance of these connections are a part of HP's future plans.

The new HP AdvanceNet product, HP SNA Server Access/XL, supplies 900 Series users with a transparent connection into an SNA (System Network Architecture) environment. Although this product does not address BSC connectivity, bisynchronous communication is available.

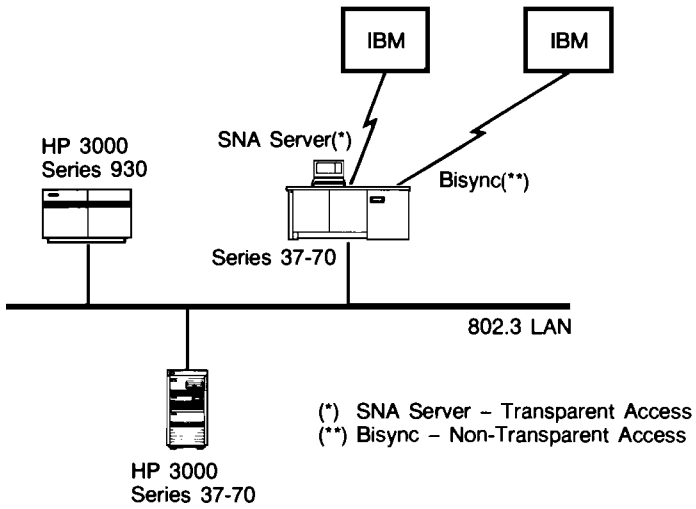


Figure 6-5. 900 Series to IBM Networking

SNA Communications

The main functionality is provided by two HP software products: SNA IMF and SNA NRJE.

HP's SNA IMF (Interactive Mainframe Facility) product provides interactive SNA communication. SNA IMF gives 900 Series users the capability to interactively access IBM mainframe databases, such as IMS/VS and CICS/VS, and to develop programs on the mainframe (using TSO). SNA IMF emulates the IBM 3276 control unit.

HP's SNA NRJE (Network Remote Job Entry) facility provides batch SNA communication. SNA NRJE emulates the IBM 8100 workstation. SNA NRJE lets users transmit large batch jobs and files from a 900 Series system to an IBM mainframe for processing, and to receive output and files from an IBM mainframe.

SNA Server allows a single MPE V based system in a network to act as a transparent server for SNA communications. The other HP 3000 systems on the network use SNA Server Access to access the SNA Server.

SNA Server Access enables users to print the results of their interactive or batch operations on printers connected to their own system instead of having to print the results at a remote location.

In order to implement SNA communications, the following products are required. The 900 Series system must have HP's SNA Server Access/XL product, plus NS3000/XL and LAN3000/XL Link. The server system requires HP's SNA Server product, the NS3000 and SNA Link products, plus SNA IMF and/or SNA NRJE (depending upon the type of host access desired).

BSC Communications

BSC communications is also available for 900 Series systems via an MPE V based system. Three HP software products provide the main functionality. HP's RJE (Remote Job Entry) and MRJE (Multileaving Remote Job Entry) products support BSC batch communications. HP's IMF (Interactive Mainframe Facility) product supports BSC interactive communications. These services are accessed via the Virtual Terminal and Network File Transfer services of NS3000/XL.

For More Information

The capabilities of these communications products are explained in greater detail in the "HP 3000 Data Communications Products Specifications Guide" and the "900 Series Networking Specification Guide Supplement".

7

Peripheral Devices

Introduction

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

For instance, the HP 7935H Disc Drive is an industry leader in the field of removable disc media in both capacity (404MB) and performance. The HP 7978B Magnetic Tape Drive Subsystem is an industry leader in price/performance (the data transfer rate you get for the purchase price) for 6250 character per inch tape drives.

HP is also a leader in printers that use laser-scanning technology. We offer laser printers that print at 45 pages per minute, 12 pages per minute and 8 pages per minute. These microprocessor-controlled printers provide advanced printing capabilities such as electronic forms, multiple fonts per page, high resolution, and type size reductions.

HP's terminals combine quality ergonomic features with high productivity features such as forms caching and color graphics. And HP is a leader in innovative, personal computers that can be used as terminals: the HP Touchscreen, the Vectra, and the Portable PLUS.

Disc drives, tape drives and system printers are connected to the Series 930 via HP-IB (Hewlett-Packard Interface Bus) channels. Serial printers, terminals and personal computers (which can be used as terminals) are connected to the Series 930 via HP's Distributed Terminal Controllers. Modem, RS-232 and RS-422 interfaces are available for these workstation products.

Many of HP's computer peripherals are supported on the first release of the Series 930. By "supported", it's meant that HP has tested and certified the given device for use with the Series 930.

Note that there are other peripheral products — besides those now listed as supported — which are compatible with the Series 930. More peripheral devices will be added to the supported list for the 900 Series as HP continues the testing and certification process.

This chapter highlights some of the peripheral devices that are supported for the first release of the Series 930. The chart at the end of this chapter lists all of the supported peripherals for the 900 Series as of the print date of this manual. The list of supported peripherals is subject to change from the print date of this manual.

For more information, ask your HP Sales Representative for data sheets and brochures on these products.

Disc Drives

HP 7933H Fixed Media and HP 7935H Removable Media

The **HP 7933H** and **HP 7935H** disc drives each provide 404MB (formatted) of mass storage. The HP 7933H is a fixed media device. The HP 7935H is a removable media device.

The performance of the HP 7933H promotes overall system throughput. Due to the reliability and service features of this drive, downtime is held to a minimum and maintenance costs are exceptionally low. The drive includes a powerful micro-processor-based controller with sophisticated internal diagnostics.

The HP 7935H is a companion product to the HP 7933H, and shares the same packaging, performance and reliability features. Its large removable disc pack and very fast data transfer rate make the HP 7935H an excellent choice for disc-to-disc backup/restore functions and system-to-system data transfers. The enclosed media pack provides a protected environment for prolonged off-line data storage.

Together, the HP 7933H and HP 7935H offer exceptional performance, functionality and reliability for large mass storage requirements. In multiple drive systems, the controllers of these drives enhance system efficiency by coordinating overlapped seeks among the individual drives.

Technical Details:

- 404MB formatted capacity (fixed and removable)
- 24.0 milliseconds average seek time
- 1 MB/second data transfer rate
- 11.1 millisecond average latency
- Automatic head alignment and automatic error correction for low downtime
- Front panel access to diagnostics
- Sector and/or track sparing
- 92 sectors per track; 256 bytes per sector

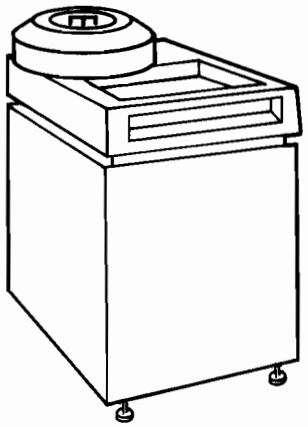


Figure 7-1. The HP 7935H Disc Drive

HP 7978B Tape Drive

The **HP 7978B** is a 1/2 inch tape drive designed for fast, reliable backup of large volumes of data. *High density 6250/1600 cpi recording packs more data per reel for faster backup, fewer reel changes and reduced tape storage.* It transfers data at up to 1MB per second over the Hewlett-Packard Interface Bus (HP-IB).

A large internal buffer and other features make the HP 7978B suitable for start-stop operations, such as data logging, as well as streaming functions. The HP 7978B contains LSI (Large Scale Integration) electronics and on-board diagnostics. The HP 7978B provides exceptional value in performance, reliability and maintenance.

Technical Details:

- Density: 6250/1600 cpi
- Format: GCR/PE
- Capacity: 140/40MB per reel
- Operating Mode: Streaming
- Tape Speed: (inches per second)
  Read/Write: – 75 ips
  Rewind: – 250 ips
- Burst Transfer Rate: (bytes per second)
  – 1MB/s (HP-IB channel)
  – 468KB/s (6250 cpi)
  – 120KB/s (1600 cpi)
- Two track error detection and correction (6250 cpi)

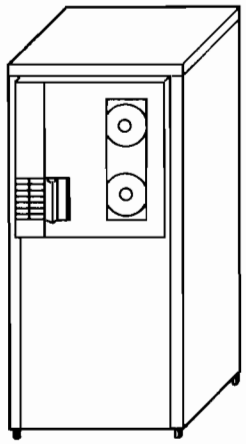


Figure 7-2. The HP 7978B Magnetic Tape Drive

Magnetic Tape Drives

HP 7974A Tape Drive

The **HP 7974A** is a 1/2 inch tape drive available in 1600 cpi PE and optionally as an 800 cpi NRZI drive. It has two operating modes: streaming and start-stop. Its 100 ips (inches per second) streaming mode of operation, designed for backup/restore functions, provides a fast data transfer transfer rate of up to 160KB/second. Its 50 ips start-stop mode of operation is excellent for logging and tape processing functions.

Reliability and ease of repair are designed into the HP 7974A for reduced equipment failures and low monthly maintenance.

Technical Details:

- Density: 1600/800 cpi (characters per inch)
- Format: PE/NRZI
- Capacity: 40/20MB formatted per reel
- Operating Modes: Start-Stop, Streaming
- Tape Speed (inches per second):
  Read/Write: – 100 ips (Streaming)
  – 50 ips (Start-stop)
  Rewind: – 200 ips
- Burst Transfer Rate (bytes per second)
  Start-Stop: – 80KB/s (1600 cpi)
  – 40KB/s (800 cpi)
  Streaming: – 160KB/s (1600 cpi)
  – 80KB/s (800 cpi)
- Single track error detection and correction (1600 cpi)

System Printers

HP 2566A/B Line Printers

The **HP 2566A** and **HP 2566B** are reliable, versatile, heavy duty dot matrix printers designed for system use. *They offer many special features such as graphics, bar code printing, lower and upper case printing, multiple character sets, and 16-channel vertical format control.* The "A" model supports three print pitches: double-sized at 5 cpi (characters per inch), normal 10 cpi pitch, and compressed 16.7 cpi. The "B" model supports five pitches: 5, 10, 12, 13.3 and 16.7 cpi.

Technical Details:

- 900 lines per minute
- High reliability due to few moving parts
- Microprocessor controlled with internal diagnostics
- Sensors indicate ribbon out, paper out and paper jams
- Easy forms alignment
- Optional OCR-A and OCR-B character sets

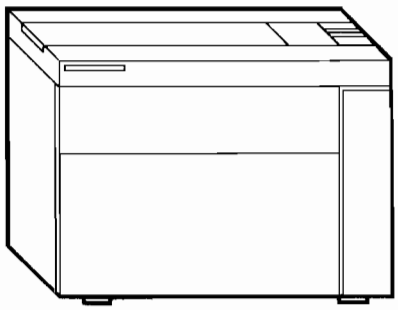


Figure 7-3. The HP 2566B Line Printer

HP 2680A and HP 2688A Laser Page Printers

The HP 2680A and HP 2688A laser page printer offer 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". The HP 2680A is designed for 300,000 to 800,000 pages per month volume printing. Bar code and OCR-A/B character sets are optionally available.

The HP 2680A prints *12 pages per minute* and is ideal for the office environment. Desktop in size and whisper quiet in operation, the HP 2688A provides 300 dots per inch resolution and unattended, cut sheet page printing.

Besides their speed and laser-technology reliability, these printers offer capabilities that traditionally have required retyping, cut and paste-up work, reformatting and photo-reduction. As a result, they provide significant cost savings and productivity improvement.

Technical details common to both the HP 2680A and HP 2688A:

- High quality output
- Electronic forms
- More than 100 predefined character sets
- More than 60 predefined forms
- Software for these printers 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

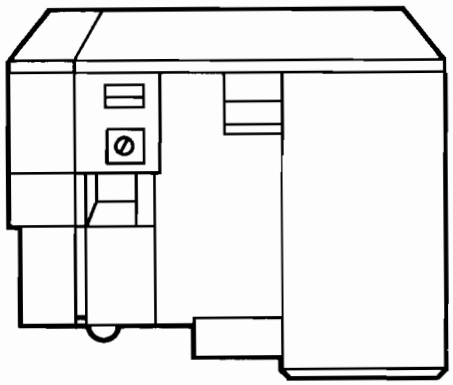


Figure 7-4. The HP 2680A Laser Printer

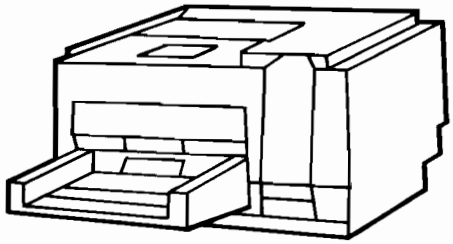


Figure 7-5. The HP 2688A Laser Printer

Serial Printers

Serial printers can be connected to the Series 930 via HP's Distributed Terminal Controller in order to be used as shareable, spooled devices. Or, serial printers can be controlled directly by a terminal.

HP LaserJet Printer

The popular **HP LaserJet Printer (HP 2686A)** is a laser technology printer which offers near-typeset print quality for the office environment. Small enough to fit on a desktop, it prints eight pages per minute and is ideal for volumes of 500 to 3000 pages a month. It is virtually noiseless, thus eliminating the need for an acoustical hood.

The HP LaserJet allows you to combine up to eight fonts on a single page and has optional raster graphics capability. Automatic sheet paper feeding eliminates the need for sheet feeders. The HP LaserJet has many of the advanced features (such as electronic forms) of HP's larger laser printers.

Providing print resolution of 300 dots per inch, the HP LaserJet can handle cut sheet letter or legal paper, in A-4 and B5 paper sizes.

HP 2934A Business Printer

The **HP 2934A** Business Printer is designed for departments that want a highly reliable, versatile printer. Using dot matrix impact technology, this printer has two modes of operation: letter quality at 67 and 40 cps, and draft quality at 200 cps. It can handle a variety of paper sizes, as well as multi-part forms. An optional single bin sheet feeder is available.

The HP 2934A offers high density printing and various pitch sizes (including large character generation). It has word processing features and variable line length up to 136 columns. Multiple character sets are available via handy plug-in cartridges.

Typical applications for the HP 2934A include business documents, internal correspondence, bar code labels and other business and factory printing. For all its versatility, the HP 2934A has a small footprint and weighs less that 45 pounds.

Terminals

HP designs and manufactures a wide variety of high quality terminals ranging from low cost, alphanumeric terminals to color graphics terminals.

To increase user comfort and productivity, HP's terminals have many ergonomic features such as anti-glare displays with high character definition, and functional keyboard layouts. Many of HP's terminals provide display screen tilt and swivel.

The HP 239x terminals described in this chapter have:

- 12-inch diagonal, integral tilt display screens
- Green phosphor monitors (except for the HP 2397A which has a color monitor)
- Low profile, typewriter-style, detachable keyboards with numeric pads
- Cursor movement and editing keys
- Screen labeled softkeys
- Display enhancements such as underlining, inverse video, blinking and half-bright display
- Optional ports for local printer connection

HP 2392A Display Terminal

The **HP 2392A** is a compact, low cost, block mode terminal designed for general use, from data entry to program development. It provides smooth scrolling, and has four pages of memory, optionally expandable to eight pages. Data entry applications are made easier using forms mode, local editing capabilities, and the standard line drawing set. The HP 2392A has eight screen-labeled function keys, plus eight user-definable function keys. A bar code reader is optionally available.

HP 2393A Graphics Terminal

The **HP 2393A** combines bit-mapped vector graphics on a monochrome raster display screen with comprehensive alphanumeric capabilities. Multiple input devices — such as HP Touch, HP Mouse, HP Graphics Tablet and the HP Bar Code Reader — can be connected to the HP 2393A.

The HP 2393's dual mode resolution lets you choose either 512 x 390 or 640 x 400 for formatting screen graphics. It offers many graphics primitives including a rubberband line for previewing lines before they are drawn, and polygonal area fill in. Twelve pages of memory are standard, as well as 160-column wide horizontal scrolling.

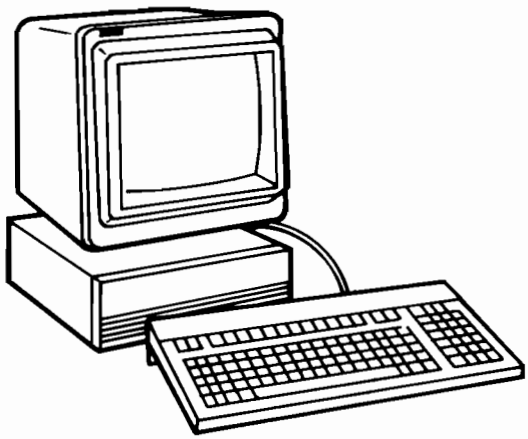


Figure 7-6. The HP 2393A Graphics Terminal

HP 2397A Color Graphics Terminal

The **HP 2397A** offers a high quality color raster display with fast vector graphics. It includes all of the HP 2393A features and is suited both for business and technical applications.

Eight basic colors can be displayed from a palette of 64, plus user-definable colors. The HP 2397A also provides color alphanumerics. Up to eight color pairs (foreground/background) can be used on a per character basis to differentiate text and identify fields.

HP Touch

HP Touch is a 12-inch, user-installable touchscreen bezel. It lets users communicate with the computer by simply touching the display screen. HP Touch is standard on the HP Touchscreen Personal Computer, and can be added optionally to the HP 2393A and HP 2397A terminals, as well as to HP's Touchscreen II and Vectra personal computers.

HP Personal Computers

HP's personal computers can be used as terminals for the 900 Series computers. *This is a very flexible, productive approach as it provides users with both the capabilities of personal computing and terminal access to the host computer.*

Users can alternatively operate in PC mode or terminal mode as best suits their needs. In PC mode, users can run the software applications designed for the personal computer and store data locally using disc drives attached to their personal computer. And users can switch their PC's to terminal mode when they want to access the host 900 Series system.

HP's **Personal Productivity Center,** which will be available on the 900 Series in the future, provides an integrated solution for the productivity needs of the office. *It includes the integration of electronic mail, word processing, business graphics, and spreadsheet applications.* As part of the Personal Productivity Center, **HP Access Central** allows data to be easily downloaded from databases on the host system to personal computers. Then, users can work with the data using personal computer applications such as Microsoft Word™, Lotus 1-2-3™, and d:BASEIII™.

The integration of office automation software (such as **HP DeskManager**), HP's office printers and personal computers, and host system processing, provides significant productivity advantages. In addition, the use of personal computers for processing reduces the processing load on the host system.

HP Touchscreen Personal Computers

The **HP Touchscreen Personal Computer** is available in several models, with monitors ranging from 9 to 12 inches in size. The HP Touch display screen (standard on some models, optional on others) lets users tell the computer what to do by simply touching the screen. A detached, adjustable, typewriter-style keyboard with numeric keypad comes with each unit.

Another standard, ease-of-use feature is **PAM,** the **Personal Applications Manager.** *PAM is a software interface that eliminates the need for users to learn complicated DOS commands.* An easy-to-use menu lets users quickly switch between PC mode and terminal mode operation.

Main memory is available from 256K bytes RAM to 640K bytes. For mass storage, 10MB and 20MB disc drives are available, and some Touchscreen models support multiple disc drives for an aggregate of up to 100MB of disc storage. Also, a 1/4 inch, 67MB tape cartridge subsystem (HP 9142) is available for fast backup convenience.

The standard flexible disc drive is 3 1/2 inch in size, with 710KB capacity. Also, for data exchange with the Vectra and the IBM PC/AT™, a 5 1/4 inch, HP/IBM formatted disc drive is available.

Optional input devices such as HP Mouse, Bar Code Reader and Graphics Tablet can be attached via **HP-HIL (Human Interface Link).** HP-HIL is standard or optional, depending on the Touchscreen model.

There are hundreds of HP and third party software applications for the HP Touchscreen Personal Computers. These include the most popular packages such as HP's Executive Memomaker, Lotus 1-2-3, Microsoft Word, Wordstar, and d:BASEII, to name just a few.

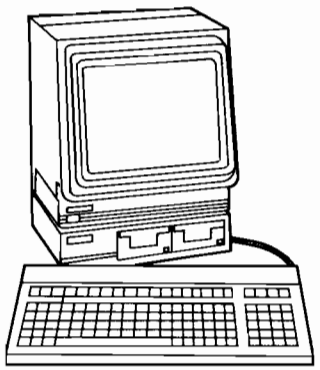


Figure 7-7. The HP Touchscreen II

The Vectra Personal Computers

HP's Vectra Personal Computer is hardware and software compatible with the IBM PC/AT. It is designed to run any off-the-shelf IBM PC/AT applications, yet takes up 30% less desk space than the IBM PC/AT.

The Vectra comes in several models, with 256K or 640K bytes of RAM memory. With optional 20MB internal hard disc and 20MB or 40MB external hard discs, mass storage capacity is expandable to more than 100MB. A 1/4 inch, 67MB tape cartridge subsystem (HP 9142) is available for fast backup convenience. The Vectra gives you the choice of either 360KB flexible disc drive or 1.2MB flexible disc drive, with the discs 5 1/4 inch in size. The Vectra also supports external, 3 1/2 inch flexible disc drives for data exchange with HP Touchscreen Personal Computers.

The Vectra can be configured with either a 12 inch monochrome monitor (green phosphor) or a 12 inch color monitor.

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

For terminal mode operation, Vectra AdvanceLink 2392 provides HP 2392 terminal emulation (full block mode).

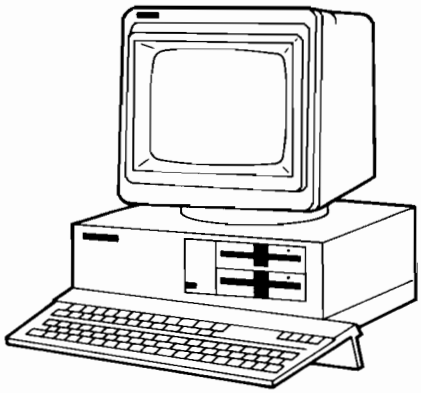


Figure 7-8. The HP Vectra

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, use it to work at home — anywhere your work schedule demands.

The Portable PLUS provides durability, reliability, full personal computer capabilities, and yet is small enough to fit inside a briefcase. It weighs less than ten 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 256K or 512K bytes of RAM memory, expandable to 1.28MB. Another of the system's advanced features is its "disc on a chip" mass storage which is expandable to 1.20M RAM bytes. Plug-in ROM memory is expandable to 3MB. 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, 710KB, 3 1/2 inch flexible disc drive is available. Also, the Portable PLUS can be connected to the HP Touchscreen and Vectra personal computers, and 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%. It automatically enters a protect mode at 5% of power which can preserve data for up to a week.

The Portable PLUS connects to a Series 900 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 that are available for the HP Touchscreen are also available for the Portable PLUS. These include Microsoft Word, Lotus 1-2-3, d:BASEII, HP Memomaker, Multimate™ and Executive Card Manager.

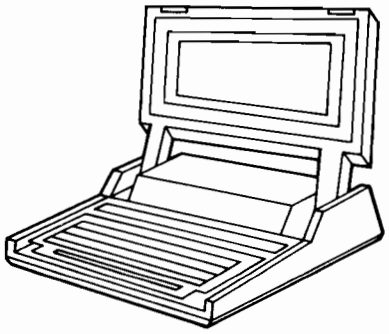
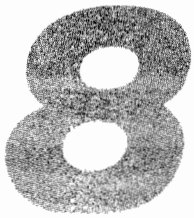


Figure 7-9. The HP Portable PLUS

List of Supported Peripherals

- HP 7933H Fixed Media Disc Drive
- HP 7935H Removable Media Disc Drive
- HP 7974A Magnetic Tape Drive
- HP 7978A Magnetic Tape Drive
- HP 7978B Magnetic Tape Drive
- HP 2565A Line Printer
- HP 2566A Line Printer
- HP 2566B Line Printer
- HP 2680A Laser Page Printer
- HP 2686A Laser Page Printer (HP LaserJet)
- HP 2688A Laser Page Printer
- HP 2934A Business Printer
- HP 2392A Display Terminal
- HP 2393A Graphics Terminal
- HP 2397A Color Graphics Terminal
- HP 2622A Block Mode Terminal
- HP 2624B Data Entry Terminal
- HP 2627A Color Graphics Terminal
- HP 150A Personal Computer
- HP 150B/Touchscreen Personal Computer
- HP 150C/Touchscreen II Personal Computer
- HP Vectra Personal Computer
- HP Portable PLUS Computer



Commitment To Your Success

Introduction

This chapter summarizes HP's support services and user documentation for the 900 Series. It also introduces you to HP's third-party Value-Added Supplier Program and to the HP computer user groups.

Customer Support Services

Hewlett-Packard's Customer Support Services are designed to ensure your long-term productive use of the 900 Series of HP 3000 systems. Support is available throughout the life of your system to help you make better use of the system to meet your own particular application needs and working environment.

HP offers a complete spectrum of customer support services to meet your needs. These services fall into four general categories:

- *Flexible hardware maintenance programs help ensure your system's productivity over time.*
- *A choice of software support programs provide you with the level of software support that best fits your software 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 worldwide network of Systems Engineers and Customer Engineers. These extensively trained professionals work closely with both your HP Sales Representative and HP factory engineers 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 900 Series. 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. All of HP's hardware services include parts and labor for remedial maintenance.

When you purchase an HP System Support Agreement, a Customer Engineer (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 the system performs to specification. Your CE also will install additional equipment by agreement, 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 900 Series 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.

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 HP resources necessary to provide a solution.

Additional features included in all system support agreements are detailed in the System Products Hardware Maintenance Service Matrix (Figure 8-1).

	Standard System Service	**Basic System Service**
Remote Support Response Time	30 Minutes	Next Day
On-Site Response Time		
*Within 100 Miles**	4 Hour	Next Day
*Within 200 Miles**	8 Hour	2 Days
*Within 300 Miles**	12 Hour	3 Days
Coverage Hours Per Day	13 Hr., 8am-9pm 16 Hr., 8am-12am 24 Hour	8am-5pm
Coverage Days Per Week	5 Days, Mon-Fri 6 Days, Mon-Sat 7 Days, Mon-Sun	5 Days, Mon-Fri
Preventive Maintenance	Yes	Yes
Add-on Installation	Yes	Yes
Engineering Improvements	Yes	Yes
Account Assigned CE	Yes	Yes
Site Surveys	Yes	Yes
Warranty Enhancements	Yes	Yes
Out-of-Coverage Option	Yes	Yes
Upgrade Response Option	No	Yes

**From an HP SRO (Service Responsible Office)*

Figure 8-1. System Products 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. Support coverage is from eight a.m. to nine p.m. every day of the standard workweek (excluding HP holidays). Extended coverage options are also available to provide service up to seven days per 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. An improved service response time and After Coverage Hours service are also available at additional cost on a per-incident basis.

Of course, the cost of maintenance services is an important consideration. You will find that the hardware support services for the 900 Series systems are quite low in price. *HP is able to pass along maintenance cost savings to you because of the high reliability of the 900 Series systems.* In fact, HP has priced maintenance services for the 900 Series systems well below the maintenance costs for other computers of similar performance.

Workstation Products Maintenance Service

Hewlett-Packard also offers a variety of cost-effective service options for your terminals and workstation peripherals. These specialized services provide a range of lower cost maintenance alternatives because they are 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.

	SERVICE				
	Priority On-Site Service	**Next Day On-Site Service**	**Scheduled On-Site Service**	**Courier Return Service**	**Customer Return Service**
Location of Service Repair	Customer Site	Customer Site	Customer Site	HP Field Repair Center	HP Rield Repair Center
Coverage Hours	8am to 5pm[1] Mon-Fri	8am to 5pm[1] Mon-Fri	8am to 5pm Mon-Fri	8am-5pm Mon-Fri	—
Response Time or Turnaround Time	4 Coverage Hours[2]	1 Coverage Day[2]	3 Days Ave.[3] (Scheduled Weekly Visits)	5-7 Days[4]	⩾7 Days[4]
"Production" Applications - Continuous - Critical	Recommended	Recommended	Not Recommended	Not Recommended	Not Recommended
"Project" Applications - Occasional Use	Not Recommended	Recommended	Recommended	Recommended	Recommended
Spare Equipment Available	Not Recommended	Not Recommended	Recommended	Recommended	Recommended

[1]*Extended hours are available for an additional charge.*
[2]*Within 100 miles of a Primary Service Responsible Office.*
[3]*Depending on coverage zone specified call closest HP Field Repair Center for coverage and availability.*
[4]*Total time varies according to Customer's proximity to an HP Field Repair Center. Total time estimated here includes shipping time.*

Figure 8-2. Workstation Service Selection Guide

Software Support Services

HP software support services are designed to provide you with the level of support which 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 your changing requirements throughout your system's life cycle.

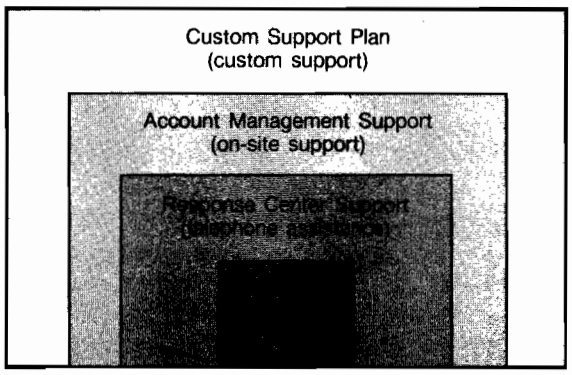


Figure 8-3. Software Support Program Structure

Account Management Support

Account Management Support (AMS) provides a locally assigned Systems Engineer (SE) who becomes familiar with your specific environment. This SE ensures that HP resources meet your software support needs.

AMS features a proactive approach to your support, made possible by the personalized attention of your support representative and his/ her familiarity with your needs. Through Support Management Reviews and Software Release Planning sessions, your account SE assists you in preparing for future needs and in managing your evolving software for maximum effectiveness.

AMS also gives you telephone access to HP's Response Centers for questions regarding the operation and use of HP system software. Highly trained specialists at these centers use advanced support technology to give you fast, helpful responses. When needed, on-site assistance is also provided to help identify a problem or to develop a workaround.

To keep you current with all enhancements to your HP software, AMS provides a complete set of software materials, including the latest software and firmware releases and documentation updates.

Custom Support Plan

HP's Custom Support Plan (CSP) is designed for AMS customers requiring additional, personalized assistance on a contractual basis. The CSP is an annual plan developed by you and your account SE. 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 multiple site coordination implementation assistance, or a training plan for new applications. Or, you may want performance consulting on a regular basis to enhance your system's operation.

The Custom Support Plan is available on a limited basis. Consult with your Sales Representative for availability in your area.

Response Center Support
Response Center Support (RCS) is an intermediate level of support which 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 online assistance. In addition, RCS provides all of the software support materials necessary to stay current with HP software enhancements.

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.

Under SMS you will receive the "Software Status Bulletin" and the "Communicator/3000", HP publications that give you complete information on HP software enhancements.

Software Service Extensions
For maximum flexibility, HP offers a number of additional services which can be easily added to your support program:

- *Additional Response Center Caller* provides authorization for one additional person to call HP's Response Center.
- *Off-Hours Emergency Assistance* provides access to the HP support organization for emergency situations occurring outside of normal business hours.
- *Software Support for Multiple Systems* extends your central system support coverage to additional HP 3000 systems.
- *Software Notification Service* provides one additional copy of the "Software Status Bulletin" and "Communicator/3000".
- *Manual Update Service* provides one additional copy of the latest updates to your HP software manuals.
- *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.

Software Support Features Matrix

Support Services	CSP	AMS	RCS	SMS
Customized Support	X			
Account-Assigned SE	X	X		
Support Management Reviews	X	X		
Software Release Planning	X	X		
Software Update Installation Assistance (HP 3000)	X	X	X	
On-Site Problem Assistance	X	X		
Access To Response Center	X	X	X	
HP Remote Support (HP 3000)	X	X	X	
Software Problem Verification	X	X	X	
Software Patches	X	X	X	
Software Updates	X	X	X	X
Software Status Bulletins	X	X	X	X
HP Communicator	X	X	X	X
Reference Manual Updates	X	X	X	X
90-Day Free Software Support Promotion	X	X	X	X
Software Service Extensions				
Additional Response Center Caller	X	X	X	
Off-Hours Emergency Assistance (HP 3000)	X	X	X	
Software Support for Multiple Systems	X	X	X	X
Manual Update Service	X	X	X	X
Software Update Installation Assistance (HP 3000)	*	*	X	X
Off-Hours Software Update Installation Assistance (HP 3000)	X	X	X	X

**included within the service*

Figure 8-4. Software Support Features Matrix

Workstation Software Support

Phone-in assistance is offered for most HP personal computer products. It is charged either on a per-incident basis or can be included with your system software support agreement. Your Office Products Coordinator or System Manager is given access to this phone-in service to provide assistance to your in-house experts. Phone-in assistance is offered to provide you with services that help you obtain maximum productive use of the personal computers used in your organization.

Consulting Services

HP offers a comprehensive set of consulting services to help you obtain the most productive use possible of your 900 Series system throughout its life cycle. *Consulting is available in standard service packages offering defined results and fixed prices, or on a time-and-materials basis.*

Migration Consulting
Migrating applications from your current HP 3000 to a 900 Series system is a straightforward process. For those who have limited experience with migrations or will migrate a large number of applications to a 900 Series system, HP offers a *Migration Planning and Analysis Consulting Service.*

This service includes a detailed planning methodology, criteria for qualifying applications for migration, special migration tools, resource requirement evaluations and the scheduling of migration tasks and enhancement efforts. In addition, HP is also available to assist you in the actual migration of your existing applications.

Working together, you and an HP Systems Engineer will develop a migration plan to guide the effective transition of your applications with minimal effects on daily operations.

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.

HPCAPLAN *enables you to accurately plan for system expansion and anticipated growth.* An HP system specialist, experienced in performance issues and equipped with advanced 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.

HPSNAPSHOT helps you identify performance bottlenecks and their causes, and recommends a strategy for corrective action and future growth. The HP specialist uses additional 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 and your system's users.

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 Material 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

In today's competitive world, the need to improve productivity is critical for success. Proper knowledge of system operating techniques and application software will make you more productive. **HP Customer Education** is your best way to quickly acquire the knowledge and skills to obtain maximum success with your 900 Series system.

Hewlett-Packard offers a full range of courses to meet your need for operating and application expertise. Typical course topics include system introduction, operation, programming and management, programming languages and tools, operating systems, data communication and data management. Also taught are a variety of courses dealing with specific application areas.

All HP courses are taught by experienced professionals knowledgeable about our products and your applications. Training is available at 40 HP Training Centers around the world, or, in many instances, at your site.

Course material is presented in a logical and businesslike 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 through hands-on 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 an HP 3000 system. HP's courses for the HP 3000 focus on the following user categories:

Fundamental User – This level of training provides the basic tools essential for the use of HP's computer systems. These courses are critical for beginning programmers and can also be a valuable tool for management personnel and others who use the system on an occasional basis.

System Manager – Taken at the beginning phases of an installation, these courses ensure the best management and operation of the system.

Programmer – Courses on programming languages and basic system applications enable programmers to effectively utilize your system. A basic introduction to HP computers is sufficient prior training for these courses.

Applications – Courses in this category teach the user how to use HP tools other than programming aids. These courses should be taken by users throughout the lifetime of their computer system as a need for a particular application is found and as more applications are developed by HP for the HP 3000 family.

Technical Support Specialist – Courses at this level refer to the technical area beyond programming languages and special applications. This includes courses on system internals and other technical applications for more advanced uses of the system.

Customer Documentation

HP has created new, comprehensive documentation for MPE XL and the 900 Series systems that is of very high quality. Logically organized and fully indexed so that information is easy to find, the 900 Series 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 and organization, readability and ease of use.

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 900 Series 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-style 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 the concise listing of syntax and parameters for the experienced user.

Several error message manuals are supplied which list error messages, explain probable causes of the errors, and state recommended corrective actions.

Note that the purchase of preconfigured Series 930 systems includes all user documentation for the Fundamental Operating Software (MPE XL and subsystems), ALLBASE/XL, System Dictionary/V and workstation communications.

The documentation set consists of the following series:

General User's Series serves as the entry point for all Series 930 users: end users, system operators, programmers, etc. This series includes "Getting Started as a New User of the Series 930", a primer on basic system usage, and "Guidebook to Series 930 Documentation", an annotated bibliography of all the Series 930 manuals. Also included are software manuals regarding general system usage.

The System Administrator's Series contains the manuals needed by system operators and system managers. The series includes "Getting Started as a Series 930 System Operator" and a full complement of manuals for system operation and resource management.

The Programmer's Series provides information about MPE XL and subsystems for the programmer. The level of detail in this series spans from "Getting Started as a Series 930 Programmer" to the "MPE XL Intrinsics Reference Manual". These manuals deal with a full range of programming topics including program design and optimization, Debug and Linker subsystems, intrinsics, file system usage, I/O, device control, process handling, interprocess communication, and message catalogs.

The Data Management Series contains manuals for the database application programmer and database administrator. Provided is complete documentation for ALLBASE/XL and its relational and network interfaces. Topics include database design, creation, maintenance and security, programmatic access, and interactive access facilities. For ease of use, a consistent set of examples are used in all the database manuals. This series also documents HP's System Dictionary/XL.

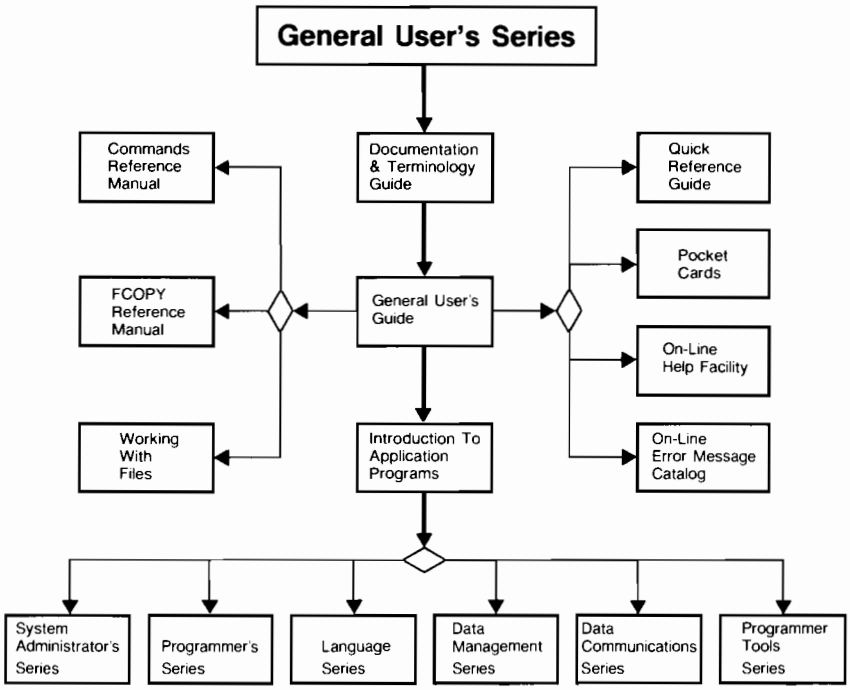


Figure 8-5. Documentation: General User's Series

The Language Series provides programmers with complete documentation for all the languages supported by the 900 Series systems.

The Data Communications Series provides complete documentation for workstation communication, system to system communication, and communication with IBM mainframe systems. This series provides extensive network configuration and troubleshooting information. Topics documented include the NS3000/XL services, HP's Distributed Terminal Controller, and data communications for programmers.

The Programmer Tools Series consists of manuals for HP's complement of programmer productivity tools, such as Inform/V, Toolset/XL and Business Report Writer/XL.

In addition, HP provides a set of migration manuals which tell customers all they need to know in order to migrate applications, databases and operations from an MPE V based system to a 900 Series system. Included in this series is the "Migration Overview" manual which summarizes all MPE V to 900 Series migration topics.

Besides the manual series described above, HP also provides comprehensive documentation for all of the HP-developed applications for the HP 3000 family of systems.

Value-Added Supplier Program

Hewlett-Packard realizes that no single computer company working alone could possibly create all solutions for all markets. That's why we maintain an *active third-party Value-Added Supplier Program* to support HP's Software Suppliers and Value-Added Resellers (VARs) for the HP 3000 family of systems. These 500 independent companies offer more than 1,200 vertical market and cross-industry solutions that make the HP 3000 more useful to you.

Software Suppliers

Hewlett-Packard Software Suppliers are part of the *HP PLUS Program* and are classified as either Listed or Referenced. *Admittance to Referenced status means that six end-users have rated the product highly.* These Software Suppliers are granted the use of the special insignia pictured in Figure 8-6.

Figure 8-6. HP PLUS User Rated Independent Software Supplier Insignia

In order to find out more about the products available from Software Suppliers, you can order the "Business Solutions Catalog" (publication number 30000-90251). This catalog is available from the HP Direct Marketing Division. Phone (408) 538-8787; from California, Alaska or Hawaii, phone (408) 738-4133.

Value-Added Resellers

HP VARs resell HP systems directly after adding value in the form of hardware and/or software. The VAR packages and/or customizes applications software to achieve a unique solution to meet your needs. The VAR and HP are independent firms and each accepts full responsibility for the products and the support they provide you, the customer. The HP VAR offers the benefit of providing a faster and less costly solution than many customers could achieve themselves. HP VARs can be recognized by the special insignia pictured here.

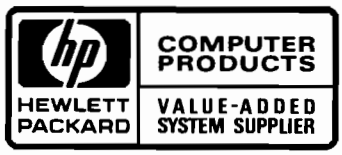


Figure 8-7. HP Value Added Resellers Insignia

HP Computer User Groups

INTEREX (the International Association of HP Computer Users) *is an independent organization formed for the purpose of exchanging techniques and ideas among users of HP computers.* Hewlett-Packard works closely with INTEREX to promote communications between HP and the user groups sponsored by INTEREX.

Membership in INTEREX is open to any interested individual using an HP 3000, HP 1000 or, HP 9000 system. There are more than 10,000 INTEREX members from 40 countries around the world.

The benefits of INTEREX membership include receiving INTEREX user group publications, discounts to user group conferences, and the option to purchase the INTEREX Contributed Software Library.

The Contributed Software Library is a wealth of useful, ready-to-run programs for the HP 3000 that have been contributed by INTEREX members. The library contains utilities for system management and operation, as well as programs for business applications. The value of the Contributed Software Library has been estimated to be in excess of $1,500,000, yet its cost to INTEREX members is only several hundred dollars per year. Documentation for programs in the Library is included.

INTEREX sponsors user groups on regional and national levels. Also, INTEREX sponsors user groups that are specific to given industries, products or data processing topics. For instance, there are special interest INTEREX user groups for consultants, government, data communications, graphics, and laser printers.

For more information about INTEREX, write to:

INTEREX
680 Almanor
Sunnyvale, CA 94086

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900 Series HP 3000 Computer Systems General Information Manual (5954-7448)

Please use this form to send us your evaluation of this manual, and to send us any questions you might have regarding its contents. **However, please do not use this form to request additional publications.** The Preface of this manual explains how to obtain additional publications relating to the 900 Series systems.

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