
White Paper



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**The HP 3000
Open System
Environment**

HP Computer Museum
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Management summary

Introduction

The HP 3000 is today an open system supporting a wide range of industry standards to provide open systems benefits. It provides multivendor interoperability and coexistence with IBM and Unix® systems and also supports key application portability interfaces as defined by the most prominent standards groups. The primary focus for the HP 3000 platform is to provide open systems leadership in On-Line Transaction Processing (OLTP) performance and functionality. Open systems functionality and industry-leading commercial functionality will make the HP 3000 the premier open OLTP platform of the 1990s.

Summary of the HP 3000 Open OLTP Environment

Standards support on the HP 3000 increases interoperability, scalability, and portability of solutions while retaining the value-added extensions in OLTP performance and functionality. This strategy is based on the following goals:

- provide industry-leading standards support
- provide commercial functionality where no official standards exist
- provide primary support for OLTP applications
- provide availability of best-in-class solutions
- provide coexistence with multivendor system solutions
- provide investment protection for existing HP 3000 customers

The HP 3000 Open OLTP Environment is based on the commercial needs of the marketplace. Several standards sources today strive to provide environments for portability and interoperability. The HP 3000 strategy is to encompass the driving forces of X/Open's interoperability and portability guidelines, OSF technology releases, de facto market standards, and IBM's SAA interoperability guidelines. With respect to X/Open™, the HP 3000 is committed to achieving XPG3 Base branding and to brand additional product components defined as extensions in the X/Open Portability Guide.

In the past, many users have equated open systems with Unix. Although Unix has played a key role in the definition of open system standards, an open computing environment is more than just an operating system. Interoperable networking and portable application programming interfaces in all key components of a computing environment are also required. The HP 3000 Open OLTP framework includes standards in:

- languages and tools for ease of application development
- database management for common distributed data access
- networking for interoperability in multivendor system environments
- operating system interfaces for increased application portability
- user interfaces for a consistent look and feel in applications

Standard application programming interfaces in each of these areas make changes in the underlying technology transparent to the end user. Thus, the developer can concentrate on the programming interfaces, not the underlying mechanics of the particular operating system. The HP 3000 provides performance-added value to these portable programming interfaces.

The HP 3000 provides open database management, languages, tools

The HP 3000 supports an ANSI- and X/Open-compliant ALLBASE/SQL for optimal relational database performance and integrity and leading multivendor 4GL tools for application portability. The HP 3000 also provides de facto standard database solutions from ISVs such as Oracle and Ingres. In the future, ALLBASE/SQL and ALLBASE tools will support the database interoperability standard developed by the SQL Access Group.

The HP 3000 also supports ANSI-standard third generation languages such as COBOL, C, FORTRAN, and Pascal.

The HP 3000 supports key operating system standards

POSIX is the IEEE operating system interface standard endorsed by both X/Open and the Open Software Foundation. POSIX defines a standard interface and does not specify internal implementation details. Thus, the HP 3000 can take advantage of its underlying, high-performance OLTP operating system benefits and also provide an industry-standard interface. The HP 3000 is committed to the POSIX 1003.1 standard and the POSIX 1003.2 standard for increased application portability and increased solutions availability. As future POSIX standards evolve, the HP 3000 will adopt those that affect OLTP application portability.

The HP 3000 provides industry-standard multivendor networking

Open systems networking is a requirement in a multivendor environment. The HP AdvanceNet strategy encompasses a long-term commitment to OSI standards and services, as well as de facto networking standards such as ARPA TCP/IP and IBM SNA connectivity on the HP 3000 platform. The HP 3000 will continue to lead in PC LAN integration and support the major PC LANs such as Novell Netware and LAN Manager. Customer needs for integrated network and system management in a multivendor environment are met by HP's OpenView products.

The HP 3000 supports user interface standards

Different graphical user interface standards have emerged for each of the major desktop systems, and today, the HP 3000 supports industry and de facto user interface standards for each. The HP 3000 is completely compatible with MS Windows and Presentation Manager running on PCs and also supports leading multivendor 4GL and 3GL forms packages. In addition, the HP 3000 has adopted the HP OSF/Motif style guide and will be adding support for the industry-standard X Window System in the near future. This will allow applications to provide the same look and feel regardless of whether the application is running on an HP 3000, DOS, OS/2, or Unix system.

The HP 3000 will provide support for future distributed transaction processing standards

The HP 3000 will be a leader in future distributed transaction processing environments and will support the standards being developed by X/Open for Distributed Transaction Processing (DTP). Transaction processing monitor technology from Transarc Inc. will be the foundation for HP 3000 distributed transaction processing technology. With the support of distributed transaction processing standards and technologies the HP 3000 will participate fully in multivendor distributed transaction processing environments where transactions transparently span multiple databases across the network.

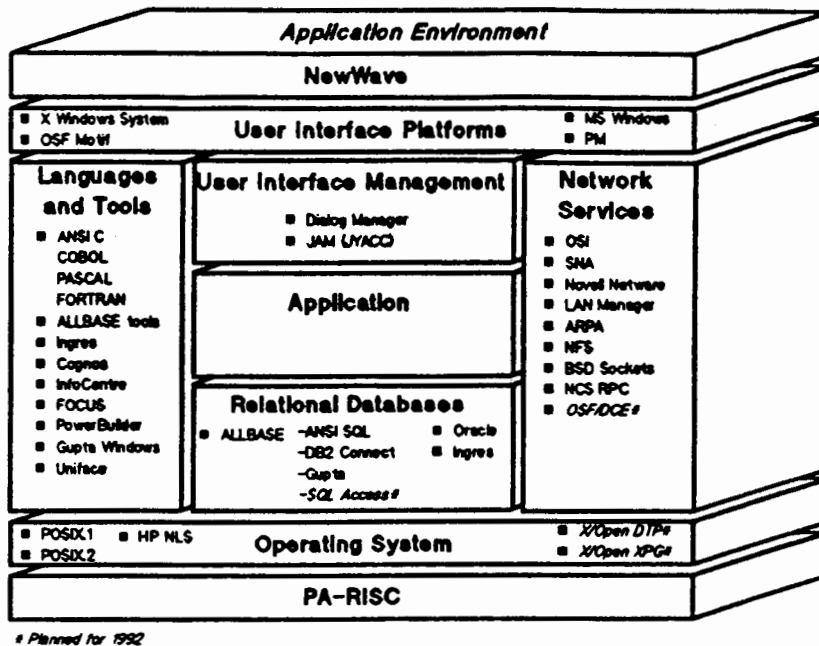
The NewWave Computing environment

HP's NewWave Computing provides an environment in which users transparently obtain the needed services and resources from a multivendor network of computers behaving as a single integrated whole. The underlying framework for NewWave Computing is a commitment to a standards-based architectural framework -- a commitment that allows interoperability and an integrated view into the computing environment. Open system standards make possible the cooperative services for transparent database access, remote applications, shared office services, and integrated network and system management services. In the future, the HP 3000 intends to support Distributed NewWave by providing server-based object management services.

HP has based its corporate strategy on product innovation with the implementation of recognized standards and has a proven track record in providing industry standards leadership. HP was a founding member of the Open Software Foundation (OSF), currently chairs or co-chairs major standards committees such as IEEE POSIX and OSI, and holds positions on the boards of OSF and X/Open.

Both the HP 3000 and HP 9000 share a common foundation for standards in networking, relational databases, languages, and user interfaces. The HP 9000 is a leader in providing standards-based systems for the commercial and technical markets. The HP 3000 is a leader in providing commercial OLTP performance and functionality and leverages HP expertise and leadership for its standards offerings.

Figure 1. The HP 3000 Open OLTP Environment



The HP 3000 supports key products for an open application environment, providing the foundation for HP's NewWave Computing strategy. Refer to appendix A for a detailed roll-out plan of the HP 3000's open systems offerings.

The HP 3000 Open OLTP value added

In the open systems commercial arena, the HP 3000 offers the following key differentiators:

- a broad, compatible family on a commercial RISC architecture
- best price/performance in OLTP (first vendor to publish TPC-A results)
- best support, reliability, and price/performance (rated #1 by Datapro)
- best support for value-added business (rated #1 in VAR Business)
- best quality, support, and reliability (rated #1 by DataQuest)
- best PC integration (rated #1 by Gartner Group)
- best client/server (#1 product rating by Forrester Research)
- best commercial minicomputer (rated #1 by Computer World)
- key commercial OLTP features, such as high OLTP and batch performance, mainframe class system management capabilities, enterprise multivendor connectivity, and client-server computing solutions

The HP 3000 offers the combined benefits of standards PLUS industry-leading OLTP commercial functionality.

The following chapters provide greater detail on the HP 3000 Open OLTP Environment.

HP 3000 Open OLTP background

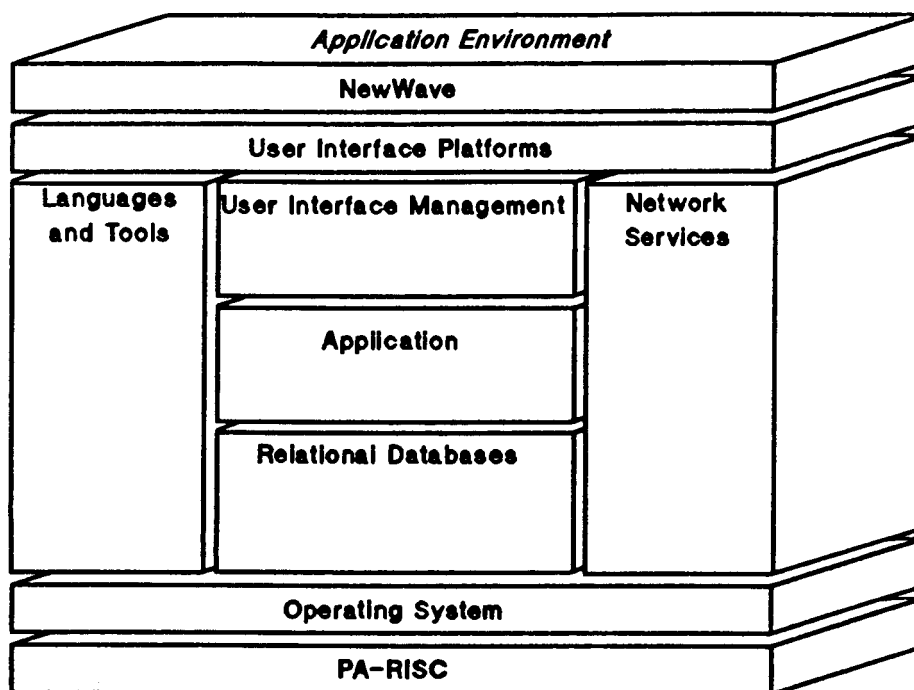
What does an open system mean to you?

X/Open describes open systems as

"Software environments consisting of products and technologies which are designed and implemented in accordance with 'standards' established and de facto; that are vendor independent; and that are commonly available."

The HP 3000 supports X/Open's open system definition. Open systems means interoperable networking and an environment for application development. The environment for application development should be based on portable application programming interfaces (APIs) that are provided only by standards-based products and services in the underlying framework of a computing environment.

Figure 2. An open environment for NewWave Computing



This figure shows the application environment framework for the HP 3000 Open OLTP Environment. An application requires user interface, language, database, networking, and operating system standard interfaces and services to maximize portability and interoperability.

Key Benefits

This framework allows HP 3000 customers to take advantage of the benefits of open systems. Among these benefits are:

End Users Benefits

- increased application availability
- transparent access to enterprise information
- productivity gains of a common user interface

MIS Administrators Benefits

- hardware and software vendor independence
- increased scalability for effortless growth
- better integration of multivendor environments
- increased solutions flexibility

Application Developers Benefits

- single source code for multiple platforms
- reduced porting costs
- increased user base
- reduced training costs

Solution Vendors Benefits

- increased application base
- increased customer base
- faster availability of new technologies

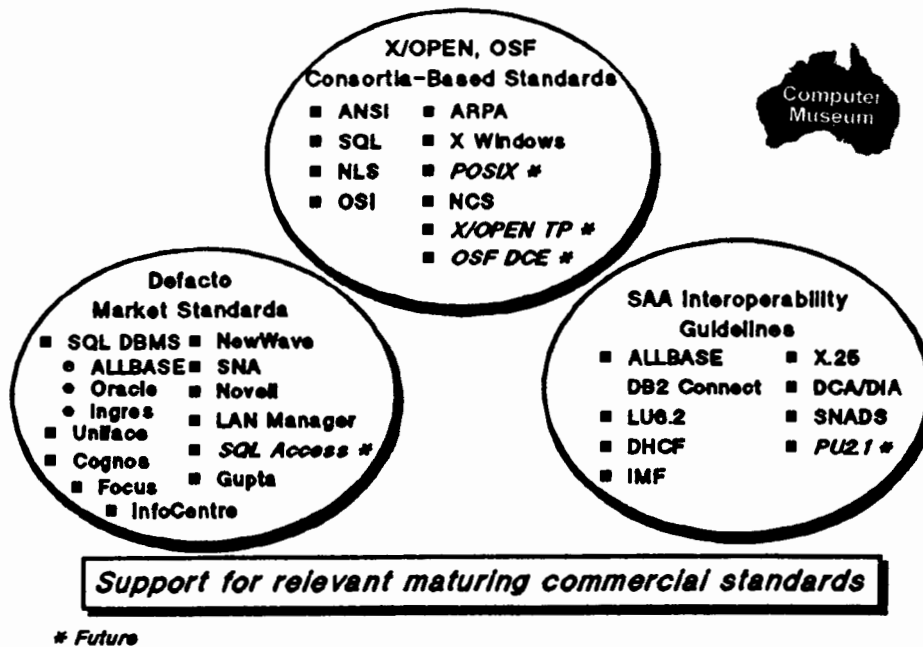
Customers can look forward to these benefits on the HP 3000 platform while maintaining OLTP performance, commercial functionality, and lasting value in their existing HP 3000 hardware and software investments.

Standards based on commercial market needs

Because no single standards source today provides a complete environment for portability and interoperability, the HP 3000 strategy is based primarily on three possible sources of standards:

- Consortia-based standards (X/Open, OSF)
- de facto market standards
- SAA interoperability guidelines

Figure 3. The HP 3000 Open OLTP driving forces



Examples of de facto and industry standards are shown. Note that these standards overlap. X/Open encompasses several de facto commercial standards. Several IBM SAA specifications are also viewed as de facto standards for enterprise computing.

X/Open

X/Open is an international consortium of computer vendors working to create an internationally supported, vendor-neutral Common Applications Environment (CAE) based on de facto and industry standards. X/Open does not develop products. It endorses international standards where they exist, and adopts de facto standards where they do not exist. X/Open's efforts are embodied in a series of publicly available reference documents called the X/Open Portability Guide (XPG), which has become widely accepted as the dominant working definition of a full open systems environment. This standards group provides a set of practical unifying standards for users and vendors that bridges the gap between proprietary and industry standards, open systems, and IBM's SAA.

OSF

Open Software Foundation (OSF) is a non-profit, industry-supported research and development organization formed in 1988 by Hewlett-Packard, Digital Equipment Corporation, Groupe Bull, IBM, Nixdorf, Phillips, Siemens, and Hitachi. More than 130 organizations are now members of OSF. Hewlett-Packard is a key participant in OSF and currently chairs the OSF Board of Directors.

OSF functions as a integrator and implementor of technologies, building on existing standards and specifications and helping in the definition of new standards and specifications where none currently exist. OSF builds source-code reference implementations that can then be used by vendors to develop software systems and applications that are portable, interoperable, and scalable. OSF complements the work of standards groups such as X/Open and IEEE/Posix by implementing

the standards adopted or defined by these standards organizations. Already, OSF has accelerated the availability of several key technologies that HP 3000 customers will have access to. One example is the OSF/Motif graphical user interface which builds on top of the X Window system standard.

De facto standards

The HP 3000 strategy to support de facto market standards represents a long-term commitment to protect customer investments in the HP 3000 and in other vendor platforms as well. HP's support of de facto standards includes PC LAN connectivity with resource-sharing products such as Novell Netware and LAN Manager; and multivendor database and 4GL offerings from ISVs such as Oracle and Ingres.

IBM SAA

IBM's Systems Application Architecture (SAA) promotes development of consistent applications by providing standardized interfaces for IBM's system environments (MVS, VM, OS/2 EE, and OS/400). SAA defines Common Communications Services (CCS), Common User Access (CUA), and Common Programming Interfaces (CPI) for IBM's proprietary systems. The HP 3000 open systems strategy is to support components of SAA to facilitate interoperability and coexistence with IBM. In addition, the HP 3000 open systems strategy under the HP NewWave Computing framework provides more standards benefits than IBM's SAA.

The HP 3000 Open OLTP goals

The goals for the HP 3000 Open OLTP Environment are:

- Provide commercial functionality today while standards evolve. Although standards organizations may lag behind technology advances in OLTP computing, the HP 3000 will continue to provide customers value-added functionality in the areas of system and network management, performance, and cooperative computing.
- Provide primary support for OLTP applications. The HP 3000 will support those standards relevant to OLTP commercial computing in both traditional and client-server configurations.
- Provide availability of best-in-class solutions. The HP 3000 is committed to reducing the time it takes to port applications written to standard interfaces by providing key programming interfaces adopted by standards groups. These guarantee new solutions for existing customers.
- Provide coexistence with multivendor system solutions. Coexistence with IBM and Unix allows customers to protect their hardware and software investments. More integrated system solutions for HP 3000, HP 9000, MS-DOS®, and OS/2 environments will also be available.
- Provide HP 3000 investment protection. The HP 3000 will provide a long-term commitment to strategic, open interfaces while maintaining existing HP 3000 functionality. Customers can retain the lasting value of current applications and also adopt new solutions based on open systems.

The HP 3000 strategy is to provide a phased roll-out for additional standards products and application programming interfaces along with design guides, consulting, and training services. The products and services will evolve to provide an even more robust application environment including integrated CASE technologies for application development. HP's next generation data repository product will support open standards. It will support integration of third-party products and data sharing among databases, front-end CASE tools, and 4GL/3GL tools. For additional information on the HP 3000 application development strategy refer to the HP 3000 Open CASE White Paper (Part number 5091-1072E).

Unfolding the HP 3000 Open OLTP Environment

1. Database management, languages, and tools

The main database strategy goals for HP 3000 open systems are:

- provide choice of key, multivendor ISV database solutions
- provide interoperability, standards, best performance, and coexistence between TurboIMAGE and ALLBASE/SQL
- provide application portability by supporting leading multivendor development environments and 4GL tools
- provide SQL Access interoperability with diverse databases

Support for multivendor relational DBMSs

Some customers want standards support for a relational database solution that runs on multivendor platforms such as HP, DEC, IBM, and Unix systems. The HP 3000 offers these customers the choice of popular database solutions from leading ISVs such as Oracle and Ingres which provide database and application portability across a wide variety of platforms. HP is working closely with these key ISVs to ensure a high level of OLTP performance and to ensure prompt availability of new versions of software.

ALLBASE/SQL high-performance relational option

The HP 3000 supports ALLBASE/SQL, with the industry-standard ANSI SQL interface. ALLBASE/SQL currently conforms to the ANSI SQL 1 standard, is X/Open XPG3-compliant, and will be extended to conform to the ANSI SQL 2 standard and X/Open's XPG4 SQL specifications. In addition, ALLBASE/SQL is committed to the support of the industry-standard database interface specifications developed by the SQL Access Group (The database interface standards of the SQL Access Group are designed to provide open database interface standards.).

Since ALLBASE/SQL is dedicated to the HP 3000 and HP 9000 only, it can more effectively take advantage of the underlying operating system and hardware technology to optimize performance, data integrity, and availability. The HP 3000 strategy is to continue to provide the best OLTP performance with ALLBASE/SQL and to position ALLBASE/SQL as the strategic database for new application development. The ALLBASE/TurboCONNECT product allows customers to develop new applications using ALLBASE as the database platform and still continue to have read-access to TurboIMAGE data. Write access (being developed) will give full interoperability.

Multivendor 4GLs linked to ALLBASE/SQL

ALLBASE/SQL also gives customers application interoperability and portability by supporting popular 4GL application development tools for both multiuser and client/server applications. Leading multiuser application development tools such as Cognos' Powerhouse, Ingres' Application By Forms, FOCUS from Information Builders Inc., PowerBuilder from Powersoft, InfoCentre's Speedware, and tools from Uniface can be used with ALLBASE/SQL. The Ingres and Cognos application development toolsets provide compatibility across a wide variety of platforms such as HP, DEC, IBM, and many Unix systems.

FOCUS is a de facto standard 4GL application development and report writing tool dominant in the mainframe market. Uniface is one of the most widely accepted 4GL toolsets in the UNIX market place. The HP 3000 will continue to have more 4GL solutions available with ALLBASE/SQL.

Client/server 4GLs for ALLBASE/SQL

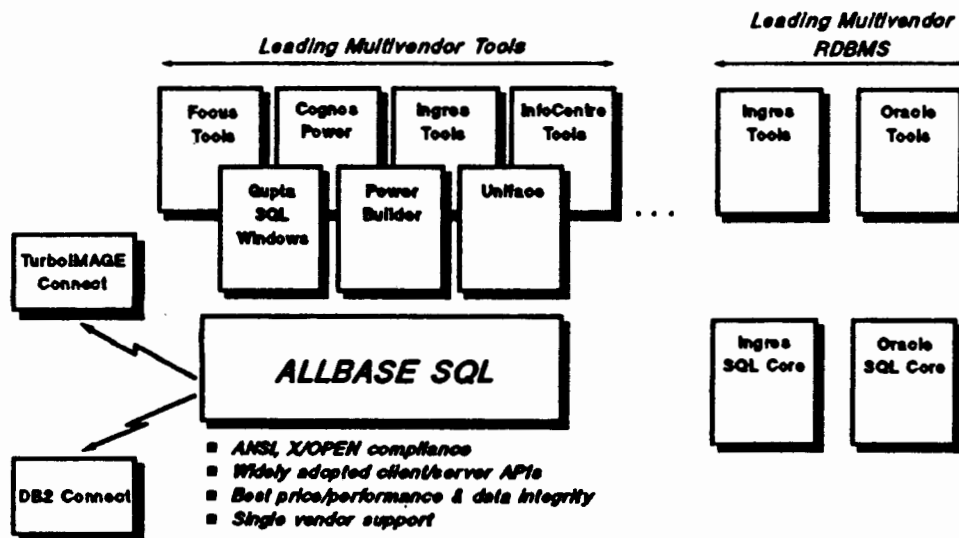
ALLBASE/SQL supports the Gupta database interface which is the defacto standard for client/server access to a relational database. This allows powerful client/server applications to be developed using tools such as Gupta Technology's SQL Windows and PowerBuilder from Powersoft. Cognos Powerhouse Windows, and Windows 4GL from Ingres can also be used to develop client/server ALLBASE/SQL applications.

SQL Access interoperability for diverse databases

IBM database interoperability is key for commercial enterprise computing. The ALLBASE/DB2 Connect product provides application-level calls allowing remote HP 3000 applications direct read and update access to IBM DB2 databases on IBM mainframe systems.

ALLBASE/SQL coexistence with existing HP 3000 TurboIMAGE applications is provided by the ALLBASE TurboConnect product. This allows new ALLBASE/SQL applications to access data in existing TurboIMAGE databases. Several third-party 4GL products such as Cognos support both ALLBASE/SQL and TurboIMAGE.

Figure 4. The HP 3000 provides open SQL solutions

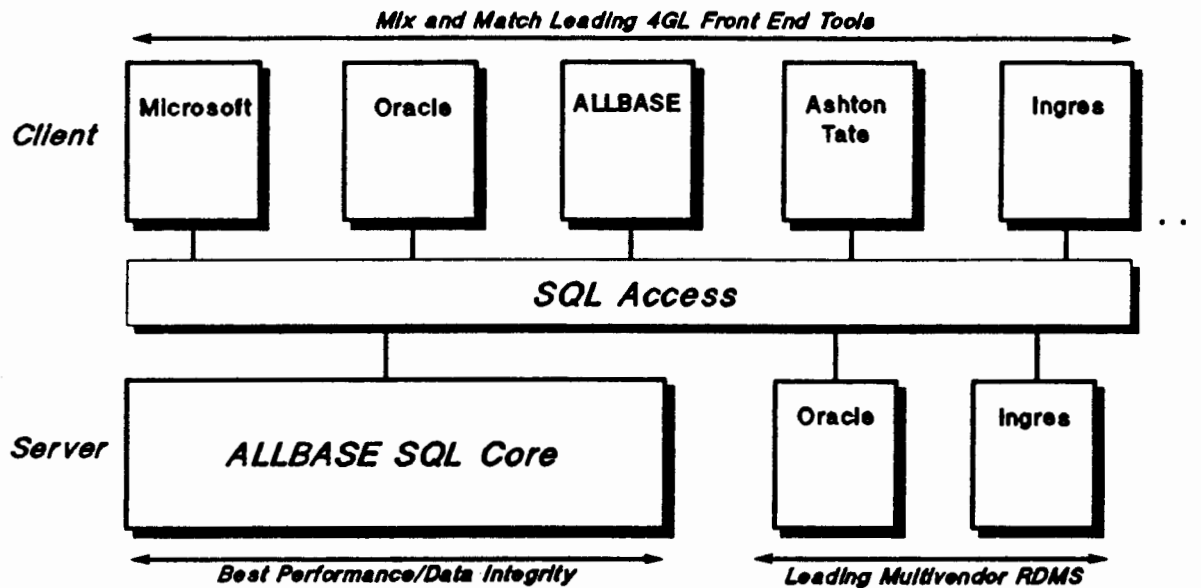


The HP 3000 offers today the choice of leading 4GL tools and databases. ALLBASE/SQL is ANSI- and X/Open-compliant and offers customers best performance and data integrity.

HP is committed to the SQL Access standard and is helping to drive the specification for SQL Remote Database Access (RDA). The SQL Access Group consists of key industry relational database suppliers such as Oracle and Informix, as well as major vendors such as HP, DEC, Tandem, Sun, and NCR. The SQL Access Group also has X/Open representation.

Based on the ISO Remote Database Access standard, the SQL Access standard will provide an interoperability solution for customers that wish to link different SQL databases running on different machines through standardized queries. In the future, users will be free to mix and match SQL-Access compliant products to meet their information management needs. SQL Access will also provide a standard programming interface for future client/server applications. ALLBASE/SQL will support both the SQL Access standard and the defacto Gupta standard.

Figure 5. The HP 3000 SQL Access vision



Interoperable tools in a heterogeneous database environment and distributed data management. SQL Access compliance will be provided with ALLBASE/SQL in 1991, allowing interoperability between ALLBASE/SQL and other database solutions that conform to SQL Access.

Standard 3GL
programming languages

The HP 3000 also provides ANSI-conformant third generation programming languages that are widely adopted in the industry: COBOL-85, FORTRAN-77, ANSI-C, and ANSI-Pascal.



2. HP 3000 and standard operating system services

Why POSIX on the HP 3000

The support of POSIX on the HP 3000 means a wider choice of application solutions for HP 3000 customers. With POSIX support on the HP 3000 there is no need to consider a costly conversion to UNIX. POSIX-compliant UNIX applications will be portable to the HP 3000. In addition to greater choice of applications and enhanced investment protection, POSIX support on the HP 3000 will also provide application development leveragable across multiple platforms and lower application maintenance costs.

What is POSIX?

An operating system performs services for an application program such as disk reads, process creations, and file management. Incompatibilities exist because each operating system performs these functions differently: the syntax of system calls to these services are different, the calls require different parameters and formats, and the order of the parameters matters. To support application portability across systems, the IEEE P1003 group, accredited by ANSI, was chartered to specify a Portable Operating System Interface (POSIX) standard for application development. The POSIX group was formed to specify the functions and services an operating system must support and to specify the application programming interfaces to these services. POSIX will be the set of interface services in common between the different flavors of Unix on the market today, DEC VMS systems, and the HP 3000.

The POSIX portable open systems environment definition is being developed by several committees. These standards include:

Working Group Status

Approved:

- 1003.1 Core POSIX System Interface

Draft:

- 1003.2 POSIX Shell and Tools
- 1003.3 POSIX Conformance Testing
- 1003.4 Real-Time Extensions

Evolving:

- 1003.5 ADA Language Bindings
- 1003.6 Security
- 1003.7 System Administration
- 1003.8 Networking
- 1003.9 FORTRAN Language Bindings
- 1003.10 Supercomputer Profile
- 1003.11 Transaction Processing
- P1201 POSIX User Interfaces (Based on X Windows)

POSIX Adopted by X/Open, OSF, and UNIX International

POSIX has substantial backing from the most important standards bodies and industry consortia. Three organizations, X/Open, Open Software Foundation (OSF), and Unix International, with funding and participation from all major industry players both in the US and in Europe, have adopted POSIX as the foundation for new distributed computing technologies. This means that existing applications on the HP 3000 will be able to benefit from new technologies invented or adopted by these organizations. This also means that open systems users can use the HP 3000 and know that, in addition to the performance and commercial functionality provided by the HP 3000, they will have access to new software standards and technologies as they become available.

HP 3000 and POSIX plans

The most mature POSIX standards relevant for commercial processing are the POSIX 1003.1 and POSIX 1003.2 standards. Accordingly, HP has provided developer's support of the POSIX 1003.1 and 1003.2 standards on the HP 3000. POSIX 1003.1 provides a standard operating system interface. The POSIX 1003.2 standard defines the interface to shell services, commands, and common utility programs as derived from the Unix operating system. Volume end-user shipments of these products on the HP 3000 will commence in 1992.

In general, the HP 3000 support for POSIX will be focused on those interface standards that directly affect portability for OLTP commercial applications. Today, focus is on supporting the POSIX 1003.1 and POSIX 1003.2 standards because these specifications are the most solidified. The HP 3000 will be certified under the POSIX 1003.3 certification standard, using the FIPS PCTS conformance tests from the U.S. government (NIST). As the POSIX committees define specifications for other key operating environment components, such as security, networking, system administration, and transaction processing, these will be adopted by the HP 3000 as appropriate. Both X/Open and POSIX are working to define transaction processing standards, and HP is helping to drive convergence of these standards.

POSIX and Unix

POSIX provides a high level of compatibility with Unix because it is based on the two most widely used versions of Unix; ATT's System V Interface Definition (SVID V.3) and Berkeley's Software Distribution (4.3BSD). Although POSIX is not a pure version of either, it seeks to incorporate the best of both plus features not found in either. Because POSIX incorporates features from the two most popular versions of Unix, POSIX support on the HP 3000 will add a Unix look and feel to the HP 3000 and allow Unix users to use the HP 3000 as they would use a Unix system. At the same time users of the existing MPE interfaces will be unaffected and use the system as they always have.

While POSIX 1003.1 and POSIX 1003.2 are key elements for software portability, the HP 3000 will support other key software functionality commonly found in the Unix environment, such as ARPA networking interfaces and the X Window System, to provide complete application portability.

With the HP 3000 support of many elements generally associated with the Unix environment, porting from a Unix system to the HP 3000 will be no more difficult than porting an application between the different varieties of Unix found on the market today.

POSIX and OSF/1 compatibility

OSF/1 will be the operating system supplied by OSF. While the HP 3000 will not run OSF/1, the HP 3000 will be compatible with applications ported from the OSF/1 environment via the POSIX and XPG standards as well as other platform-independent OSF standards such as Motif, DCE and DME.

The HP 3000 provides performance

POSIX is an operating system interface standard and does not specify any details regarding the underlying operating system. Because of this both Unix and non-Unix systems can be POSIX-compliant. All that is required is support of the POSIX interfaces. This feature allows the POSIX interfaces to be implemented on top of the base MPE/iX operating system alongside the existing MPE/iX interfaces to provide the high performance OLTP advantages of MPE/iX to POSIX applications. These advantages include an advanced RISC architecture, elimination of disk I/O bottlenecks through the caching of files and databases in the very large memories that are supported, and the fastest network and relational databases in the industry.

POSIX 1003.1 provides standard operating system interfaces

Support for the POSIX 1003.1 programmatic interfaces means that the HP 3000 will provide run-time support for Unix applications and that POSIX-compliant applications can be ported to the HP 3000 with little or no modification. As a POSIX core-compliant system, the HP 3000 will support standard programming interface conventions for process management, signal handling, file and directory management, general terminal interface, as well as Unix file restore capabilities (tar and cpio).

POSIX 1003.1 provides file system compatibility

Support for the POSIX 1003.1 hierarchical directory and file naming conventions will add a Unix-compatible directory to the HP 3000. Users and application designers will be able to create directories on the HP 3000 that match the directories of their DOS PCs or Unix workstations and portability of Unix applications to the HP 3000 is greatly increased. While hierarchical directory support will add new functionality to the MPE/iX directory, there is no impact on current MPE/iX applications.

POSIX 1003.2 provides Unix look and feel

The support of the POSIX user interface means that a Unix user or application developer will be able to use the HP 3000 in the same way that they use a Unix system today. In addition to the easy-to-use MPE command interpreter, the HP 3000 will also support a Unix-like command shell that provides features of the Bourne and Korn shells, the two most popular Unix shells available today. The new shell supports a separate command-line interface which provides the HP 3000 with the "look and feel" of Unix. It supports popular Unix commands and features, such as "pipes" for redirecting one command's output into another command. POSIX 1003.2 also provides compatibility with familiar MS-DOS commands.

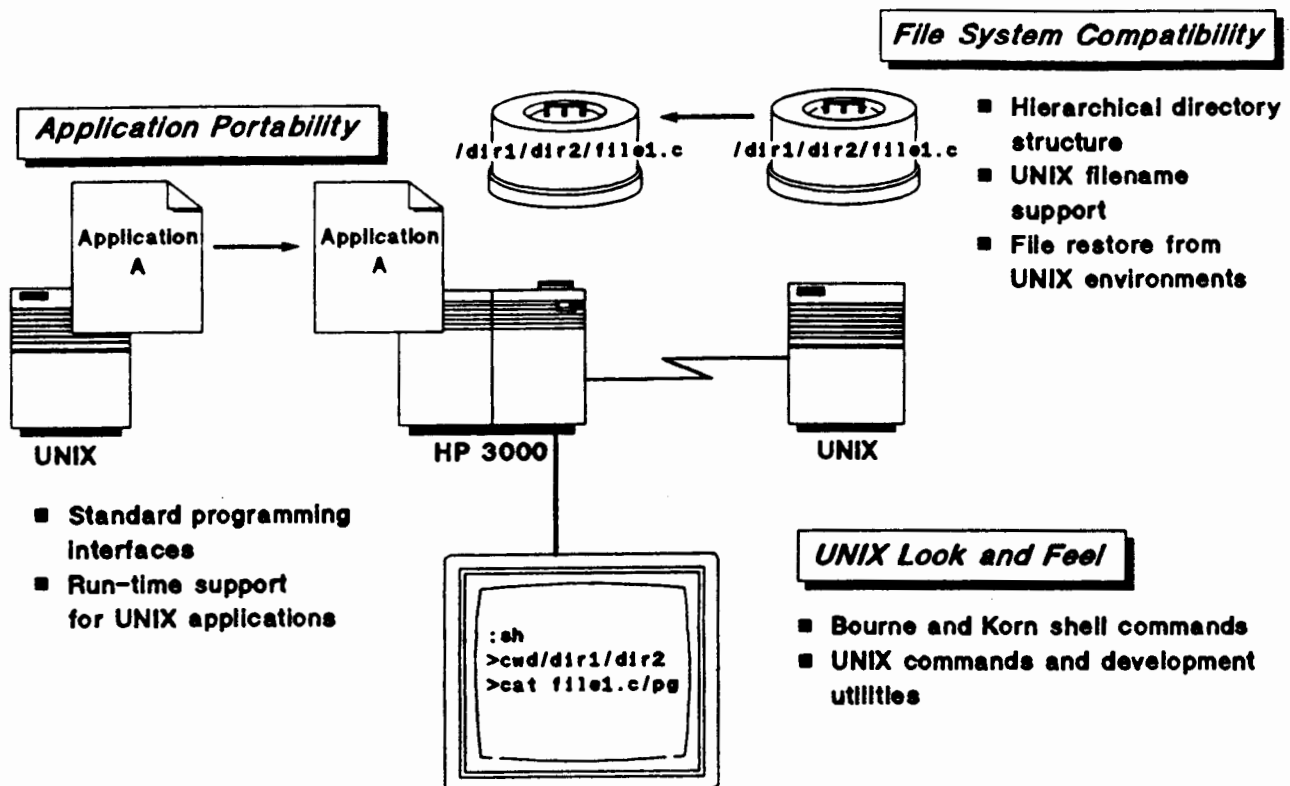
POSIX 1003.2 provides application development utilities

POSIX 1003.2 also provides a program development environment familiar to users experienced with Unix. The standard specifies a viable set of tools and utilities providing parity with basic Unix development environments. It includes tools such as *awk*, a powerful data manipulation and report generation language; *make*, a versatile maintenance tool for handling large programs; and *lex* and *yacc*, construction tools for compilers. This allows application developers with Unix skills to use the same tools and utilities on the HP 3000.

The HP 3000 vision for an integrated POSIX environment

The addition of POSIX to the HP 3000 will have no impact on existing HP 3000 applications. Moreover, the POSIX environment will be integrated with the MPE/iX environment so that the new POSIX features are accessible to MPE users. MPE users will be able to use the new functionality, such as hierarchical directory management, via MPE intrinsics and commands. MPE applications will be able to access POSIX files and POSIX applications will be able to access MPE/iX files and databases such as TurboIMAGE, thus providing interoperability and integration between MPE/iX and POSIX applications and data.

Figure 6. POSIX Key Features



The HP 3000 provides added value for open systems users

As a result of compromises necessary to achieve consensus on standards, POSIX will typically provide only a subset of the functionality required to meet commercial needs of customers. Thus, it is important to complement the POSIX standards with the added value benefits that HP 3000 customers enjoy today. Unix applications on the HP 3000 will benefit from the performance, scalability, reliability, availability, and commercial functionality of the HP 3000 environment.

Unsurpassed high availability benefits

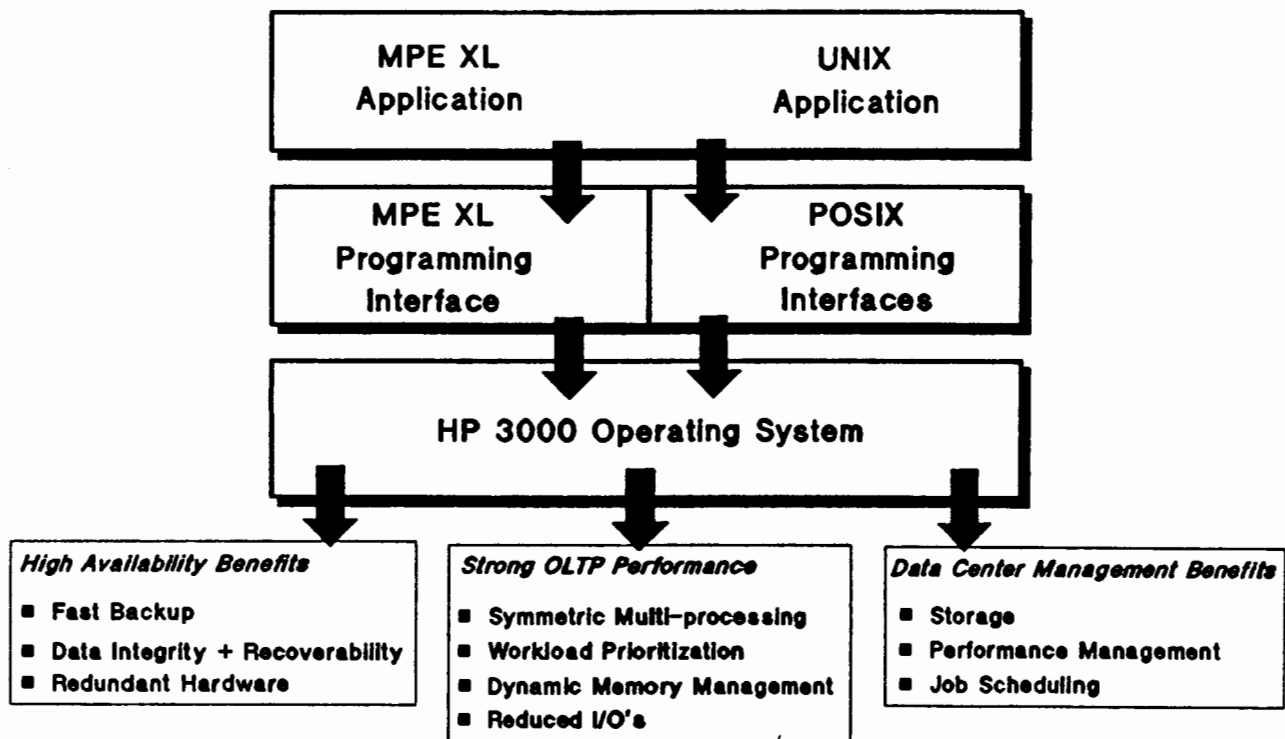
Open systems users will be able to take advantage of key HP 3000 high availability features, such as fast backup, automatic data integrity and recoverability, and backup processor capabilities. The uniquely powerful family of TurboSTORE/XL data backup products will support POSIX directories and files. POSIX applications also receive the benefits of full data integrity and recoverability provided by the integrated MPE/IX transaction manager. This standard HP 3000 feature ensures fast and automatic data recovery of user files and TurboIMAGE databases as well as critical system tables and files with no operator intervention.

Data center management ease-of-use

The POSIX environment on the HP 3000 will still continue to be managed via MPE system management commands and utilities. This allows existing HP 3000 system managers to use familiar tools and commands and avoids heavy retraining. MPE/IX provides a full set of system management capabilities including an extensive command set for the managing of batch jobs and interactive users.

POSIX will provide significant extensions to the already rich MPE/IX environment. This will allow HP 3000 users to reap the benefits of open systems while they continue to enjoy the advantages of an operating system and architecture designed with 1990's technology.

Figure 7. The HP 3000 POSIX run-time environment



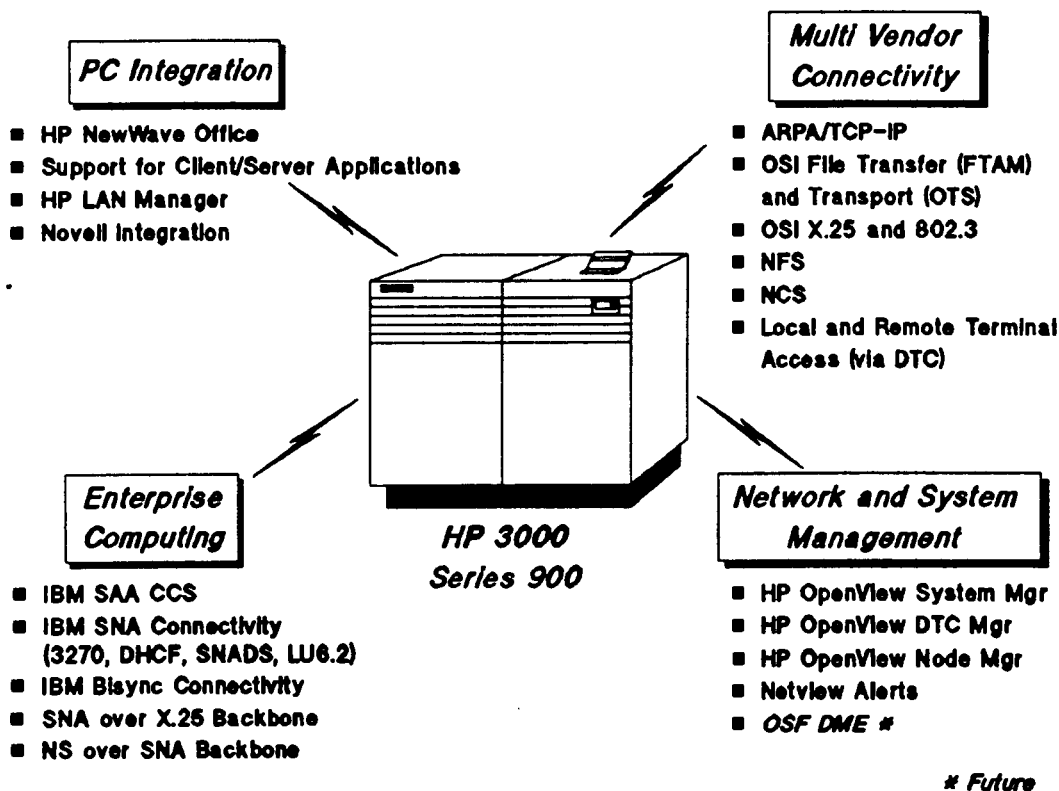
POSIX will sit side-by-side with MPE/IX programming interfaces and will be tightly integrated with operating system services. A Unix application can run on the HP 3000 using the POSIX interfaces and take advantage of HP 3000 features.

3. HP 3000 multivendor networking

Open networking offerings today

The HP 3000 supports a multivendor networking environment through a long-term commitment to OSI standards, as well as ARPA TCP/IP, IBM SNA, and PC LAN (Novell & LAN Manager) connectivity. The HP AdvanceNet strategy encompasses meeting a customer's unique mix of networking needs for connectivity, interoperability, and integrated network management.

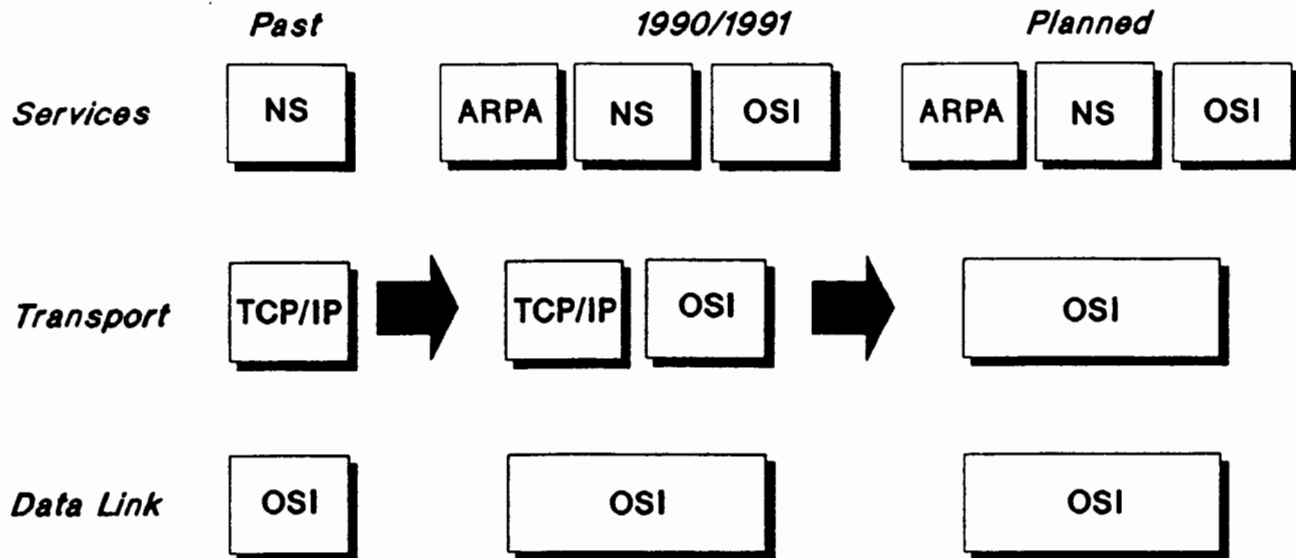
Figure 8. Highlights of the HP 3000 open networking offerings



HP AdvanceNet for multivendor communications

Developed by the International Standards Organization (ISO), the Open Systems Interconnection (OSI) represents a growing set of networking standards that will be adopted worldwide. TCP/IP and the ARPANet protocol suite is a DoD standard widely implemented by vendors today. The HP 3000 supports these standards today, and customers using ARPA, NS, and TCP/IP today may use OSI in the future for multivendor networking. Customers can safely buy HP AdvanceNet today as their first step toward OSI.

Figure 9. The HP 3000 AdvanceNet strategy



HP's AdvanceNet strategy is to provide solutions that will allow users to build on existing ARPA/NS networks that can evolve to OSI. The solutions will integrate new OSI capabilities with existing applications and network services.

The HP 3000 provides a variety of the basic networking services (electronic mail, file access and transfer, virtual terminal support, network management, and network directory services) under OSI and ARPA. Products based on these services can operate on all OSI physical connections, such as X.25 for wide area networking, IEEE 802.3/Ethernet; and in the future, IEEE 802.5/Token-Ring for local area networking.

Enterprise-wide networking capabilities

IBM connectivity and SNA architecture support will continue to be strategic for the HP 3000 and are part of HP's AdvanceNet strategy. The HP 3000 provides:

- a complete family of batch, interactive, and programmatic HP-to-IBM communication products
- advanced interoperability through high-level APIs and office connect products
- support for SAA and selective non-SAA capabilities

A variety of HP 3000 products and services provide interoperability with IBM: LU 6.2 for peer-to-peer networking, Distributed Host Command Facility (DHCF) for IBM 3270 access to HP 3000 applications, and SNA Distributed Systems (SNADS) for HP 3000 communication with IBM's electronic mail protocols. The HP 3000 also offers significant backbone flexibility providing HP-to-HP or HP-to-IBM communications capability over either X.25 or SNA links. SAA Common Communication Services (CCS) interoperability is also provided with HP AdvanceNet products.

PC client-server integration

NewWave Office solutions provide resource sharing, database access, electronic mail, and networked PC management and have placed the HP 3000 in a leadership position for PC integration. HP will maintain this leadership position by providing open server support and application programming interfaces for the key PC LAN networking products that have emerged as de facto standards, such as Novell Netware and Microsoft's LAN Manager. This allows the HP 3000 to tie into existing PC networks for customers who require additional processing capability and want to protect their investment in PC LANs. Netware's (SPX) and LAN Manager's (named PIPES) application programming interfaces enable program-to-program communications between the HP 3000 and PCs over these LANs.

Integrated network management

In keeping with HP's AdvanceNet strategy, HP OpenView is fully committed to international and industry standards for network management. Derived from the OSI Management Framework and optimized to include TCP/IP networks, the HP OpenView Architecture was designed as the foundation to manage multivendor network environments. HP's OpenView Windows Developer's Kit allows any vendor to develop network management applications under a common user interface based on standards. The HP 3000 uses OpenView Windows on DOS as the management station for its DTC and system management products and is planning to provide support for the ARPA SNMP and OSI CMIP network management services.

The HP 3000 also provides the ability to coexist and be managed by IBM network management services. SNA/Netview Alerts are provided to allow HP 3000s to signal IBM Netview operators in the event of a link failure.

Support for OSF DME

In addition, the HP 3000 will support OSF's Distributed Management Environment (DME). This will allow the HP 3000 to co-exist in a multivendor network managed in a unified and efficient manner with a consistent graphical user interface. HP 3000 support for DME will begin in late 1992.

A network foundation for distributed applications

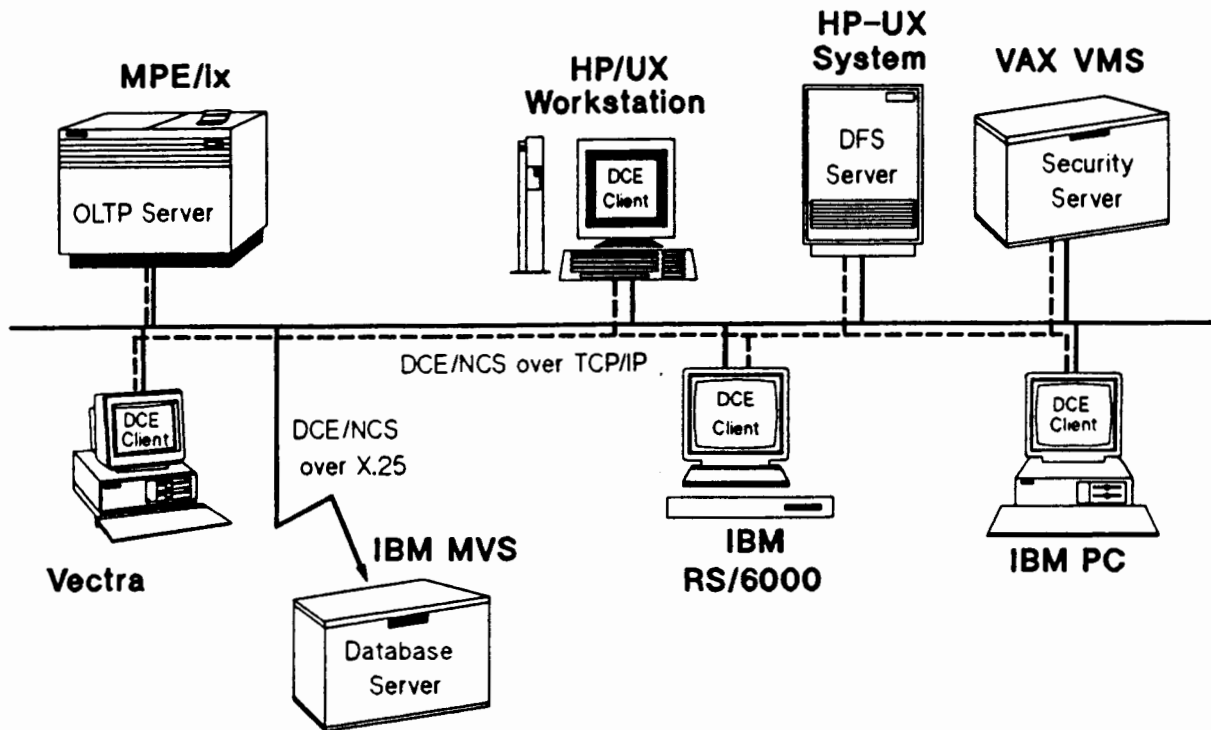
HP encompasses a combination of the OSI, ARPA, LAN Manager, Novell, and IBM SNA standards to provide services needed to build distributed applications. These include:

- Process-to-process communications. Currently provided with support of the SAA- and X/Open-adopted LU6.2 APPC protocol. The HP 3000 will also make available other process communication standards, such as remote procedure call capabilities through support of HP/Apollo's Network Computing System (NCS), LAN Manager Named Pipes, Novell's SPX/IPX, and ARPA Berkeley Sockets.
- Store-and-forward services are provided through support of the OSI X.400 standard and support of IBM's SNA Distribution Services (SNADS).
- Built-in communication services. This includes products available to allow networked user interfaces, remote database access, transparent file sharing, and shared office services.
- Standard data streams. The HP 3000 will provide products built on ANSI, SNA, and ISO standards for document and graphics formats.

OSF DCE for global interoperability

The Open Software Foundation announced their selection of Distributed Computing Environment (DCE) technology in 1990. OSF's DCE includes remote procedure calls, naming authentication and directory services, and a distributed file system technology. One of the key technologies selected was HP's Network Computing System (NCS). The HP 3000 is committed to support components of OSF's DCE in the 1992/1993 timeframe.

Figure 10. DCE, a vendor-neutral Distributed Computing Environment



DCE will enable the creation of transparent, distributed applications in a Multi-Vendor Computing Environment.

4. The HP 3000 and user interfaces

Common look and feel for applications

Support of open window-based user interfaces is a key interoperability feature for open systems of the future. An application's graphical user interface (GUI) makes it possible for applications running on different platforms to present a common "look and feel" to the end user, allowing users to move between systems and applications with ease. Thus, GUIs offer reduced training time for new applications and improved user productivity.

Different user interface standards have emerged for each of the major desktop systems. Therefore, no one standard satisfies all of the system requirements for a standard user interface. For example, the most widely known graphical user interfaces are Microsoft® Windows on MS-DOS, Presentation Manager (PM) on OS/2 systems, and the Apple Macintosh -- each with significantly different application programming interfaces.

In the absence of a single, standard user interface API, the application developer must consider the desktop devices to be supported. The HP 3000 provides application developers a wide variety of highly portable user interface alternatives for PCs, X-displays, and terminals, each providing a different level of interoperability, portability, and performance. Similar to functionality provided by several 4GLs on the market today, HP plans to provide services in the future that will mask the technology differences between user interface APIs such as X Windows, PM, MS Windows, and VPLUS.

PC-based GUIs: NewWave, MS Windows, Presentation Manager

NewWave is not a graphical user interface but derives its "look and feel" from the underlying GUI. NewWave provides a highly productive end-user environment through the incorporation of object management facilities and agents. This results in benefits to the end user such as active links between applications and task automation. It is currently supported under MS Windows with plans for support under Presentation Manager and OSF/Motif™. There are currently no formally adopted standards for object management, but HP is leading these efforts with NewWave's Object Management Facility. Several vendors such as Data General, NCR, and AT&T have licensed NewWave.

PC user interface packages based on NewWave, MS Windows or Presentation Manager are consistent with HP's cooperative computing strategy and provide the user portability benefits associated with the common "look and feel" of these GUIs. Oracle, Ingres, and HP ALLBASE will also provide PC-based application development forms packages that provide a high degree of portability across platforms.

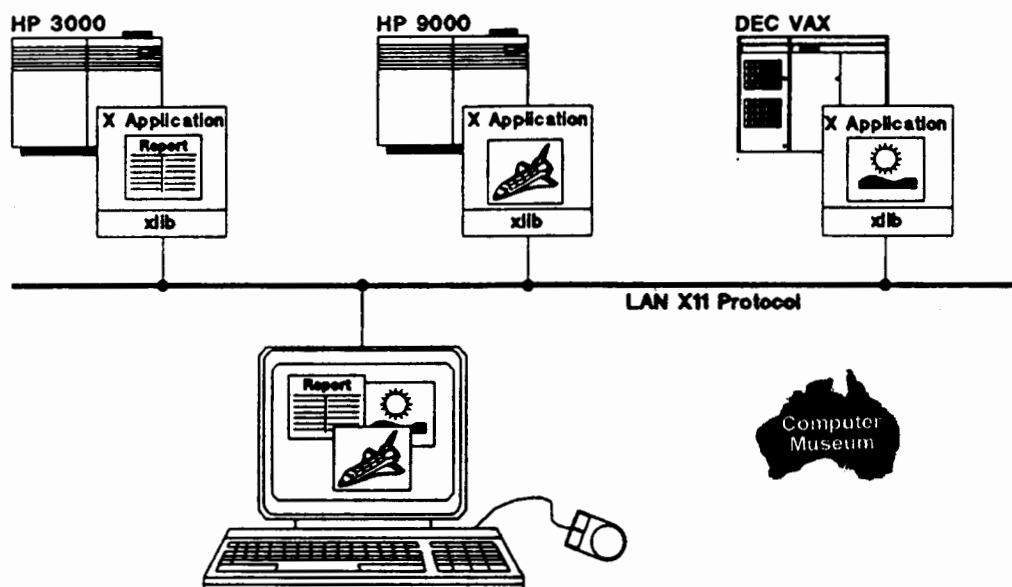
VPLUS/Windows is an alternative for existing VPLUS customers who desire a smooth migration path to a graphical windows-based user interface on PC platforms under a more common GUI.

X-based GUIs: X Windows, HP OSF/Motif

X Windows has been adopted by X/Open as the industry-standard protocol for implementing a distributed, graphical user interface. OSF/Motif is the graphical user interface built on top of X Windows that is provided by HP. The X Window System allows integration of applications that run on different vendor systems in a network to be displayed simultaneously on an X-display device. HP Motif XL is the HP 3000 X Windows product and is available to developers today.

The OSF/Motif environment provides behavior consistent with PC-based de facto standards, along with an enhanced 3D appearance. In manufacturing arenas, HP 3000 planning and control applications can also now share an integrated "look and feel" with HP 9000 or workstation-based X Windows applications managing the factory floor.

Figure 11. The HP 3000 and OSF/Motif



The HP 3000 provides a common user interface for multivendor network environments through support of X Windows and OSF/Motif.

Terminal-based interfaces: 4GLs, and VPLUS

Ingres, Oracle, and Cognos all offer 4GL forms packages that isolate the application developer from terminal interface processing. The key benefit of using these packages is a consistency of behavior for applications across different platforms and their windows functionality.

Although not an industry standard, VPLUS will also continue to be supported on the HP 3000 as a high performance OLTP forms package. VPLUS/Windows allows PC users to use MS-Windows for windowed graphical user interface access to existing HP 3000 applications.

5. Open Distributed Transaction Processing

HP 3000 committed to standards-based distributed transaction processing

The HP 3000 will support the application programming interfaces currently being defined by X/Open for Distributed Transaction Processing (DTP). X/Open DTP will allow transactions to transparently span multiple databases on the network with full support for data integrity. This will allow ALLBASE/SQL and the HP 3000 to participate in a multivendor distributed transaction processing environment.

In January of 1991 HP made an announcement of strategic commitment to the distributed transaction processing monitor technology of Transarc Inc. Transarc technology will be the foundation for online transaction processing within an open, distributed, client-server computing environment. Endorsing Transarc technology along with HP were IBM, Stratus, Informix, Sybase, Ingres, JYACC, and Independence Technologies Inc.

Transarc features and benefits

As a result of this commitment, HP will introduce a distributed transaction processing monitor based on Transarc technology for the HP 3000. The distributed transaction processing monitor will increase the ability of the HP 3000 to meet the requirements of mission critical OLTP applications in a distributed environment of heterogeneous systems. Specific benefits will be provided:

- Support for distributed OLTP applications involving multiple heterogeneous systems and databases
- Transaction coordination across multiple sites for maximum data integrity
- Reduction of the number of processes required in an OLTP environment, thus lowering system overhead and increasing connectivity
- Efficient routing of transactions
- Tools for OLTP application development, maintenance, and configuration

HP reasons for choosing Transarc

Transarc Corporation is based in Pittsburgh, PA and is a supplier of systems software for local and wide-area networks of distributed computers. Transarc developed the Andrew File System (AFS) that has been chosen by OSF as a component of OSF's Distributed Computing Environment (DCE). The Andrew File System has been recognized for its ability to provide network file sharing.

In addition to technological leadership in distributed computing and OSF acceptance, Transarc technology is attractive for other reasons as well:

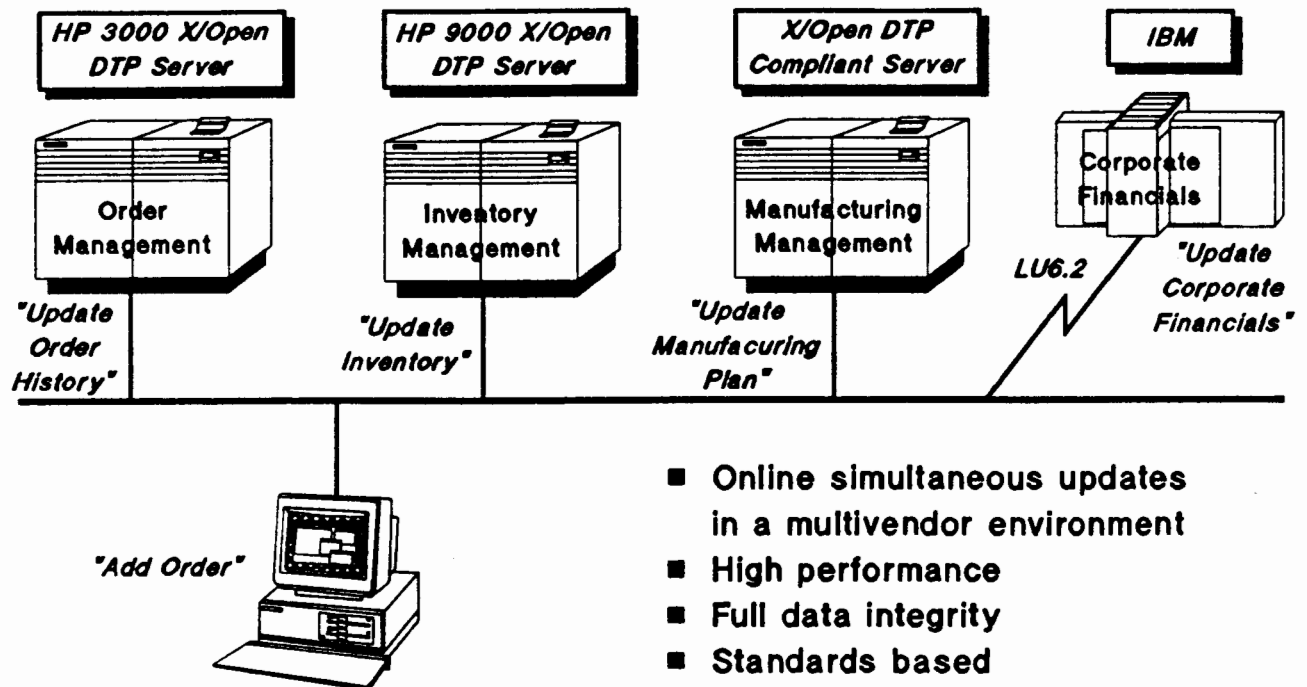
- Transarc is built on top of HP's NCS RPC technology and is consistent with HP's strategy to use DCE as a framework for distributed computing
- Transarc is compliant with X/Open's Distributed Transaction Processing (DTP) model and the XA interface standard

- Transarc technology is functionally rich and robust
- Transarc technology is modular and allows for easy portability and extendability

HP 3000 OLTP vision and plans

HP's strategy is to extend HP 3000 OLTP leadership by using Transarc's technology to evolve the HP 3000 to a distributed client/server environment. Transarc technology will be integrated on both the HP 3000 and the HP 9000 to provide support for database software and CASE tools.

Figure 12. X/Open DTP: Enterprise wide OLTP applications



Transarc technology and HP NCS provide the foundation.

HP 3000 Open OLTP summary

The HP 3000 strategy is to support relevant commercial open system standards to provide application portability and multivendor interoperability while providing industry-leading OLTP performance and functionality and protection of customers' investments. The strategy encompasses support for de facto market standards, consortia-based standards (X/Open, OSF), and IBM SAA interoperability standards and provides key application programming interface standards for all components of a software computing environment. In addition, the HP 3000 supports a long-term commitment to OSI (HP AdvanceNet), industry-wide database interface definitions (SQL Access Group), standard graphical user interfaces (for example, PM, OSF/Motif), industry-leading object management (NewWave Computing), and standard network management protocols (HP OpenView). Commitments to both standards and industry-leading OLTP will make the HP 3000 one of the premier open platforms of the 1990s. The remainder of this document contains appendixes, which may be of interest to some readers.

- **Appendix A: *The Open OLTP Environment roll-out*** provides details on availability of HP 3000 open system offerings.
- **Appendix B: *How to get started today*** provides basic guidelines on programming for portability on the HP 3000.
- **Appendix C: *HP 3000 and HP 9000 interoperability*** presents details on shared open system components among the two platforms.
- **Appendix D: *HP 3000 and X/Open alignment*** discusses XPG3 and XPG4 compliance for the HP 3000.
- **Appendix E: *HP 3000 and IBM SAA interoperability*** presents HP 3000 functionality compatible today with IBM's Systems Application Architecture.

Appendix A

The Open OLTP Environment roll-out

	Available	Planned
Application Portability		
User Interface	- NewWave - MS Windows - Presentation Manager	- X Windows System - OSF Motif - JAM/XL - Curses
Languages	- COBOL - Pascal	- C - FORTTRAN - MicroFocus COBOL
Client/Server API	- LAN Manager APIs - Portable NetWare	- Client/Server ALLBASE - NCS RPC 1.5.1 - Berkeley Sockets - Softbench - NCS Run Time
Database Management and Tools	- ALLBASE/SQL - ALLBASE/DB2 Connect - Oracle RDB - Ingres RDB - Uniface - FOCUS *	- Cognos * - InfoCentre * - Gupta SQL Windows * - PowerBuilder * - Ingres/Windows 4GL * - ANSI OSQL - SQL Access
Operating System	- HP Native Language Support (HP NLS) - POSIX.1, POSIX.2 Developers	- AT&T SVID IPC - POSIX RunTime - XPG Branding - POSIX FIPS - Transarc TP Monitor - Password/etc. - Kerberos - Streams
Interoperability		
ARPA Networking	- Net IPC/Sockets Interoperability - FTP (File Transfer) - Ethernet	- Telnet VT - SNMP
OSI Networking	- X.25 - X.400 - OTS Transport	802.3 - File Transfer FTAM - XTI - X.500
IBM Networking	- SNA IMF 3270 - BSC RJE - SNA RJE - DHCF	- Netview Alerts - SNA over X.25 - NS over SNA - SNADS - LU6.2 on PU2.1
OSF		- DCE Core RunTime (Timing, Threads, Security Directory/Naming, RPC2.0) - DFS - DME
PC/Workstation Integration Networking	- NewWave Office - Novell Gateway - HP LAN Manager Clients	- Token-Ring Connectivity - NFS - Native Token Ring - FDDI

* Tools on ALLBASE/SQL

Appendix B

How to get started today

Programming for portability guidelines on the HP 3000 follow closely those standards embraced by X/Open's CAE. Outlined below is a specific approach developers should consider when creating open systems applications for the HP 3000 environment.

This section will only highlight some of the key points of programming for portability on the HP 3000 because thoroughly explained guidelines would require a separate document. Application developers can expect more information on programming for portability on the HP 3000 in the future.

What about MPE/V?

Customers need to upgrade to the PA-RISC architecture to take advantage of open systems products and programming interfaces.

Modularized code

The framework for the HP 3000 Open OLTP Environment describes the key application programming interfaces required. Applications must be modularized so that programming interfaces for database management, user interface screen handling, networking, and the operating system are separated and can evolve easily to use new standard interfaces as they become available on the HP 3000.

Traditional OLTP versus client-server

New application development must consider whether the application will solely support traditional terminal-host configurations or client-server configurations as well. Either a 3GL or 4GL development environment is recommended for traditional terminal-host applications. A 4GL development environment is recommended for client-server applications because most popular 4GL tools on the HP 3000 today accommodate a variety of display devices, supporting both terminal-host processing and interfaces for PC-based distributed applications.

SQL database options

Application development on a standard SQL relational database management system is necessary for maximum application portability. HP 3000 customers can choose ALLBASE/SQL or any of the multivendor ISV database solutions available on the platform, such as Oracle or Ingres.

ALLBASE/SQL provides investment protection for HP 3000 who have developed applications on TurboIMAGE through support of the ALLBASE/Turbo Connect product. New applications may be written using standard SQL statements in 3rd or 4th generation languages and automatically continue to have read-access to TurboIMAGE data, as well as ALLBASE/SQL data. Several 4GLs also provide access to both ALLBASE/SQL and TurboIMAGE data. Migration guides and consulting services will also be provided by HP to ensure smooth customer transitions to ALLBASE.

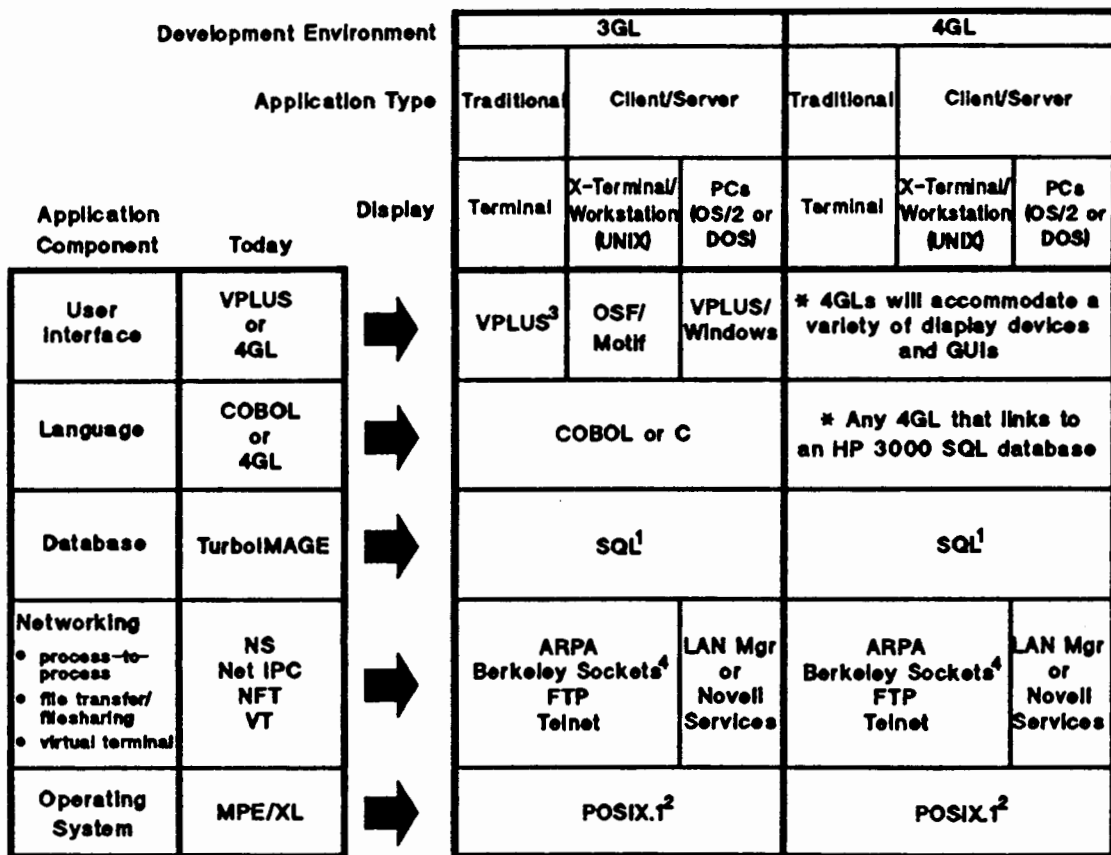
The future of VPLUS

Many HP 3000 customers have written their applications in VPLUS to capitalize on its block mode high-performance features. Although not a standard, VPLUS will continue to be the premium alternative for OLTP performance on the HP 3000. VPLUS is recommended when the primary design consideration is performance. OSF/Motif is recommended for 3GL applications when the primary design consideration is standardization. It is important to note that 4GL forms packages will provide the most flexibility for portability across systems and various desktops.

As VPLUS will continue to be the high performance block mode forms interface for HP 3000 applications, HP has integrated VPLUS with the new HP 3000 CASE tools. Maestro II from Softlabs will support the generating of VPLUS forms as will the CASE tools from CGI Systems Inc.

In addition, VPLUS/Windows provides a migration path for host/terminal-based VPLUS applications to a MS-Windows based client/server environment and VPLUS/Windows will also allow VPLUS applications to run under the state-of-the-art NewWave environment.

Figure 13. HP 3000 basic portability options



1. Any HP 3000 SQL database can be used. ALLBASE/TurboCONNECT for TurboIMAGE to SQL transition;

2. Initial support for C language bindings only. Note many applications independent of operating system calls;

3. VPLUS for optimal OLTP performance;

4. NetIPC provides Berkeley Sockets interoperability.

Appendix C

HP 3000 and HP 9000 interoperability

HP's NewWave Computing strategy offers both the HP 3000 and HP 9000 systems as platforms of choice in the distributed computing environment. Thus, system and application interoperability between the two environments is significantly increasing. The interoperability provided by the HP 3000 open software platform also extends to other Unix environments as well. Key areas of interoperability include:

Table 1. HP 3000 and HP 9000 interoperability

Communications/connectivity	ARPA TCP/IP Services
	OSI Services
	LU6.2
	LAN Manager API
	NCS Remote Procedure Call
	Netware
	Token Ring 802.5 Router
	HP OpenView
	ALLBASE/SQL
	Oracle
Network Management	Ingres
	Sybase
	Cognos
	FOCUS
Databases and Tools	InfoCentre
	ALLBASE/Net
	NewWave Office Resource Sharing
	Netware PC Clients
Distributed Database Management	LAN Manager PC clients
	NFS
	X Windows OSF/Motif
	Dialog Manager
Shared Files	JAM
	NewWave
	PM
	MS Windows
Presentation Services	HPDeskManager and OpenMail
	X.400 capabilities
Mail Exchange	POSIX 1003.1
	POSIX 1003.2
Operating System	ANSI C
	ANSI FORTRAN
Common Languages	

Appendix D

The HP 3000 and X/Open alignment

X/Open's Common Applications Environment (CAE) provides a verification suite that allows vendors to be 'branded' to specific levels of X/Open compliance. X/Open's Portability Guide (XPG) defines a set of mandatory base components, extension components, and optional components for specific levels of branding. The HP 3000 strategy is to align itself with X/Open's XPG mandatory base components and to provide support and branding for other components as required for commercial OLTP environments. Commonalities between XPG Issue 3 and planned HP 3000 standards support include:

Table 2. X/Open Common Applications Environment -- 1989 Issue 3

Mandatory Base Components	
System Calls & Libraries	POSIX 1003.1
Commands & Utilities	POSIX 1003.2
C Language	ANSI C
Internationalization	HP NLS
Extension Components	
COBOL Language	ANSI COBOL
FORTRAN Language	ANSI FORTRAN
Pascal Language	ANSI Pascal
ISAM	KSAM equivalent functionality
SQL	ANSI ALLBASE/SQL
Terminal Interfaces	Under Investigation
Optional Components	
Window Manager	X Windows, OSF/Motif
Transport Interface	ARPA-Net/PC equivalent functionality
PC Interworking	VT100 Emulation
Source Code Transfer	Under Investigation
Inter-Process Communication	Under Investigation
ADA Language	Not Planned

It is important to note that XPG3 minimally defines networking interoperability for commercial environments. The X/Open Portability Guide Issue 4 is expected to articulate X/Open's commitment to OSI and ARPA networking and further specifications for security, system administration, PC networking (LAN Manager protocols and APIs), and distributed transaction processing. HP is actively helping to drive X/Open's transaction processing standard. The HP 3000 intends to provide XPG4 compatibility in most of these areas.

Appendix E

HP 3000 and IBM SAA interoperability

The HP 3000 strategy for SAA compatibility focuses on the IBM interoperability requirements as defined by SAA's Common Communication Services (CCS) specifications. With strong SNA offerings, the HP 3000 meets almost every requirement specified by SAA for communications interoperability. There also exists commonality between the HP 3000 and SAA's Common Programming Interface (CPI) specifications for application portability. The HP 3000 will provide compatibility with SAA's Common User Access (CUA) definition through support of HP OSF/Motif.

Table 3. Summary of HP 3000 IBM CCS compatibility

	CCS	AdvanceNet
Data Streams	3270 Data Streams Doc Content Arch (DCA) Intelligent Printer Data Stream (IPDS)	SNA IMF & DHCF HP DeskManager No plans
Application Services	Doc Interchange Arch (DIA) SNA Distribution Service (SNADS) Distributed Data Management (DDM) SNA Network Management (SNA NMA)	HP DeskManager HP SNADS No plans Netview alerts
Session Services	APPC (LU6.2)	LU6.2 API
Network Services	Low Entry Network (PU2.1)	SNA Link Netview Alerts
Data Link	SDLC Token-Ring X.25	SNA Link Planned SNA X.25

Table 4. Summary of HP 3000 and IBM CPI and CUA compatibility

	CPI	HP 3000 Product
Programming Languages	COBOL '85 C '86 FORTRAN 77 RPG III REXX CSP	COBOL/XL C/XL FORTRAN/XL RPG II/XL Under Investigation No plans
Application Services	Database Query Dialog Manager* Presentation PM* Presentation GDDM* Communication	ANSI ALLBASE/SQL ALLBASE/DB2 Connect Under Investigation Under Investigation OSF/Motif Under Investigation LU6.2

* CUA Components

For Additional Information

**Toward Open Systems: A primer on operating environment standards,
Hewlett-Packard Part No. 5953-6348**

**For IEEE POSIX Draft, contact: Computer Society Standards,
(202) 371-0101**

For IEEE Standards, contact: IEEE Computer Society, (714) 821-8380

For ANSI Standards, contact: ANSI, (212) 642-4900

**For Open Software Foundation, contact: 11 Cambridge Center,
Cambridge, MA 02142; (617) 621-8700**

**For X/Open, contact: 1750 Montgomery St., San Francisco, CA 94111
(415) 773-5383 or Apex Plaza, Fobury Rd., Reading, Berkshire,
UK RG11AX; 44 734 508311**

For X Window Consortium, contact: Bob Sheifler, M.I.T., (617) 253-0628

**The HP 3000 General Information Manual, Hewlett-Packard
Part No. 5952-0994**

**HP 3000 Open CASE White Paper, Hewlett-Packard
Part No. 5091-1072E**

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