



The AT&T UNIX PC

This micro-
powerhouse
incorporates
mouse,
windows,
and a 10-MHz
CPU with
UNIX multi-
tasking
capability

BY
ALASTAIR J. W. MAYER

The AT&T UNIX PC is a rugged machine that is ideal for both business users and software developers. It is significant that AT&T changed the name of this machine from the PC 7300 to the UNIX PC shortly before its introduction. This computer is clearly intended to bring the power of UNIX to the personal computer market, and a multitasking operating system like UNIX is needed to take full advantage of all the features built into this machine.

The windowing, mouse-driven, pop-up menu "shell" provides a comfortable user interface to the underlying UNIX System V operating system. The built-in telephone subsystem, consisting of a 1200-bps auto-dial/auto-answer modem plus a voice line and telephone manager software, makes this an ideal office computer for anyone who does a lot of work over the telephone.

The UNIX PC has a built-in hard disk, serial port, and parallel (Centronics) printer port, and it uses the powerful Motorola 68010 processor (an enhanced version of the 68000), which can access up to 4 megabytes of virtual memory. Add to this the battery-backed real-time clock, the 720 by 348 bit-mapped display, 103-key keyboard, and three-button mouse, and you have a very impressive package. (See photo 1.)

DISPLAY

The AT&T UNIX PC features a built-in green monitor on a tilt-and-swivel mount. This display is bit-mapped to 720 by 348 pixels, or 29 lines of 80 characters in the default character set. (See photo 2.)

Some of these 29 lines are usually reserved for operating system or application program use. Line 1, at the top of the screen, displays the status of the two phone lines, the current date and time, and a notice area for icons indicating electronic mail, system messages, and access to the window manager.

The two bottom lines display a graphic

representation of the eight function keys at the top of the keyboard, to provide for dynamic labeling of these keys. The two lines above that (immediately below the main screen area) are for command entry and message display and also provide space for a "working" icon when the system is busy in response to keyboard or mouse input.

KEYBOARD

The AT&T UNIX PC keyboard has an impressive 103 keys. The basic layout is identical to that of AT&T's 5620 terminal. This is a standard QWERTY layout for the alphanumeric keys, with large Shift keys. There is a separate numeric/cursor keypad on the right, with the cursor keys in an inverted "T" arrangement.

Eight slightly oversize function keys are arrayed along the top of the keyboard in a 3-2-3 arrangement. This layout makes it easy to match the keys with the labels displayed in a similar 3-2-3 format at the bottom of the screen.

The Control keys are situated on either side of the space bar. This arrangement is convenient if you need to frequently key different control codes, but I found it almost impossible to do the one-handed Ctrl-S/Ctrl-Q (XOFF/XON) sequence that I often use when browsing through a file.

There are also 14 keys, marked for use with the Wang-like word-processing software, that are arranged in a double vertical row down the left side of the keyboard. The noncursor keys (when Num Lock is off) and 9 other keys grouped above the numeric keypad are used for a variety of system-control functions, including window paging and scrolling, duplicating the mouse buttons, screen printing, and for calling the help function.

The keyboard gives the same tactile sensation that people like in the IBM PC keyboard, but without the "ka-chunk" sound. The Caps Lock and Num Lock keys incorporate LEDs to indicate when those fea-

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tures are active. Overall, it's a well-designed and pleasant keyboard to use.

MOUSE

The AT&T UNIX PC's three-button mouse is a compact, low-profile item, a little larger than the Mac's. The three buttons are usually configured as select, mark (for later selection) and pop-menu. (With the three-button mouse, there is no need to double-click.)

The AT&T mouse uses the same inverted-trackball technology as the Macintosh (as opposed to optical sensors), but I felt its response was more positive than the Mac's.

While the UNIX PC has excellent monochrome graphics capability, it does not come with a program like MacPaint, so I was unable to try my hand at sketching with this mouse. However, C library routines that interface the mouse and the graphics screen are included with the optional AT&T UNIX utilities package, so I expect that someone will create such a program soon.

SYSTEM BOARD

The UNIX PC is built around a single large (18 by 18 inches) printed circuit board, designed to AT&T specifications by Convergent Technologies, makers of the UNIX-based Mini Frame Plus and Megafame supermicros.

Contrary to rumor, though, the UNIX PC motherboard is not a slightly modified Mini Frame Plus motherboard. However, it is likely that some of the circuitry is similar. Features unique to the UNIX PC system board include the telephone line-control circuits, a 1200-bps modem, and a gate-array chip that controls the video display. Also on this board is the main processor (a Motorola 68010 32-/16-bit microprocessor that runs at 10 MHz), as well as 512K bytes of RAM and (virtual) memory-management hardware. (Since the RAM chips used are only 64K-bit types, the potential exists for future upgrades to 2 megabytes of on-board memory using 256K-bit chips.)

Onboard peripheral support includes the

controllers for both the floppy and the hard disk, control chips for the RS-232C serial and Centronics-compatible parallel ports, and the connector to the expansion backplane.

The system I used had an additional 512K-byte RAM board plugged into one of the three expansion slots in the backplane.

DISK DRIVES

UNIX is a disk-intensive operating system that requires fast drives and plentiful disk space. The basic UNIX PC comes with a fast 10-megabyte hard disk and 320K-byte floppy. The speed of the hard disk is reflected in the benchmark results in tables 1 and 2.

The hard disk supports virtual memory and program swapping, as well as storing the large collection of UNIX tool and utility programs supplied. Software developers

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Photo 1: The AT&T UNIX PC showing tilt-and-swivel display, keyboard (not extended; disk drives are covered by the keyboard in this photo), and the three-button mouse.

Table 1: Results of UNIX benchmarks for the AT&T UNIX PC and some comparison machines.

Machine	UNIX version	System time in seconds											
		Pipe			System Call			Function Call					
		real	user	system	real	user	system	real	user	system	real	user	system
VAX-11/780	4.1 BSD	3.2	0.1	1.2	4.8	1.4	4.0	1.0					
AT&T UNIX PC	System V	4.2	0.0	1.6	8.1	0.2	7.5	0.7					
IBM PC XT	PC/IX	16.6	0.1	7.6	39.8	2.9	35.6	4.7					
TRS-80 16B	XENIX	8.0	0.1	3.4	15.0	1.5	12.7	1.4					

Machine	UNIX version	Sieve			Write	Read	Shell			Loop		
		real	user	system	real	real	real	user	system	real	user	system
VAX-11/780	4.1 BSD	1.7	1.5	0.1	2.0	8.0	3.3	0.3	1.3	2.6	2.5	0.1
AT&T UNIX PC	System V	2.4	2.1	0.0	3.9	11.6	5.1	0.2	1.2	6.8	6.2	0.1
IBM PC XT	PC/IX	8.2	7.8	0.3	11.6	20.7	8.5	1.1	3.2	32.2	31.5	0.3
TRS-80 16B	XENIX	6.0	4.8	0.3	8.0	22.0	18.0	0.4	2.6	14.0	12.5	0.5

and others who purchase the UNIX utilities package, which includes traditional UNIX text-processing tools as well as the C compiler and library, will find the 10-megabyte hard disk an extremely tight squeeze and should consider the 20-megabyte drive instead. (The disk-formatting routine provides for a 40-megabyte drive.)

The single floppy-disk drive can be used in a number of ways. In AT&T-formatted mode, it gives a 320K-byte "mountable file system." A mountable file system is UNIX terminology for a collection of files and directories that can be "mounted" at any directory branch on the hierarchical UNIX file-system tree, although the usual practice is to mount them at the top or "root" directory to prevent confusion.

The floppy can also be used to make backups of the hard disk in any of several ways: as a structured file system, using ordinary copy commands, or in tar or cpio program formats. Tar, or "tape archive," is a traditional backup program on older systems, while cpio stands for "copy in/out," which is more widely used on UNIX System V systems. UNIX PC users do not need to know these commands; the System Administration menu takes care of such details.

Table 2: Results for the multitasking UNIX benchmark with a variable number of processes.

Machine	UNIX version	System elapsed (real) time in seconds					
		Number of concurrent processes					
		1	2	3	4	5	6
VAX-11/780	4.1 BSD	4.3	5.5	7.8	9.0	11.0	13.8
AT&T UNIX PC	System V	6.3	8.7	12.7	19.2	22.8	29.8
TRS-80 16B	XENIX	20.0	24.5	33.0	56.5	1:10.5	1:39.3
IBM PC XT	PC/IX	10.6	23.4	42.8	1:14.1	1:24.2	2:10.7

System Configuration

VAX-11/780 4-megabyte RAM, two 256-megabyte disks
 AT&T UNIX PC 1-megabyte RAM, one 10-megabyte disk
 IBM PC XT 512K-byte RAM, one 10-megabyte disk
 TRS-80 16B 384K-byte RAM, one 15-megabyte disk

(Note: All figures for tables 1 and 2, except those for the AT&T UNIX PC, are taken from "Benchmarking UNIX Systems" by David F. Hinnant, August 1984 BYTE, page 132. See the "At a Glance" box for details.)

AT&T has provided a feature that is almost a must in today's MS-DOS-dominated market, that is, the ability to read MS-DOS-formatted floppies. Since this computer is 68000-based, it will not run MS-DOS, which is tied to the Intel 8088/8086 chips. However, MS-DOS data files, word-processing document files, and program source

can all be transferred to the UNIX PC via special disk-read routines.

Unfortunately, though, I was not happy with the software provided for reading MS-DOS disks. Since MS-DOS floppies are formatted differently from the standard AT&T UNIX PC format (360K instead of 320K), the nor-

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AT A GLANCE

Name

AT&T UNIX PC

Company

AT&T Information Systems
National Sales Center
111 Westwood Place, Suite 300
Brentwood, TN 37027
(800) 247-1212

Components

Processor: Motorola 32-/16-bit
68010

10-MHz clock speed

Main memory: 512 bytes

RAM, expandable to 2

megabytes on-board;
16K bytes EPROM start-up
program

Virtual memory: Custom
memory-management
hardware and Winchester disk
allow a memory address
space of 4 megabytes

Display: 12-inch green-on-
black; 348- by 720-pixel bit-
mapped graphics capability

Keyboard: 103 keys; 8

function keys, numeric

keypad, and 14 multifunction
word-processing keys

Disk storage: Double-sided
5¼-inch floppy stores 320K
bytes in AT&T format, 360K
bytes in MS-DOS format;
Winchester hard disk, in 10-,
20-, and 40-megabyte options

Ports: Standard RS-232C port
configured as DTE (data
terminal equipment),
Centronics-compatible parallel
port, three modular phone
jacks

Software

UNIX System V, version 2
operating system, window
manager, phone manager,
word processor, spreadsheet,
and business graphics
package

Miscellaneous

Clock/calendar, three-button
mouse, three expansion slots,
built-in 300/1200-bps modem

Price

\$5095 with 10-megabyte hard
disk, 512K bytes RAM (UNIX
\$495 extra); \$6590 with UNIX,
20-megabyte hard disk, and 1
megabyte of RAM (includes
512K-byte expansion card)



About the Benchmarks

User time is the amount of time a process spent executing nonprivileged instructions (e.g., arithmetic calculations, sorting, searching, calling user-level functions, and so forth).

System time is the time a process spent executing privileged (kernel) commands (i.e., system calls) plus some system-level overhead (e.g., context switching between processes).

The elapsed time is just that. And it is often not the sum of the user and system times. The majority of missing time is spent waiting for I/O operations to complete, waiting for a signal from another process, sleeping, or being swapped out on disk while another program is running. Note that the UNIX operating system utility `/bin/time filename` counts real time in even second increments and user time in tenth-of-a-second increments. This accounts for some of the apparent inconsistencies in the benchmark timings.

The Pipe benchmark is a measurement of how long it takes to set up a pipe (an I/O channel that is written into by one program and read by another) and pass 0.5 megabyte of data through it.

The System Call benchmark repeatedly queries (25,000 times) the operating system concerning its process identity with the `getpid()` system call. As the program doesn't do much other than system calls, the elapsed time is important here. System time and user time are not very significant in this test.

The Function Call benchmark consists of running two programs, one that uses a function call to accomplish a goal and one that doesn't use the function call for the same goal. The user time of the program not using the function is subtracted from the user time of the program using the function. The difference is function call overhead.

The Sieve benchmark is a test of compiler efficiency and processor throughput and is the time required for one pass through the Sieve of Eratosthenes prime-number generator. System overhead is not very significant in this benchmark.

The Disk Write and Read benchmarks test the random-access disk implementation. Disk Write creates, opens, and writes a 256- by 512-byte file. The Read benchmark reads this file and then removes it.

The Shell benchmark invokes six background processes. The shell statement `wait` causes the shell script to pause until all background processes have terminated. Note that invoking `tst.sh` more than six times may not be possible on some systems if a per-user process limit is defined.

The Loop benchmark tests long integer arithmetic and is almost totally processor-bound.

For more information on benchmarking UNIX systems, see "Benchmarking UNIX Systems" by David F. Hinnant, August 1984 *BYTE*, page 132.

mal device driver has to be bypassed and another used. The UNIX PC Office software comes with a menu-driven program to do just that.

However, I was unable to persuade the software to "mark-for-copying" more than one file at a time, and it was quite tedious to scroll through a list of files on the floppy, select one to be copied, start the copy routine, and, when that had completed, scroll through the list from the beginning again to select the next file. The mouse button that normally allows you to pick several items from a list is apparently ignored in this software, so the process is very time-consuming for multiple files.

For that matter, it was a while before I discovered that the floppy drive is considered another logical unit of the hard disk, rather than a separate device. The same device-driver interface is used for both, in a manner similar to Convergent Technologies' Mini Frame Plus; indeed, the C program file for this interface makes specific mention, in comments, to Mini Frame Plus.

SOFTWARE

As is obvious from its name, the AT&T UNIX PC uses the UNIX operating sys-

tem. The AT&T PC supports full System V UNIX, although the system comes "unbundled." The essential commands and utilities for running and maintaining the system are included, but special-purpose utilities, such as the C compiler, are optional extras.

UNIX is the ideal operating system for a powerful machine like this because it is a multiuser, multitasking operating system. This means that more than one user can use the system at one time (with extra terminals), and that each user may run a number of processes, or tasks, simultaneously.

WINDOW MANAGER

UNIX provides for "shell" programs that reside between the operating system and the user and interpret the user's commands. Users of early "mainframe" versions of UNIX will be familiar with the traditional Bourne shell (named after the author) or perhaps the Berkeley C shell, which are both command-line-oriented.

These users might be a little startled at the windowing or visual shell known internally as "ua" for "user agent" (a multiwindow system like that popularized by the Apple Macintosh) that is the default on the UNIX PC.

Other systems tie this command-interpreter function directly to the operating system kernel, making the command interpreter difficult to change, but in UNIX this shell is always a separate program.

The user agent shell provides pop-up menus and icons for nearly all normal user functions and system administration tasks and can be used with either the mouse or the cursor keys. The windows can be resized, although it seems to take a long time (actually only a second or two) between clicking on the resize icon and waiting for the system to respond with the resize ghost outline. Actually, this is not too surprising since, as mentioned previously, the windowing software is not part of the resident kernel software, as it is on the Macintosh, but a separate program.

Traditional complaints about UNIX being cryptic or terse are generally misdirected. It is a particular shell program that may be terse, not the operating system itself. The windowing shell on the UNIX PC goes a long way to counter such complaints.

The UNIX PC makes more use of text menus rather than the Macintosh-style icons. This is a welcome change, in my opinion, and the menus pop out rather than having to be pulled down with the mouse. (For those who dislike mechanical rodents, the window and menu software can also be used with keyboard and select keys.)

The window manager must first be loaded from disk (the 2-second delay) before resizing can be done. I didn't find this a hardship, as the windowing routines are designed to optimize initial placement and size of windows when they are created. This process can be speeded up by setting the "sticky" bit on the code file for the window manager, a standard UNIX technique for telling the operating system to retain the swap image of the program in the swap area of the disk after the program has finished running. At the next invocation, the program then only has to be swapped back in, which is quite a bit faster than being reloaded. However, if you do this with too many programs, your swap disk rapidly becomes full.

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Photo 2: The AT&T UNIX PC display screen showing two overlapping windows. Status of communications lines is shown at the top left, followed by the internal clock date-and-time display.

*The -S option on the
C compiler produces
Motorola 68000
assembly language,
making the UNIX PC
a true 68000
development system.*

The Bourne shell is available to run "shell scripts" (programs written in the shell command language) or it can be the default shell for those who prefer it. The auxiliary commands most commonly used in shell programming are also included with the system (the looping and branching control structures are built into the shell itself).

APPLICATIONS SOFTWARE

The AT&T UNIX PC comes bundled with three application packages as well as UNIX. These are the Supercomp 20 spreadsheet, the business graphics package, and the word processor. The latter is modeled on word-processing systems like Wang's and makes use of the PC's special word-processing keys, but it can also be used with the mouse for menu selection and text block moves.

To make best use of the word-processing software, you should not use windowing, as the window borders rob you of several screen columns. You can also edit quite easily from the Bourne shell using more conventional UNIX text-processing software, and although the word processor seems adequate, I expect that UNIX old-timers (to whom this machine will greatly appeal) will prefer the traditional UNIX text-processing tools.

The line editor *ed* is included with the basic system, but for the full-screen editor *vi* and the *nroff* formatter, you'll need to get the optional UNIX utilities package. Users with complex word-processing needs may choose to investigate some of the

dedicated third-party word-processing packages, such as Microsoft's Word or Syntactics' CrystalWriter.

Unlike the word processor, the spreadsheet does not work with the mouse, which I thought a little odd, although it works quite well with the cursor keys. Since you need to use the keyboard anyway to enter data in the spreadsheet cells, I didn't find this much of a hardship.

The spreadsheet program seemed very responsive; pressing Enter to update the spreadsheet causes the screen to be rewritten almost instantly. While I found it more than adequate for my needs, I confess I do not use spreadsheets a lot and did not test this program to its limits.

I was more interested in the UNIX PC as a development tool. The business graphics package produces bar charts, line graphs, and pie charts from data developed with the spreadsheet or from any other application. On the high-resolution UNIX PC screen, these graphics were crisp and quickly produced.

What I felt the need for was an option in the graphics package to create a device-independent file for transmission of graphics data to another computer. It would not have been very difficult to have the program output NAPLPS PDIs (picture description instructions) while it created the graphs, and these could be used to send (via electronic mail) the graphs to anyone with a NAPLPS-capable microcomputer.

UNIX UTILITIES PACKAGE

Anyone interested in software development or even just writing an occasional C program on the UNIX PC will need this package. It includes all the commands and utilities normally found on a mini or mainframe UNIX environment. (These utilities are not bundled with the basic PC package.)

The utilities package is a bargain when you consider what you get for \$495: the C preprocessor and compiler; a 68000 assembler; enhanced editors; text-processing software; numerous UNIX utilities; LEX (Lexical Analyzer Generator), a C-program generator; YACC (Yet Another Compiler Compiler), a different C-program

generator; and more.

The software fills over a dozen floppy disks, grouped by function (editing, text processing, program development) so that if you are running with the small (10-megabyte) hard disk, you need not (indeed, cannot) load them all at once.

The software, as distributed, installs itself on the hard disk (this is true of all the AT&T UNIX PC software). This is a straightforward task, invoked from the System Administrator menu. If you are short on disk space, you can clean out what you don't need once everything has been installed. There is also a "de-install" routine with each collection of software that makes it quite easy to remove a whole package should you need the disk space.

The UNIX utilities package is strictly UNIX System V, with a few Berkeley utilities such as *vi*. I found no limitations or restrictions in this software, other than what would be expected of a 10-megabyte disk environment. The -S option on the C compiler produces true Motorola 68000 assembly language, allowing the UNIX PC to be used as a development system for other 68000-based systems that lack suitable compilers.

As a test of the UNIX implementation and the C compiler, I copied the 10,000-line source of the CoSy conferencing system, used for BIX (BYTE Information Exchange), and compiled it. I did not expect any major problems, but I was quite surprised when it compiled perfectly (and very quickly for a microcomputer). The program ran without any problems.

Similarly, the programs in the UNIX benchmark all compiled with no problems, and the benchmark performance is very impressive (see tables 1 and 2).

It is quite easy to create floppy disks in the "self-installing" format that AT&T recommends to developers as a standard. Copies of example shell scripts are included in the system, and the process is quite painless. This self-installation extends beyond merely copying the programs from floppy to hard disk and includes updating the system menus for program selection by mouse. I was able to develop a self-

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Using the phone manager, you can build a telephone directory file, select the appropriate name, and start dialing with a click of the mouse button.

installing CoSy disk (albeit not a complete or polished one) in only a few hours.

The system comes bundled with the UUCP electronic mail software needed to hook into the worldwide network. This same software can be used to exchange files between UNIX PCs, or between the UNIX PC and a mainframe computer.

The UUCP software uses either the built-in serial port or the modem port and runs as a background task while you use the PC for something else (as long as the port is free). The computer can be set up to send or receive files unattended, such as in the middle of the night when the phone rates are lower.

PHONE MANAGER

This is one of the better features of the AT&T UNIX PC. Anyone who feels it is important to keep a record of phone calls will appreciate this feature (especially if time spent on the phone can be considered billable consulting time).

This software is an intimate part of the system, since the UNIX PC's hardware includes built-in telephone jacks for a voice line, a data line, and a telephone. If you only have one telephone line, it can be switched between voice and data. The modem software provides both auto-dial and auto-answer. The voice-line capabilities of this machine are more impressive, though. You can dial (on either line) from the PC's keyboard, or you can build a telephone directory file, select the appropriate name using

the mouse, and start dialing with a simple click of the mouse button.

For each entry in your on-line phone book, there is a work area to take notes (keyed in from the keyboard) during the phone call. The window for this function opens automatically as soon as dialing is finished. The time of the call (both time of day and duration) can also be recorded automatically if you so wish. The telephone manager window pops up automatically whenever an incoming call is detected. You have the choice of creating a new work area for the incoming caller or accessing the old work area (and adding to it) if the caller is already in your phone book.

DOCUMENTATION

The AT&T UNIX PC comes with an impressive shelf of documentation in 9-inch D-ring binders contained in slip boxes. All of the documentation is well written, well laid out, and reasonably straightforward. Some smaller spiral-bound booklets are also included, such as the "Getting Started" guide.

AT&T includes handy reference cards for each of the application programs. *The UNIX System V Programmer's Guide*, familiar to UNIX old-timers, is included with the optional utilities package. (It was the edition number of this manual that UNIX version numbers used to refer to, hence Seventh Edition equals Version 7.) *The UNIX System V Programmer's Guide* pages are organized alphabetically by command, function, or filename, within each of eight logically distinct sections.

CONCLUSION

The AT&T UNIX PC is an excellent machine. It's ruggedly constructed, the keyboard has an excellent layout and a nice feel, and the display screen is easy on the eyes. The display's tilt-and-swivel mounting is a definite plus. The electronics and disk drives seem solid and reliable. I had no problems with either, despite having transported the system between my home and office on the back seat of my car a few times.

The power of the 10-MHz 68010 processor really shows, and the fast

hard-disk drive is well matched to it. Although the machine has virtual memory, I would recommend getting at least 1 megabyte of real RAM (minimum is 512K bytes). Also, since the virtual memory uses a few megabytes of disk space, and the wealth of UNIX utilities and commands takes up a few more, the basic 10-megabyte hard-disk drive fills very quickly. I'd recommend the 20-megabyte drive, or even the 40-megabyte drive, for serious software development.

The built-in 1200-bps modem (in addition to an RS-232C serial port) is another plus, although I was disappointed at the lack of documentation on programmer access to the modem functions.

The software is solid UNIX System V, although many of the utilities are not bundled with the basic package and must be purchased separately. These utilities are a must for any C programming, but the whole utilities package is good value for the money. The windowing software is unique to the UNIX PC and its ease of use (together with the mouse) should put an end to all those nasty (but not entirely untrue) stories about UNIX being terse and cryptic.

The bundled word processor, spreadsheet, and business graphics software are quite usable but may lack some of the power and features of available dedicated third-party software. The electronic mail and telephone manager software (also bundled) are a real plus and make this machine a communications tool as well as just a computer.

The system is readied for multiuser mode by just plugging in a dumb terminal for the other user and runs multiple processes well enough to compare with a VAX.

For the price, you could perhaps have wished for color capabilities as well, but if that would have meant using a slower hard disk, I'll take the fast disk and settle for monochrome.

The standard UNIX System V operating system also makes the AT&T UNIX PC an ideal, relatively low-cost, software development system. Overall, the AT&T UNIX PC is a solid computer with impressive performance. ■