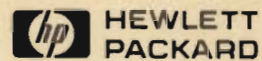


HP 9000 HP-UX Operating System



A Technical Supplement* for the
HP 9000 Model 20, 30 and 40 Computers

* Data subject to change.



Introduction

The HP 9000 Computer family provides a broad choice of 32-bit computers that are ideally suited, in size and computational power, for engineering and scientific problems. The HP-UX Operating System, which is supported on all models of HP 9000 Computers, can successfully meet the software challenges encountered in fully utilizing engineering/scientific networks. The HP 9000 HP-UX system is HP's version of the popular System III UNIX* Operating System designed originally by American Telephone and Telegraph's Bell Laboratories. It offers HP FORTRAN 77, HP Pascal and C language compilers; virtual memory and a rich assortment of Hewlett-Packard engineering tools such as DGL/AGP Graphics (GRAPHICS/9000), IMAGE Data Base Management and Data Communications.

The combination of the UNIX programming environment plus the powerful HP engineering tools provides a single computer system that satisfies the needs of both the computer scientist and the engineer. The standard software tools and modular design of HP-UX helps the computer scientist in designing and managing large software projects. The HP-UX tools provide engineers with the languages and utilities they are accustomed to using with a technical computer.

Functionality

The HP-UX Operating System offers a productive environment for those who depend on computers to solve large, complex problems. Software professionals may easily share and re-use files and tools without sacrificing system security and reliability. And the 3D graphics and Data Base Management tools supported on HP-UX provide an optimum level of communication and interaction between the user and the HP 9000.

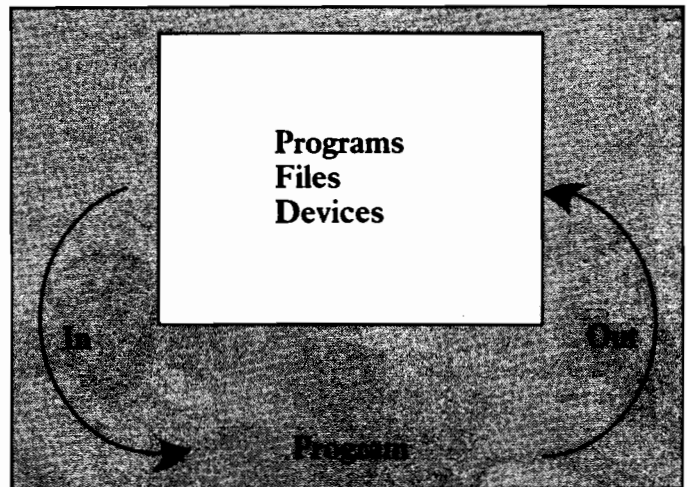
HP-UX Operating System Key Features

- Multiple or single-user capability.
- Multi-tasking capability.
- Virtual memory for code and data.
- UNIX System III software environment.
- HP engineering tools such as graphics, DBM and datacomm.

I/O Redirection

One of the most powerful features of the HP-UX Operating System is the ability to program I/O transactions between files, processes and devices using identical read and write statements. The power of this I/O redirection is further enhanced by the HP-UX command interpreter (the shell). With FORTRAN 77 and Pascal programs, the programmer has the option of declaring an input and an output "standard". By using standard I/O, programs can be compiled without directing I/O toward a

specific object. The HP-UX shell permits the user to specify the I/O objects at run-time. This feature offers significant productivity gains for programmers modifying, testing and re-using software.



Process Scheduling

HP-UX is a system in which every program starts with an equal priority. Tasks can be initiated from a terminal keyboard or from another program. The multi-tasking capability of HP-UX can support up to 59 user processes concurrently. To support concurrent programming, HP-UX implements UNIX System III's "pipes" and FIFO files. These two features allow interprocess communication in which data can be passed asynchronously between two tasks using a high-level language's read and write commands. In addition, HP-UX intrinsics permit synchronization to control the initiation and resumption of task execution.

Memory Management

HP-UX virtual memory supports segmentation of program code and either segmentation or paging of data with a maximum virtual address space of 1000 Mbytes per process. Of this maximum space, 500 Mbytes can be used for local code and data and 500 Mbytes can be shared system code. With HP-UX, a minimum portion of the Operating System must be resident at all times. The range for this block of resident code and data is approximately 300 to 400 Kbytes.

As suggested above, it is possible for users to share code from one address space in physical memory. And with HP-UX Demand Loading, the user can choose between having an entire program loaded into memory before execution or loading program segments only when they are required for execution.

* UNIX is a trademark of Bell Laboratories, Inc.

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File System

The HP-UX file system is a hierarchical system that supports mounting of removable mass storage media. This system is well suited for a software development environment in which users wish to share data and code. The hierarchical or "tree-like" structure of the system allows users to organize files in a convenient, logical fashion. For each file, permission to read, write and execute can be assigned on an individual, group or community basis. The result is a file system in which users, files and access permissions can be grouped to best facilitate sharing of resources among project teams.

In addition to providing a UNIX System III interface, HP-UX offers capabilities to facilitate code and data transportability. The HP-UX file shares a common disc format and directory access method with the HP 9000 BASIC Language System's Structured Directory Format (SDF). This feature permits BASIC and HP-UX systems to share the same physical file system and pass data files between the two environments.

To transport data among other HP computers, HP-UX supports a set of utilities which will selectively convert and copy HP-UX files to Logical Interchange Format (LIF) files. The LIF directory format is a vehicle for transporting ASCII files on removable mass storage media among a wide variety of Hewlett-Packard computers.

Standard UNIX commands are supported to transport files between HP-UX and other UNIX systems.

The HP-UX to UNIX Relationship

UNIX is a licensed software product and as a licensee of this product, Hewlett-Packard is required to distribute a UNIX System III binary license with every HP-UX operating system. It is important to note that HP has added several significant enhancements to AT&T's System III.

Because it is a hierarchical operating system, UNIX can be separated into two components: the kernel (an interface between the HP 9000 hardware and the application software) and the command and utility level software. The HP 9000 HP-UX kernel is a proprietary product of Hewlett-Packard designed to provide a highly reliable system with such tools as virtual memory, 3D graphics and IMAGE Data Base Management. The HP 9000 kernel also provides a flexible base for future system enhancements.

The HP-UX Operating System commands and system libraries are derived directly from AT&T's UNIX System III. The HP-UX command set is written in C language which assures a high degree of portability for software. It addresses every aspect of program development and still has room for future expansion using UNIX as a guideline for product development.

Another key difference between HP-UX and UNIX is in the area of support. The UNIX Operating System has gained wide acceptance as a standard operating system for future microcomputers. At this time, however, many UNIX products offer no support services for the software. On the other hand, HP-UX is fully supported by Hewlett-Packard.

Supported HP-UX Commands

System Access

- login – user request for system access
- newgrp – login to new group
- passwd – change login password

File archival and backup

- cpio – copy file archives in and out
- tar – tape file archiver

Language compilers

- fc – HP FORTRAN compiler
- pc – HP Pascal compiler
- cc – C language compiler

Program execution and development

- ar – archive and library maintainer
- at – schedule and execute commands at a later time
- basename – deliver portions of pathnames
- cron – execute command at specified time
- dirname – provide full pathname
- echo – print arguments to standard output
- expr – evaluate arguments as an expression
- getopt – parse command options
- kill – terminate a process
- ld – link editor
- make – maintain, update and regenerate groups of programs
- nm – print name list
- od – octal dump
- ranlib – convert archives to random libraries
- sh – shell, the standard command programming language
- sleep – terminate all processing
- tee – send output to both the standard output and user-specified file
- test – condition evaluation command
- time – time a command
- true – provide truth value
- wait – wait for child processes to terminate

File system control

- cd – change working directory
- chgrp – assign file to different group of users
- chmod – change mode
- chown – change owner or group
- chroot – change root directory for a command
- find – find files

- ln – link a file to a directory
- mkdir – create directory
- mv – move/rename files
- mvdrr – move/rename a directory
- rm – remove files
- rmdir – remove a directory
- touch – update access and modification times of a file

Data Communications*

- aterrn – HP Asynchronous Terminal Emulator
- cu – call another UNIX system
- mail – send mail to users or read mail
- mesg – permit or deny messages
- uucp – UNIX-to-UNIX copy
- uustat – uucp status inquiry and job control
- uusub – monitor uucp network
- uuto – public UNIX-to-UNIX file copy
- uuclean – uucp spool directory clean-up
- uux – UNIX-to-UNIX command execution

Document and Text Preparation

- ed – text editor
- egrep – pattern search for full regular expression
- fgrep – pattern search for fixed strings
- grep – search a file for a pattern
- sed – stream editor
- vi – Univ. of California Berkeley full screen editor
- wc – count lines, words or characters in a file

File access

- cat – concatenate and print files
- cp – copy, link or move files
- lpr – line printer spooler
- pr – print file

System administration and maintenance

- fsck – file system consistency check and interactive repair
- hostname – set hostname for uucp
- install – installs commands
- lsdev – list device drivers in system
- mkdev – make device shell script
- mknod – build special file
- mount – mount and dismount file system
- news – print news items
- osmgr – operating system option and boot area manager
- pm – inquire and/or set code segment attribute
- revision – revision status shell script
- sdfinit – initialize discs with SDF
- setmnt – establish mn ttab table
- shutdown – terminate all processing
- stty – set options for terminal
- su – request "super-user" access
- sync – update the super block

- tabs – set tabs on terminal
- uconfig – set system configuration
- umount – unmount a file system
- wall – write to all users

Miscellaneous file tools

- cmp – compare two files
- diff – differential file comparator
- sort – file merge and/or sort

System status

- date – print and set date
- df – report number of free disc blocks
- du – summarize disc usage
- file – determine file type
- id – print user and group identification
- logname – report login name
- ls – list directory contents (Berkely implementation)
- ps – report process status
- pwd – report working directory
- tty – get terminal's name
- uname – print name of current HP-UX revision
- who – report names of all users logged in
- whodo – which users are doing what

System Intrinsic

- access – determine if a file is accessible
- alarm – set a process's alarm clock
- brk – change data segment space allocation
- chdir – change working directory
- chmod – change mode of a file
- chown – change file's owner/group
- chroot – change root directory
- close – close file descriptor
- creat – create or rewrite a file
- dup – duplicate an open file descriptor
- exec – execute a file
- exit – terminate a process
- fcntl – file control
- fork – create a new process
- getpid – get process group and parent process ID'S
- getuid – get real and effective user, real and effective group ID's
- ioctl – control device
- kill – send signal to process(es)
- link – create a link between a file and a directory
- lseek – move read/write file pointer
- mknod – make a directory, or a special or ordinary file
- mount – mount a file system
- nice – change process priority
- open – open a file for reading or writing
- pause – suspend process until signaled

* These commands are available only with the HP 97076A HP-UX Asynchronous Terminal Emulator.

HP-UX Languages

pipe – create interprocess data channel
read – read from file
setgid – set group identification
setpgid – set process group identification
setuid – set user identification
signal – specify action to be taken when signaled
stat – get file status
stime – set time
sync – update super block
time – get time
times – get a program's process time
ulimit – get and set user limits
umask – get and set file creation mask
umount – unmount a file system
uname – identify name of current HP-UX revision
unlink – remove directory entry
ustat – get file system statistics
utime – set file access and modification times
wait – wait for process to terminate
write – write on a file

HP-UX features two of the most popular languages in the scientific computing world today: FORTRAN 77 and Pascal. And because all these languages, libraries and extensions are linkable at the object level, the programmer is free to mix the computational power of FORTRAN with the structured methodology of Pascal to produce optimal software solutions. In addition, programs written in either of these languages can access all HP-UX system intrinsics and other libraries.

HP 9000 FORTRAN 77

The HP 9000's FORTRAN 77 compiler is a super-set of the ANSI X3.9-1978 FORTRAN standard. This compiler is designed to provide a well-defined language standard for software portability and to feature extensions that enhance the flexibility and power of the FORTRAN 77 language. The result is a modern programming language for the engineer that allows for growth on the large base of available FORTRAN 77 software.

Features

- Complete ANSI 77 FORTRAN implementation with MIL-STD-1753 extensions
- Virtual address space for up to 500 Mbytes of data
- Supports recursion and generation of re-entrant code
- Extended FORTRAN features
- Support of all HP-UX system calls, GRAPHICS/9000 and IMAGE Data Base Management.

Below is a summary of some of the major improvements added to FORTRAN 77 since the ANSI 66 standard.

Program Control

The IF THEN ELSE construct. This feature will improve the structure and readability of code. The ELSEIF and ENDIF keywords permit the object of a conditional statement to be a block of statements rather than just one statement.

Alternate entry points and returns. This feature allows multiple entry points for functions and subroutines. Permits graceful error handling.

DO loops with more flexibility and efficiency. The trip count is computed and tested before loop execution which allows zero-trip loops. Also, the loop index can be of integer, real or double precision data type.

Data Manipulation

The CHARACTER data type. This type replaces Hollerith constants and offers easy manipulation of character string literals and variables. Related to this new data type is the ability to concatenate strings.

Variable array dimensions. This allows the upper and lower bounds of arrays to be computed at run-time from parameters and COMMON variables. Improves the flexibility and modularity of application software.

General-Purpose I/O

Direct access I/O. Allows data to be accessed quickly by referencing a record number.

List-directed I/O. Programs can input and output data using "free-field" format. The compiler will automatically select the proper format for the data.

HP-UX Extensions to FORTRAN 77

- The INCLUDE Keyword allows the inclusion of source code text from other files.
- Short logical, short integer and double complex data types.
- DO WHILE-END DO construct for program looping (MIL-STD-1753 extension).
- The ONETRIP compiler directive executes ANSI 66-type, one-trip DO loops.
- The ability for CHARACTER data types to be equated to non-character data types.
- Implicit and explicit recursion.
- Arrays with up to 32767 dimensions.
- HP FORTRAN 77 continues support of Hollerith constants.
- An ANSI directive that flags any program construct in violation of the FORTRAN 77 standard.

HP-UX Compatibility With ANSI 66 FORTRAN

Although HP FORTRAN 77 is not fully compatible with ANSI 66 FORTRAN and the HP 1000's FORTRAN 4X, most existing programs should port with only minor alterations. The ONETRIP directive and the support of Hollerith constants are helpful in porting existing FORTRAN code. Known incompatibilities between FORTRAN 77 and FORTRAN 66 are listed below:

1. While passing FORTRAN system intrinsics between subroutines, FORTRAN 77 requires that the INTRINSIC keyword be used instead of the EXTERNAL keyword.
2. FORTRAN 77 prohibits FORTRAN 66's extended-range DO loops. This is the condition in which program control can leave an active DO loop and return at a later time.

HP-UX FORTRAN Specifications

Keywords

ASSIGN	END DO	OPEN
BACKSPACE	END IF	PARAMETER
BLOCK DATA	ENDFILE	PAUSE
CALL	ENTRY	PRINT
CHARACTER	EQUIVALENCE	PROGRAM
CLOSE	EXTERNAL	READ
COMMON	FORMAT	REAL
COMPLEX	FUNCTION	RETURN
CONTINUE	GO TO	REWIND
DOUBLE COMPLEX	IF	SAVE
DOUBLE PRECISION	IMPLICIT	STOP
DATA	INCLUDE	SUBROUTINE
DIMENSION	INQUIRE	TO

DO	INTEGER	THEN
ELSE	INTRINSIC	WHILE
ELSE IF	LOGICAL	WRITE
END	NONE	

Data Types

Type	Bits	Signif. Digits	Range
Integer	32	9	-2^{31} to $2^{31} - 1$
Short Integer	16	5	-32768 to 32767
Real	32	7	1.2×10^{-38} to 3.4×10^{38}
Double Precision	64	15 - 16	2.2×10^{-308} to 1.8×10^{308}
Complex*	32	7	1.2×10^{-38} to 3.4×10^{38}
Double Complex*	64	15 - 16	2.2×10^{-308} to 1.8×10^{308}
Logical	32	—	.TRUE., .FALSE.
Short Logical	16	—	.TRUE., .FALSE.
Character	8	—	Up to 2^{31} characters/string
Hollerith	8	—	8-bit ASCII characters

* Complex variables have an element of the described precision for both the real and imaginary part.

HP-UX FORTRAN 77 Intrinsics

Conversions

INT* - conversion to integer
REAL* - conversion to real
DBLE - conversion to double precision
CMPLX - conversion to complex
DCMPLX - conversion to double complex
ICHAR - character to integer conversion
CHAR - integer to character conversion

Truncation and Rounding

AINT* - truncate real
ANINT* - round to nearest whole number

Numerical Manipulation and Representation

ABS* - absolute value
MOD* - divide and save remainder
SIGN* - transfer of sign
DIM* - absolute difference
DPROD - double precision product
MAX* - choose maximum
MIN* - choose minimum
SQRT* - square root function
EXP* - exponential function
LOG* - logarithm function
LOG10* - base 10 logarithmic function

Character Strings

LEN - determine number of characters in string
INDEX - find location of substring within string

Complex Number Manipulation

AIMAG - magnitude of imaginary part
CONJG - determine conjugate

Trigonometric Functions

SIN* – sin function
COS* – cos function
TAN* – tangent function
ASIN* – arcsin function
ACOS* – arccos function
ATAN* – arctangent function
ATAN2* – arctangent of a quotient function
SINH* – hyperbolic sin function
COSH* – hyperbolic cos function
TANH* – hyperbolic tangent function

Lexical Comparisons and Bit Manipulation

LGE – true if greater than or equal†
LGT – true if greater than†
LLE – true if less than or equal†
LLT – true if less than†
IAND – bitwise AND
IOR – bitwise OR
IEOR – bitwise exclusive OR
NOT – bitwise NOT
ISHFT – bitwise shift
ISHFTC – bitwise shift and rotate
IBITS – extract bits
MVBITS – move a bit field
BTEST – bit test
IBSET – set bit
IBCLR – clear bit

Compiler Directives

ALIAS – change external name
INCLUDE – include source text from other files
EMA – allocate storage in virtual memory
SUBTITLE – specify subtitle heading of listing
TITLE – title heading of listing
OPTION LIST – generate program listing
PAGE – generate form feed on listing device
OPTION ANSI – flag use of non-ANSI features
OPTION LINES – control number of lines per page on listing
OPTION LONG – change default on INTEGER and LOGICAL data types to 32 bits
OPTION SHORT – change default on INTEGER and LOGICAL data types to 16 bits
OPTION SYMTABLE – generate symbol table listing
OPTION CODE – enables or inhibits generation of object code
OPTION CROSSREF – generate cross reference listing
OPTION ONETRIP – execute DO loops at least once, as per ANSI 66
OPTION RANGE – enable range checking on subscripts and substring indices

* Denotes a generic name. HP-UX FORTRAN also supports more specific intrinsic names which will operate on specific argument and function data types.

† These functions use character data types for arguments. Comparisons are based on a Standard ASCII collating sequence.

OPTION WARNINGS – enables or inhibits listing of warnings

HP 9000 Pascal

HP Pascal is the HP 9000's software tool for structured application software. Pascal has gained wide acceptance among software professionals as a block-structured, strongly typed language that produces easily read source code. Because it is such a simple and concise language, Pascal is recognized as highly portable and easily learned. HP Pascal complies with the proposed ANSI Pascal Language Standard, but is richly enhanced with HP extensions to improve flexibility in data manipulation and I/O.

Features

- A versatile and concise set of program control statements that can be easily applied to modern programming methodology.
- Strong-typing. The requirement that all program objects be declared plus the programmer's ability to declare his own data types results in early detection of program errors and self-documented code.
- Virtual address space for up to 500 Mbytes of data.
- Support of all HP-UX system intrinsics, GRAPHICS/9000 and IMAGE Data Base Management.

HP-UX Extensions to Proposed ANSI Pascal

- HP Pascal supports separate compilation. A programmer can link previously compiled routines into a new program without re-compiling those routines.
- Structured constants offer easy initialization of arrays, records and sets.
- A double-precision real data type.
- Random-access I/O for all files (except text files).
- Functions can return any data type except for files and types containing files.
- The CASE statement supports subrange labels and utilizes the OTHERWISE statement to provide a default clause.
- The MARK and RELEASE procedures provide efficient, dynamic memory management of heap data structures.
- HP Pascal supports identifiers up to source line in length and any mixture of upper and lower case characters to more clearly document code.

HP Pascal Compatibility

When considering any Pascal compiler, it is important to realize that Pascal has two components: the language core and the extensions. Throughout the Pascal community there is a high level of portability associated with the language core because most implementations closely follow the proposed ANSI Pascal Standard.

Most compatibility problems emerge from differences in the implemented extensions. The HP implementation of sequential and text file type I/O is compatible with most Pascal compilers. Combined with the language core, this set of features is highly portable. Utilization of additional procedures and extensions affect the portability of code.

Within Hewlett-Packard, there is a standard for Pascal implementation to insure a high level of portability among Hewlett-Packard computers. When considering transportation of Pascal code, however, you must examine the differences between HP Operating Systems and be aware of extensions that are not common to all HP computers.

HP Pascal Specifications

Keywords

AND	END	NIL	REPEAT
ARRAY	FILE	NOT	SET
BEGIN	FOR	OF	THEN
CASE	FUNCTION	OR	TO
CONST	GOTO	OTHERWISE	TYPE
DIV	IF	PACKED	UNTIL
DOWNT0	IN	PROCEDURE	VAR
DO	LABEL	PROGRAM	WHILE
ELSE	MOD	RECORD	WITH

Data Types

Type	Bits	Signif. Digits	Range
Integer	32	9 decimal	-2^{31} to $2^{31}-1$
Real	32	7	1.2×10^{-38} to 3.4×10^{38}
Longreal	64	15 - 16	2.2×10^{-308} to 1.8×10^{308}
Boolean	32	—	true, false
Char	8	—	8-bit ASCII

In addition to these standard data types, users may declare:

- array (normal or packed format)
- record (normal or packed format)
- set

plus file data types comprised of these standard types or enumerate their own data type. In addition, HP Pascal supports text, pointer and subrange data types.

Standard Math and File Functions

abs — absolute value
 sqr — square function
 sqrt — square root function
 exp — exponential function
 ln — natural logarithm
 sin — standard trigonometric function
 cos — standard trigonometric function
 arctan — standard trigonometric function
 odd — boolean test for odd/even integers

trunc — truncate real types
 round — round real types
 hex — convert hexadecimal string to integer
 octal — convert octal string to integer
 bin — convert binary string to integer
 ord — return position in sequence of ordinal set
 chr — return specified expression in ordinal set
 succ — return next member of ordinal set
 pred — return previous member of ordinal set
 eof — end of file predicate
 eoln — end of line predicate
 linepos — returns number of characters read/written since last eoln
 position — returns value of file index pointer
 maxpos — returns file index of last file component

Standard I/O Procedures

put — write file buffer to next file index
 get — read present file index to file buffer
 read — a get which can be used with text
 write — a put which can be used with text
 reset — access sequential file for reading
 rewrite — access sequential file for writing
 append — same as rewrite, but append to end of file
 open — access file in direct-access mode
 close — discontinue file access
 seek — access specified file component
 readdir — equivalent to a seek followed by a read
 writedir — equivalent to a seek followed by a write
 readln — read line from text file
 writeln — write line from text file
 page — generate form feed before writing text
 overprint — causes next line of text to be printed over current one
 prompt — print a line without a carriage return

Standard Allocation Procedures

new — create a new variable and return pointer
 dispose — release storage occupied by specified variable
 mark — store heap state
 release — restore heap to specified state

Standard Control Procedure

halt — abnormal program termination

Compiler Directives

ALIAS — changes a routine's externally referenced name
 ANSI — flags any departures from ANSI Standard Pascal
 AUTOPAGE — form feed at end of each procedure
 CODE_OFFSETS — print code offset table
 IDSIZE — set number of significant characters for identifiers
 INCLUDE — nest an external text file
 LINES — set number of lines printed on page of listing
 LINESIZE — set maximum line length in text files
 LINEINFO — includes each line's scope and nesting level in listing

LIST – generate source listing
PARTIAL_EVAL – suppresses evaluation of the right operand of the AND (OR) operator when the left operand is FALSE (TRUE)
PAGE – generate form feed to listing device
RANGE – enable checking on range of indices, subrange assignments and actual value parameters
STANDARD_LEVEL – sets the level of syntax which the compiler will handle routinely
SUBPROGRAM – designates source segment as subprogram
SUBTITLE – set page subtitle for listing
TABLES – print symbol table
TITLE – set page title for listing
UPSHIFT_LEVEL1 – forces the default names of externals and entry points to be uppercase.
WARN – on or off suppress or list warnings
WIDTH – set number of valid characters on a source line

C Language

The C Language is the HP 9000's system programming tool and a vehicle for transporting software from other UNIX systems. Functionally, C is similar to Pascal from the standpoint of operators and program control statements. C Language features a concise syntax that produces self-documenting code but does not enforce rigid type checking like Pascal. The increased flexibility of the C Language offers system programmers a closer, more efficient interface to the hardware than does Pascal.

C Language Features

- A portable, high-level language with the flexibility and efficiency needed in system programming.
- Virtual address space for up to 500 Mbytes of local code and data.
- Support of all HP-UX system intrinsics, GRAPHICS/9000 and IMAGE Data Base Management.
- HP-UX includes a complete set of standard libraries, compiler pre-processor directives and operators associated with C and UNIX System III.
- An extension (recent C changes) that allows structures to be assigned, passed as arguments to functions and then returned by functions.

C Language Specifications

Keywords

auto	double	int	switch
break	else	long	typedef
case	enum	register	union
char	extern	return	unsigned
continue	float	short	while
default	for	static	
do	goto	struct	
	if		

Data Types

Type	Bits	Signif. Digits	Range
short	16	5	-32768 to 32767
int	32	9	-2^{31} to $2^{31}-1$
float	32	7	1.2×10^{-38} to 3.4×10^{38}
double	64	15	2.2×10^{-308} to 1.8×10^{308}
char	8	—	—
long	32	9	-2^{31} to $2^{31}-1$

HP-UX Engineering Tools

GRAPHICS/9000

The GRAPHICS/9000 family is a set of powerful, flexible tools for display and design graphics. This system consists of two sets of procedure libraries: AGP (Advanced Graphics Package) and DGL (Device-independent Graphics Language) both of which can be called from application programs.

DGL is the foundation of GRAPHICS/9000. It provides fundamental graphics functionality and device support. AGP builds upon DGL, providing similar functionality plus enhanced capabilities. For this reason, you must have DGL to operate AGP.

GRAPHICS/9000 DGL Features

- Device independent graphics input and output for simplified development of graphics applications.
- Graphics workstation capability provides a flexible operator environment without additional programming.
- Output primitives include: Move, Draw, Polyline, Polygon, Hardware Text and Alphanumeric Text.
- Color modeling capability using either Red/Green/Blue (RGB) or Hue/Saturation/Luminosity (HSL) models.
- Efficient design for fast execution.

GRAPHICS/9000 AGP Features

AGP has all DGL features (above) plus:

- ACM SIGGRAPH CORE compatibility.
- Run-time device independence allows concurrent operation of multiple workstations, without re-programming or re-linking an application program.
- Two- or three-dimensional viewing transformations with parallel or perspective projections.
- Picture segment capability for fast, interactive manipulation of graphics images.
- Additional pick input function to allow operator interaction with picture segments.
- Full clipping capability.
- Additional software-generated graphics text with six different fonts.

SIX TEXT FONTS

Roman Simplex

Roman Triplex

Eurostyle

Script

Gothic

αβψΦεθληιθκω

Graphics Workstation

A graphics workstation is a collection of one or more graphic devices which perform an assigned function under the control of DGL or AGP. A workstation may perform the following functions: display, locate, valuate, keyboard input, alphanumeric message handling and picking (AGP only). With DGL and AGP, it is possible for one physical graphics device to assume the role of one or more of these listed functions.

A Workstation Program (WSP) is a program, configured by the user, which serves as the interface to AGP application programs in controlling graphics devices. To create a WSP, the programmer uses the HP-UX linker to select only those device handlers needed by the application. Thus, programmers can preconfigure a set of WSPs to accommodate a variety of hardware configurations. There is no limit on the number of WSPs which can be created.

Device Independence

This feature allows an application program to operate any supported graphics peripheral with little or no application code changes. For DGL, the programmer specifies a single workstation by linking only the desired device handlers with his application program.

The AGP implementation uses HP-UX's support of multi-tasking and interprocess communication to offer concurrent graphics I/O and the ability to select WSPs at run-time. From an application program, up to four workstations can be selected for use. When an application program is run, AGP will automatically load each workstation program into memory for later execution. Graphics I/O is performed by the AGP commands passing messages to the appropriate WSP via HP-UX "pipes" which specify the operation to be performed (see Figure 1).

Additional graphics device support will be added to GRAPHICS/9000 on a continuing basis. Consult your local Hewlett-Packard Sales Office for current graphics peripheral support status.

Picture Segmentation and Picking

AGP contains an internal data base called Segment Display Area (SDA). When AGP output primitives are transformed into display images, users may specify groups of output primitives (called SEGMENTS) to be stored in the SDA. A single image may contain many segments. With AGP, segments may be easily referenced for highlighting or for permanently or temporarily deleting a displayed segment.

AGP supports one level of segmentation which precludes nesting of picture segments. Pick identifiers, however, can be assigned to output primitives within a segment to provide a second level of picture element selection.

To complement picture segmentation, AGP supports interactive picking. When a data tablet or cursor positioning keys are used to point at a segment on a graphic display, AGP returns to the user program the name assigned to the picture segment being pointed to,

as well as the identifier of the nearest output primitive. This saves the programmer from decoding X-Y coordinates to determine which segment or primitives are being selected for editing or highlighting.

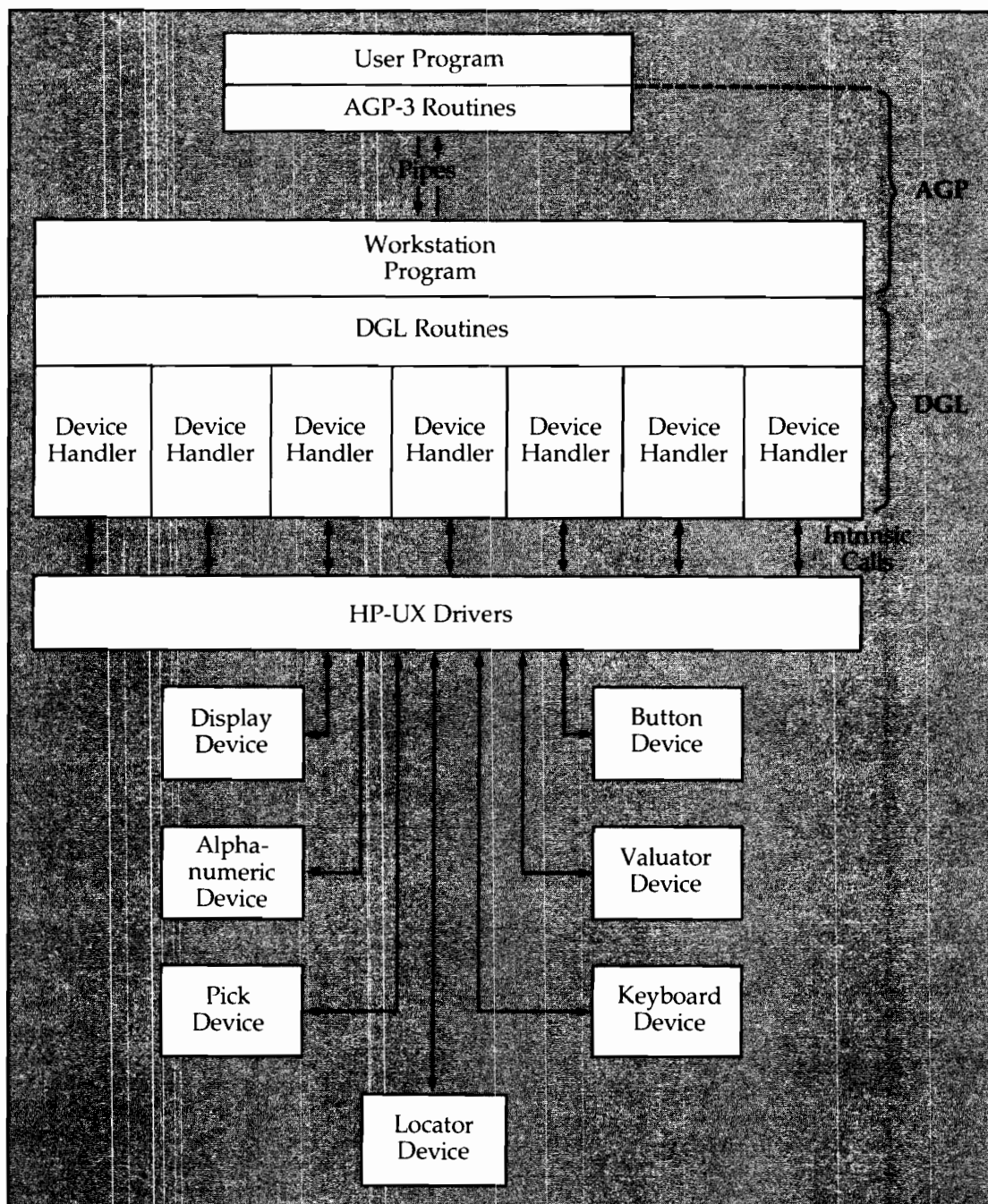


Figure 1. DGL/AGP System Structure

GRAPHICS/9000 Peripherals and Their Supported Functions

	Button	Locator	Valuator	Pick**	Display	Alpha	Keyboard
Input Device							
9111A Data Tablet	Yes	Yes	Yes	Yes	—	—	—
Output Device							
Model 20* Monochromatic Display	—	—	—	—	Yes	Yes	Yes
Model 20* Color Display	—	—	—	—	Yes	Yes	Yes
7470A A-size Plotter	—	Yes	—	—	Yes	—	—
9872C/T B-size Plotter	—	Yes	—	Yes	Yes	—	—
7580A D-size Plotter	—	Yes	—	Yes	Yes	—	—
7585A E-size Plotter	—	Yes	—	Yes	Yes	—	—
Terminals							
*2623A Graphics Terminal	Yes	Yes	Yes	Yes	Yes	Yes	Yes
*2647F Intelligent Graphics Terminal	Yes	Yes	Yes	Yes	Yes	Yes	Yes

* Supports simultaneous display of alphanumerics and graphics.

** Supported by AGP only.

Definitions

Button: A device which returns an integer value.

Locator: A device which returns a point position (x,y).

Valuator: A device which returns a real number value.

Pick: A device with the capability to select a picture segment (AGP only).

Display: A device which can visually represent output primitives.

Alpha: A device which can display alphanumeric messages.

Keyboard: A device which returns alpha numeric strings.

The DGL Library

SET_COLOR_MODEL – set color model

SET_COLOR_TABLE – set color table

SET_PGN_STYLE – set polygon style

SET_PGN_L_STYLE – set polygon style

SET_PGN_TABLE – set polygon table

INQ_COLOR_TABLE – inquire color table

INQ_PGN_TABLE – inquire polygon table

GALPHA – send text string to alpha display

LINE – draw line on display

MARKER – draw marker on display

MOVE – set starting position

POLYGON – draw polygon on display

GTEXT – draw graphics text

SET_COLOR – set color attribute

SET_CHAR_SIZE – set character size attribute

SET_HIGHLIGHT – set highlight attribute

SET_LINE_STYLE – set linestyle attribute

SET_LINE_WIDTH – set linewidth attribute

AWAIT_BUTTON – await button press

AWAIT_KEYBOARD – await entry from keyboard

SAMPLE_LOCATOR – sample locator

SAMPLE_VALUATOR – sample valuator

AWAIT_LOCATOR – await operator response from locator

AWAIT_VALUATOR – await operator response from valuator

ALPHA_TERM – disable alphanumeric device

ALPHA_INIT – enable alphanumeric device

GRAPHICS_INIT – initialize DGL system

BUTTON_TERM – disable button device

BUTTON_INIT – enable button device

SET_TIMING – set the batching mode

DISPLAY_TERM – disable graphic display

DISPLAY_INIT – enable graphic display

GRAPHICS_TERM – terminate DGL

KEYBOARD_TERM – disable keyboard

KEYBOARD_INIT – enable keyboard

LOCATOR_TERM – disable locator device

LOCATOR_INIT – enable locator device

SET_ECHO_POS – define locator echo position

MAKE_PIC_CURRENT – make picture current

CLEAR_DISPLAY – initiate new display frame

VALUATOR_TERM – disable valuator device

VALUATOR_INIT – enable valuator device

SET_ASPECT – define aspect ratio of coordinate system

SET_DISPLAY_LIM – define logical limits of display

CONVERT_VTODMM – convert world coordinates to millimeters on display

SET_LOCATOR_LIM – define logical limits of locator

CONVERT_VTOLMM – convert world coordinates to millimeters of locator

SET_VIEWPORT – define viewport boundaries

SET_WINDOW – define window boundaries

INQ_ACSIZE – return character size on display

INQ_WS – return DGL status

INPUT_ESC – perform device-dependent inquiry to display

OUTPUT_ESC – perform device-dependent output to display

The AGP Library

LINE_ABS n – draw absolute positioned line
MOVE_ABS n – set current position to absolute location
MARKER_ABS n – draw absolute positioned marker
POLYGON_REL n – draw relative positioned polygon.
POLYLINE_ABS n – draw absolute positioned polyline
POLYGON_ABS n – draw absolute positioned polygon
LINE_REL n – draw relative positioned line
MARKER_REL n – draw relative positioned marker
MOVE_REL n – set current position to relative location
POLYLINE_REL n – draw relative positioned polyline
TEXT_HIGH – write high-quality text from software
TEXT_LOW – write low-quality text from hardware
TEXT_MEDIUM – write medium-quality text from hardware

Note: for n in above commands, substitute 2 for 2D graphics or 3 for 3D graphics

SET_PGN_TABLE – set polygon table
SET_PGN_STYLE – set polygon style
SET_PGN_COLOR – set polygon color
INQ_PGN_TABLE – inquire polygon table
SET_COLOR_MODEL – set color model
SET_COLOR_TABLE – set color table
INQ_COLOR_TABLE – inquire color table
SET_PGN_L_STYLE – set polygon line style
SET_COLOR – set color attribute
SET_CHAR_ORIENT – set character orientation
SET_CHAR_SIZE – set character size attribute
SET_FONT_SOURCE – assign font number to font file
SET_FONT – select character font for writing
SET_TEXT_JUST – specify text justification
SET_LINE_STYLE – set linestyle attribute
SET_LINE_WIDTH – set line width attribute
SET_PICK_ID – set id to object within picture segment
CLOSE_SEG – close a picture segment
CLEAR_WS – clear all segments from system and display
OPEN_SEG – create a new picture segment
PURGE_SEG – purge a picture segment
RENAME_SEG – rename a picture segment
SET_GLOBAL_DET – insert interactive picking information for new segments
SET_GLOBAL_HIGH – set detectability attribute for picture segments
SET_GLOBAL_VIS – set visibility attribute for picture segments
SET_SEG_DET – set detectability attribute for existing segment
SET_SEG_HIGH – set highlight attribute for existing segment
SET_SEG_VIS – set visibility attribute for existing segment
SET_ALL_SEG_VIS – controls visibility for all existing segments
SET_ASPECT – set aspect ratio of coordinate system

SET_DEPTH_CLIP – set hither and yon (depth) clipping
SET_WINDOW_CLIP – set window clipping
SET_MODELING – select 4x4 object modeling matrix
SET_DISPLAY_LIM – set logical limits of display
SET_MODEL_MATRIX – define a 4x4 modeling matrix
CONVERT_VTODMM – convert virtual coordinates to millimeters on display
SET_DEPTH_PLANES – define hither and yon clipping planes
SET_HAND – define world coordinates to right or left handed
SET_LOCATOR_LIM – set logical limits of locator device
SET_ECHO_POS – set locator reference position
CONVERT_VTOLMM – convert virtual coordinates to millimeters on locator
SET_PICK_LIM – set limits of pick device
CONVERT_VTOPMM – convert virtual coordinates to millimeters on pick device
SET_PROJ_TYPE – select 3D projection type
RESET_VIEWING – reset viewing transformation parameters
SET_VIEW_DIST – set distance from view reference to view plane
SET_VIEWPORT – define 2D viewport
SET_VIEWPLANE – define viewport orientation
SET_VIEWPOINT – define view reference point (world coordinates)
CONVERT_WTOV – convert world point to virtual coordinates
CONVERT_VTOW – convert virtual point to world coordinates
SET_WINDOW – define viewplane clipping window boundaries
INQ_CP – return current position in world coordinates
INQ_MODEL_MATRIX – returns current 4x4 modeling matrix
INQ_n_REAL – return n real variable with state information of graphics system
INQ_SEG_ATTR – return picture segment attributes
INQ_SEG_TO_WS – return workstation names that a picture segment is bound to
INQ_TEXT_SIZE – return size of text string
INQ_FROM_WS – return workstation status
INQ_WINDOW – return 3D untransformed coordinates of viewplane clipping window
INPUT_ESC – perform device-dependent inquiry from display
OUTPUT_ESC – perform device-dependent output to display
AWAIT_BUTTON – await button press
AWAIT_KEYBOARD – await keyboard entry
AWAIT_PICK – invoke logical pick input function
SET_P_ECHO_POS – set pick position on display
SAMPLE_LOCATOR – sample locator
SAMPLE_VALUATOR – sample valuator

AWAIT_LOCATOR – await operator response from locator
 AWAIT_VALUATOR – await operator response from valuator
 GALPHA – send text string to alpha display
 START_B_OF_U – send batch of updates to display
 GRAPHICS_INIT – initialize graphics system
 DEVICE_TERM – disable non-display device
 WS_INIT – initialize graphics workstation
 DEVICE_INIT – enable logical device
 GRAPHICS_TERM – terminate the graphic system
 INQ_LAST_ERROR – return an AGP-3 error
 SET_LV_OFF – ends immediate-visibility batch mode
 SET_LV_ON – set batching mode for immediate-visibility
 MAKE_PIC_CURRENT – update display
 NEW_FRAME_ACTION – initiate new output frame
 SET_ERR_REPORT – set error reporting level
 END_B_OF_U – ends START_B_OF_U operation and updates images
 WS_TERM – terminate workstation
 WS_DISABLE – disable graphics output
 INQ_1_INTEGER – returns one integer with information on state of graphics system
 WS_ENABLE – enable graphics output

HP-UX IMAGE Data Base Management

For data base management, HP 9000 HP-UX supports the same IMAGE Data Base Management package that has become popular with the HP 3000, HP 1000, HP 250 and HP 9845 computer families. IMAGE implements both networked and hierarchical data structures. It consists of two levels of data objects and uses a path-oriented or chained approach to data retrieval.

The first level is comprised of master data sets which define and store a search or key item to access data in the master data set or a detail data set. Detailed data sets are the second level of objects and are used strictly to store data.

IMAGE offers statements to create and maintain data bases as well as access a data base for information update and retrieval.

Modes of Operation

IMAGE's DBOPEN command lets the programmer choose between an exclusive or shared mode of operation. Exclusive mode permits the user to request exclusive access to the whole data base. Shared mode permits the user to gain access to a list of specified data sets through a locking mechanism. Shared mode is useful when you want multiple programs in separate partitions to access a common data base concurrently.

IMAGE is able to limit user access to the data base and data sets by the use of passwords. There are 13 passwords available for assignment to each data base.

Each password can be assigned to multiple data sets and a user may gain access to the data sets if he knows the password associated with that set. Once a user has gained access to a data set, he has access to all data items within that set.

To retrieve data, IMAGE supports four classes of access methods:

- Serial – A sequential progression forward or backward through a data set.
- Direct – Immediate access to any user-specified record number.
- Calculated – IMAGE supports a hashing algorithm that allows a record to be calculated directly from the key item value, rather than through search.
- Chained – A progression that uses linked lists to step forward or backward through a data set.

One of IMAGE's key features is the simplicity and power of the programmer interface. The following data base definition and design tools highlight this simple interface.

Codes – This lets the user declare his own item type and specify a set of strings that describe the range of values allowed. For example, an item called "color" could have the range red, blue or green.

Ranges – You can define a minimum, maximum and default value for any numeric item. The values are available to your program via a DBINFO request.

Pseudonyms – This feature lets you assign up to four names for one data item. This allows searching of a data base by specifying abbreviated field names.

Utilities – Included with IMAGE is a set of utility commands to help manage the data base. These commands can create and initialize data sets, purge data sets, erase all or part of a data set or extend the capacity of a data set.

HP 9000 IMAGE Specifications

Data Bases

Data sets/data base	63
Max. number of volumes	20
Max. data base size	Limited by media

Data Sets

Number of entries/data set	$2^{31} - 1$ constrained only by physical volume. Note: data sets cannot span volumes.
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Detailed data sets/master key	31
Keys/detail data set	31

Data Items

Items/data base	1023
Items/data entry	1023



Item Types

I2	2 byte integer
I4	4 byte integer
R4	4 byte floating point number
R8	8 byte floating point number
Xnn	nn byte character string
C2	Code (enumerated type)

The HP 9000 IMAGE Library

dbcreate – create and initialize data set
 dberase – delete all data entries in a data set
 dbpurge – purge data set
 dbextend – extend capacity of data set
 dbopen – request access to data base
 dbclose – terminate access to data base
 dblock – initiate exclusive access
 dbunlock – terminate exclusive access
 dbinfo – request data base status
 dbput – add entry to a master or a detail data set
 dbfind – build current search item chain
 dbget – retrieve data values for specified data entry
 dbdelete – delete an entry from master or detailed data set
 dbupdate – modify an entry in a master or detailed data set
 dbcontrol – controls mode in which buffers are transferred to data base

HP-UX Asynchronous Communications Software

Two terminal emulators are included in the HP 97076A HP-UX Asynchronous Communications Software. A general purpose emulator (aterm) allows communication with any remote system that supports logon, asynchronous, ASCII terminals. A specialized UNIX terminal emulator (cu) is useful for communicating with other computers with UNIX or HP-UX operating systems.

In addition to the terminal emulators, the software package includes the UNIX uucp and uux commands. Both are useful when communicating with UNIX- or HP-UX-based systems. The uucp command features convenient file transfers; uux allows remote command execution. The uucp command also works with the mail command to allow sending mail to a user on another computer.

Features

- 50 to 19200 baud data rates.
- Full duplex modem control with either line character mode.
- Supports ENQ/ACK and X-ON/X-OFF protocols.
- Provides file up-load and down-load capabilities which can be executed in background.

- Easily configurable for most manufacturer's computers.
- Support of the UNIX uucp, uux and cu commands for communication to other UNIX features.

Supported Peripherals

External Peripherals

	Model 20	Models 30 and 40
Mass Storage		
7908P	Yes	Yes
7911P	Yes	Yes
7912P	Yes	Yes
7933H	Yes**	Yes**
9895A	Yes	Yes
82901M	Yes	Yes
82902M	Yes	Yes
7971A	Yes	Yes
Printers		
2631B/G	Yes	Yes
2608S†	Yes	Yes
Plotters		
7470A*	Yes	Yes
9872C/T	Yes	Yes
7580A	Yes	Yes
7585A	Yes	Yes
Graphics Input		
9111A	Yes	Yes
Terminals		
2622A	Yes	Yes
2623A	Yes	Yes
2626A	No	Yes
2647F	No	Yes

* Requires 9/82 plotter firmware revision, check with your local Hewlett-Packard Sales Office.

** Requires in addition a 7908, 7911 or 7912 for initial system boot and updates.

† No graphics support.

Model 20 Internal Peripherals

With all Model 20 configurations, the 5 1/4 inch flexible disc drive is supported as a secondary mass storage device. The 10 Mbyte fixed disc is supported as a primary local mass storage device for HP-UX. For performance and ease of system backup, however, it is recommended that HP-UX users use a 7908P, 7911P or 7912P external disc with the HP 9000 Model 20.

The optional internal thermal printer offered on the Model 20 is also supported on HP-UX.

All Model 20 displays are supported. HP-UX does not support the Model 20 Light Pen or soft keys.

Manuals

HP-UX Reference Manual
(prelim.) 97089-90002
FORTRAN/9000 Reference 5955-8845
Pascal/90000 Reference 5955-8846
The C Programming
Language (Kernighan &
Ritchie) 97089-90000
A User Guide to the UNIX
System (Thomas &
Yates) 97089-90001
GRAPHICS/9000 AGP
User's Guide 97085-90000
GRAPHICS/9000 DGL
Programmer's Reference 97084-90000

GRAPHICS/9000 AGP
Reference 97085-90005
GRAPHICS/9000 Device
Handler's Manual 97085-90025
IMAGE Data Base
Programming 97053-90000
Techniques

Training

Introduction to HP-UX (3
days) 97006A
Advanced HP-UX (2 days) 97007A

HP-UX Ordering Information

Model No.	Single-user Prod. No.	Multi-user* Prod. No.	Description
All 9020 9030A, 9040A, S	97079A 97070A	97089A 97080A	HP-UX Operating System HP-UX Operating System
Optional:	97071A 97072A 97073A 97074A 97075A 97076A	97081A 97082A 97083A 97084A 97085A 97076A	FORTTRAN 77 Compiler HP Pascal Compiler IMAGE DBM GRAPHICS/9000 (DGL) GRAPHICS/9000 (AGP) Asynchronous Communications Software
			Distribution Media options for above: Opt. 042 5¼" Flexible Disc Opt. 022 ¼" Tape Cartridge

* Single-user software will not execute on multi-user operating systems.