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MULTIPROCESSING

THE AT&T
UNIX PC



THE AT&T UNIX PC

Editor's note: The following is a BYTE product description. It is not a review. We provide an advance look at this new product because we feel it is significant.

THE UNIX OPERATING SYSTEM has been heralded as the answer to many of the problems that face computer users, especially those who need multiuser programs or who need to move a large software system from, say, a microcomputer to a mainframe. But, despite its good features, one fault of UNIX makes many people doubt that it can succeed in a commercial environment: UNIX contains many cryptic commands that must be mastered and remembered to make use of its power (for example, *mv* renames a file, *cat* prints it out, and *ls* gives a catalog of files in your current area).

The AT&T UNIX PC is AT&T Information Systems' attempt to establish UNIX as a standard for the business environment and to challenge IBM's dominance in the office. Its extensive use of windows and a menu-driven "front-end" program called the Office bring most of the power of UNIX to the unskilled user. Its Motorola 68010 processor gives the machine *virtual memory* capabilities—the system appears to software as if it has 4 megabytes of memory, even when it actually has as little as 512K bytes. Its telephone subsystem integrates the computer and the telephone, allowing such functions as computerized logging of phone calls, dialing from a customized directory, and saved, on-screen note taking during calls.

The UNIX PC comes with either a 10- or a 20-megabyte internal hard disk, can support up to two additional users (but without telephone services or multiple windows), and can read IBM PC-DOS data and source-code files. Although the machine has both good design features (it can be used equally well with or without its mouse, for example) and bad ones (windows respond sluggishly to mouse-initiated moves and change-size commands), its base price of \$5590 for the 10-megabyte model (and \$6590 for the 20-megabyte model) makes it a serious candidate for office use or UNIX program development. Buying the unit, however, forces you to cast your lot with the AT&T/UNIX world—AT&T says it has no plans to offer an add-on board that would allow the UNIX PC to run IBM PC programs.

SYSTEM DESCRIPTION

The UNIX PC was designed to AT&T specifications by Convergent Technologies of Santa Clara, California; its characteristics are summarized in the In Brief section on page 100. The AT&T mouse (see photo 1) has three buttons. These mimic the Enter, Cmd, and Mark keys on the keyboard (see photo 2); you can perform

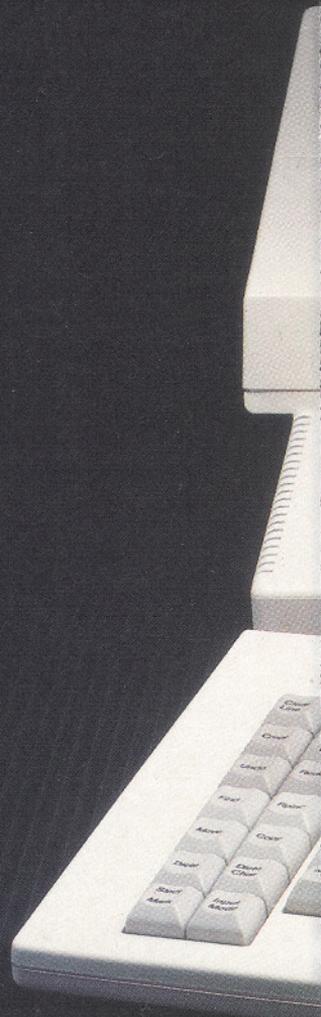
(continued)

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Photo 1:

The AT&T

UNIX PC.



PRODUCT
DESCRIPTION



IN BRIEF

Name

AT&T UNIX PC

Price

\$5095 with 10-megabyte hard disk and 512K bytes of memory (UNIX \$495 extra, for a total of \$5590); \$6590 with UNIX, 20-megabyte hard disk, and 1 megabyte of memory (includes 512K-byte expansion card)

Microprocessor

Motorola 68010, a 32-/16-bit microprocessor (32-bit internal data path and registers, 16-bit external data bus), 24-bit address line (maximum address space of 16 megabytes), support for virtual memory

Clock Speed

10 MHz

Main Memory

512K bytes of dynamic RAM with parity bit on motherboard, currently expandable to 2 megabytes via expansion boards; machine's design allows for a maximum of 4 megabytes

Virtual Memory

Custom memory-management hardware and the Winchester disk allow a virtual memory space of 4 megabytes; page size is 4K bytes

ROM

16K bytes of EPROM used as initialization program when power or reset applied

Floppy Disk

Double-sided 5¼-inch floppy-disk drive using 48 tracks per inch; capable of reading IBM PC data and source-code disks; stores 320K bytes per disk AT&T format, 360K bytes per disk MS-DOS format

Hard Disk

10- or 20-megabyte Winchester disk

Mouse

Three-button optomechanical mouse (needs no special surface)

Video Display

12-inch green-on-black display; displays bit-mapped graphics at resolution of 348 by 720 pixels

Keyboard

Detachable 103-key keyboard

Serial Port

Standard RS-232C port configured as DTE (data terminal equipment); maximum transfer rate of 9600 bps (bits per second)

Parallel Port

Centronics-compatible

Telephone Subsystem

Built-in 300/1200-bps 212A-compatible modem, modular jacks for two incoming phone lines (one voice, one data), one outgoing line connects voice line to external telephone

Miscellaneous

Three expansion slots, battery-powered clock/calendar

Operating System

Custom version of UNIX System V, revision 2; extensions include demand-paging virtual memory, windows, shared function and source libraries, record locking at the character level; software provides for multiple users (up to three, with limitations) and multiple processes executing simultaneously for each user; only selected "core" functions provided with standard product; the rest of UNIX is available in optional AT&T UNIX Utilities package (\$495)

The UNIX PC Office Program

A window- and menu-driven software environment that allows the non-UNIX user access to computer-assisted telephone functions, UNIX functions, and optional application programs

Optional Hardware

512K-byte expansion card, \$1195

most operations with either the mouse or the keyboard. The video display is a bit-mapped display of 348 rows of 720 dots each—or 24 rows of 80 characters each (plus five lines of status information). The top line is a status line for the two phone lines, the time and date, and icons for window management and (if present) pending error messages and mail. The bottom two lines show the current functions of the eight function keys on the keyboard.

The UNIX PC is shipped with all its software already on the hard disk. The floppy-disk drive's odd placement (behind the ledge in which the keyboard fits) reflects the designers' UNIX orientation: Everything you need is on the hard disk. Still, you will use the floppy-disk drive to back up the contents of the hard disk, to install commercial software onto the hard disk, to format a floppy disk for later use, or to read data or source code from an IBM PC disk for use in the UNIX environment.

This system makes considerable use of windows but only occasional use of icons. Windows represent *folders* (which can contain files and other folders), but the UNIX PC represents an item inside a folder as a single line of text—its name, type, and optionally some other information.

THE OFFICE PROGRAM

The Office program is the mechanism through which most users will interact with the UNIX PC. It is a menu-driven "front-end" program that translates your selection to the proper UNIX commands and executes them. Once the Office window has been made active, you can execute an item by highlighting it with the cursor keys and hitting the Return key, by pointing to it with the mouse cursor (which highlights it) and pressing the left mouse button (or, equivalently, the Return key), or by typing enough of the item's name for the software to recognize it (this highlights the item) and hitting Return. When the software needs more information, it opens up another window that contains the additional choices.

The Administration item leads, through additional menus, to 24 operations that must be performed to keep the computer and the part of it you control in order. This includes everything from changing your password, to configuring the parallel and serial ports, to backing up the hard disk (see table 1 for a full list). Normally, you would need considerable knowledge about UNIX *and* the file structure of the machine to perform these functions; for example, it takes four pages of C code to implement the add/change/delete user log-on menu. The Administration item is at the heart of AT&T's attempt to make UNIX palatable to the average user.

The Clipboard item is rarely opened; it stores files and parts of files that are being trans-

ferred to a new location.

The Filecabinet item opens to a window that contains all your files and folders; the Filecabinet window is open in photo 1. The Filecabinet window can also contain modem data and RS-232C profiles. A profile contains the information needed to set up the internal modem or the serial port for a given use.

The Floppydisk item expands into a window that displays the contents of the disk currently in the floppy-disk drive. By copying files and folders into the Floppydisk window, you copy them onto the disk itself.

The Preferences item expands into several menus that allow you to change the order and manner of displaying items within windows, change the default window size, and turn on or off the availability of the UNIX window and certain Administration items.

The system automatically puts all material to be printed into a print queue and prints it as a background task. The Printer Queue item expands into a window that lists all items awaiting printing; you can examine the list and, optionally, cancel one or more items.

The UNIX System item expands to a window that acts like a standard UNIX terminal. This item defaults to the Bourne shell (this is a UNIX term that denotes the user interface between you and UNIX); you can access other shells (when they become available) by specifying a shell's name in the Office Preferences window.

When files and folders are deleted, they move to the Wastebasket. Only when they are removed from this window are the files and folders physically deleted from the hard disk.

WINDOWS

Windows in the AT&T UNIX PC behave differently from other windowing systems on personal computers. Different programs control their windows in different ways, and windows often adjust their dimensions to what they think best. The windowing system (called the *user agent* in the AT&T literature) automatically positions windows so that, if possible, all windows are at least partly visible from the screen. When that is not the case, you can cycle through all the windows by using "next window" and "previous window" function keys, or by opening and choosing from a window that lists all the windows currently open.

A window always has four icons (the ones in the corners) and may have pairs of arrows on the right edge (for up/down scrolling) and the bottom edge (for left/right scrolling); these arrows appear only if the window cannot display its complete contents. The corner icons are, clockwise from upper left, the move-window, help, grow-window, and close-window icons. The help icon, when clicked on, *always* gives a window—sometimes several—of explanatory information. The close-window icon,

when clicked, causes the window to vanish; if it represents a program, closing it exits the program.

The move-window and grow-window icons must be dragged—place pointer on icon, hold down the left button, move the mouse (which drags the icon with it), then release the button. When you press the left button, a "W" in a box appears with a ghost outline of the window; both follow the mouse movement until you release the left button. The UNIX PC displays inferior behavior to its competitors when moving or resizing a window; see the "Problems" section for details.

SYSTEM V UNIX

The UNIX PC contains a complete implementation of UNIX System V, revision 2. AT&T has added some enhancements including: demand-paging virtual memory, windows implemented as character devices, multiple processes in different windows executing simultaneously, Bass-style record locking at the character level (needed for multiuser business software), shared function libraries (saves space by using only one copy of a routine used by multiple processes), and shared source libraries (has a similar effect on simultaneous compilations). AT&T will not offer the source code for the enhancements to the standard release of System V UNIX.

To execute UNIX functions, you can either open a UNIX window (see photo 3) or, from any window, you can execute any single UNIX command by preceding it with the customary "!" sign.

Although the basic system contains the full UNIX operating system, it does not contain many of the utilities associated with a UNIX software developer's workstation. Instead, AT&T has divided the software into the Foundation Set (\$495), the UNIX Utilities package (\$495), and a UNIX Development Tools pack-

(continued)

Photo 2:

The UNIX PC

keyboard.

Many of the

dedicated keys

allow the

computer to be

controlled

without using

the mouse.



Table 1: Functions handled through the menu-oriented Administration window.

- Change password
- Set date and time
- Run diagnostics from floppy disk
- View system configuration
- User log-ins (add, change, delete)
- Disk backup and restore (full, incremental, single user, by filename)
- Floppy-disk operations (copy disk, format, read MS-DOS disk)
- Hardware setup (RS-232C, serial printer, parallel printer, telephone, drivers)
- Software setup (install, remove, show installed software)
- Mail setup (name this machine, identify other machine)

Table 2: Software announced for the AT&T UNIX PC at the machine's introduction.

SOFTWARE FROM AT&T

- AT&T UNIX PC Word Processor
- AT&T UNIX PC Business Graphics
- AT&T UNIX PC Electronic Mail
- AT&T UNIX PC BASIC Interpreter
- AT&T UNIX PC BASIC Compiler
- AT&T UNIX PC UNIX Utilities (includes C and assembler)
- AT&T UNIX PC Development Tools
- AT&T UNIX PC Business Accounting System General Ledger, Accounts Payable, Accounts Receivable, Order Entry/Inventory, and Payroll (five packages)

SOFTWARE FROM THIRD-PARTY VENDORS

- Language Processors Inc. Debugger, COBOL, Pascal, C
- Silicon Valley Software Pascal and FORTRAN
- SUPERcomp 20 (spreadsheet)
- Graphic Software Systems Inc. Chart
- CDI Sound Presentations
- Microsoft Word, BASIC, and Multiplan
- Ashton-Tate dBASE III
- Ryan-McFarland Inc. RM/COBOL and RM/Run Time

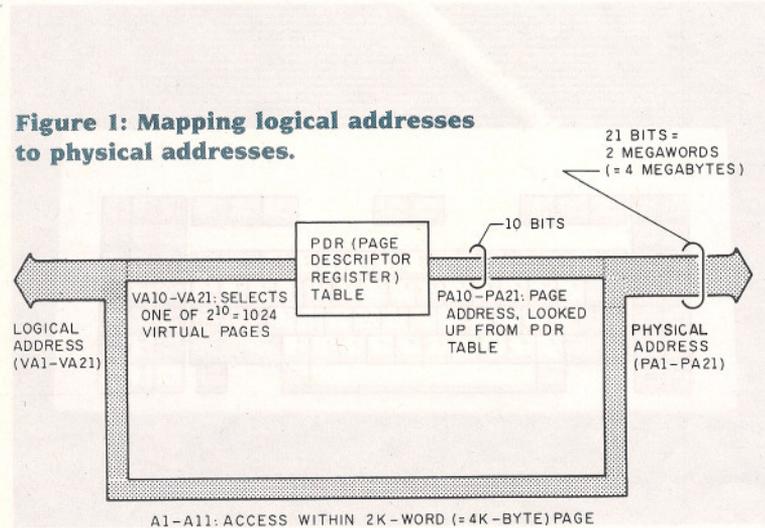


Figure 1: Mapping logical addresses to physical addresses.

age (which includes ISAM-file and sort/merge routines, \$395). For example, the Foundation Set contains the standard ed line editor, but the Utilities package contains things like the vi screen editor, the nroff text formatter, and the yacc compiler tool.

TELEPHONE FUNCTIONS

Though AT&T's adaptation of UNIX is more important, the telephone functions (called *telephony* in the AT&T literature) most visibly distinguish the UNIX PC from other personal computers. These functions are available by opening the Telephone item in the Office window, which becomes a window of names and phone numbers titled Call Screen. Convenience features include dialing both people and computers by selecting a telephone directory entry, timing a call, redialing the last number, single-keystroke speed dialing, and putting a call on hold.

Other telephone functions go beyond simple convenience and will prove invaluable to people who use telephones a lot. The UNIX PC automatically maintains a log of all incoming and outgoing calls, including the time and duration of the call (plus name and number for outgoing calls). In addition, it gives you a chance to open a "Current Notes" window to take notes in; if you have taken notes during previous calls to the same person, the computer shows them to you (annotated with date, time, and number called) in a separate window. If you have installed the optional Electronic Mail program, you can also send UNIX-style electronic mail through either the Call Screen or the Electronic Mail windows.

INSIDE THE UNIX PC

The UNIX PC consists of removable modules that can be replaced by the user. Once the cover is off, you can see a pan assembly (which houses the floppy-disk drive, the hard disk, and the power supply) and, under it, the motherboard. (The three expansion boards each slide underneath the motherboard from the rear of the machine and connect to each other through a narrow backplane that runs along the front of the machine. The slots have a 21-bit address bus and a 16-bit data bus.)

Photo 4 shows details of the motherboard; photo 5 shows the pan assembly and the motherboard. The on-board memory area contains 512K bytes (with parity) in 4864 64K by 1-bit dynamic RAM (random-access read/write memory) chips; the chips have an access time of 150 nanoseconds and run with no wait states. These chips are pin-compatible with 256K by 1-bit dynamic RAM chips; at some later time, AT&T will start using them to get 2 megabytes of RAM on the motherboard. (The system can add up to 2 megabytes of memory via expansion cards, for a maximum of 4

megabytes of memory. AT&T plans to use one slot to connect to an external expansion-card box, but expansion memory must be in the internal slots.) The bit-mapped video display requires 32K bytes of the memory.

The system contains only 16K bytes of EPROM (erasable programmable read-only memory)—two 8K by 8-bit 2764s. These contain bootstrap and diagnostic code for power-up, as well as code executed on shutdown that ensures that the attached telephone works when the computer is off.

The 10- and 20-megabyte Winchester hard disks are built by MiniScribe. The 10-megabyte drive, which comes in the basic system, has an 85-millisecond access time and a transfer rate of 5 megabits per second. The UNIX PC uses a novel form of DMA (direct memory access) to move data from the hard disk to memory. Most computers transfer control of the address and data buses to specialized hardware that first moves data from the hard disk to a buffer area; the processor regains control of the buses and moves the data from the buffer to its final destination. The UNIX PC speeds this process by capturing the buses many times, each time only long enough to move a word of data *directly* to its final destination. By not holding the buses while the hard disk is forming the next word to be transferred, this method also decreases the time the DMA transfer prevents the 68010 processor from doing its work.

Finally, three custom gate arrays (see photo 4) perform complex functions in much less space than they would have taken using discrete logic chips.

MEMORY MANAGEMENT

One of the main differences between the 68010 processor, used here, and the 68000 processor, used in the Apple Macintosh and other computers, is the former's virtual-memory capability. In a virtual machine, dedicated hardware looks at the memory address being asked for by the processor (the *logical address*) and translates it to a *physical address* that the processor can access if the data is currently in physical memory. If it is not (meaning that it is stored instead on the hard disk), the hardware generates a *page fault* that eventually causes the needed data to be swapped into physical memory before allowing the memory to be accessed. In a 68010-based computer, the page fault is fed to the BERR* (Bus Error) pin on the 68010; the 68010, in turn, suspends the current instruction in midexecution, runs a routine that swaps the needed data into physical memory, performs related housekeeping tasks, and completes the suspended instruction.

Most computers use a dedicated integrated circuit called an MMU (memory-management

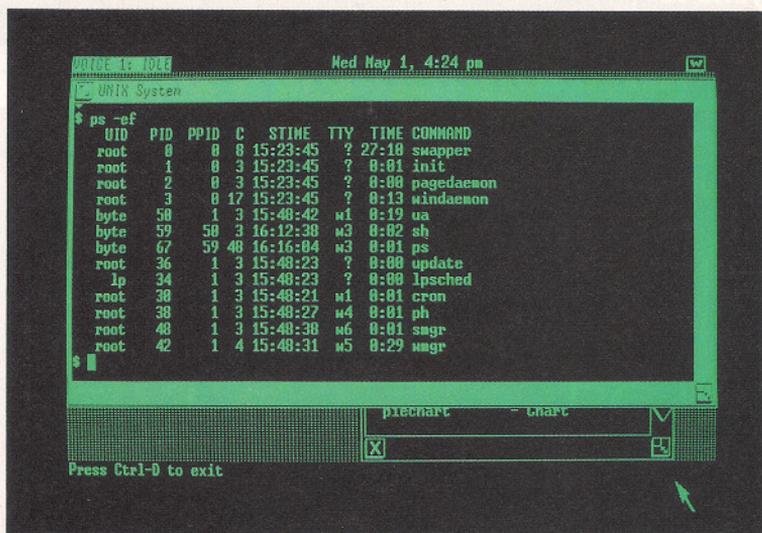


Photo 3:

A UNIX window.

This window is running the

Bourne shell

and behaves like

a conventional

UNIX system.

unit) to translate logical addresses into physical ones and declare page faults. Instead, the designers of the UNIX PC use discrete logic and a table of high-speed static RAM called the PDR (page-descriptor register) table to do the translation (see figure 1). The lower 11 bits of the address are left alone; this gives a page size of 2K words or 4K bytes. (The 68010 does not have an address line A0 as such, but it uses the UDS [upper data strobe] and LDS [lower data strobe] lines to access byte-sized data.) The PDR table contains 1024 16-bit entries, one for each logical page. Six bits in each entry give status information about the page (including whether or not the page is in memory). If it is, the remaining 10 bits give its physical page number; if not, the logic generates a page fault and the 68010 interrupts itself to run a routine that puts the page into physical memory and updates the PDR table.

SOFTWARE

AT&T recognizes the need for as much application and system software as possible. Table 2 lists the software announced (at the time that this article was written) as immediately available. Included are several languages and popular application programs like Microsoft Multiplan, BASIC, Word, and Ashton-Tate's dBASE III. AT&T representatives said Lotus 1-2-3 will not be available; they also denied reports that they were developing an expansion card that would give their machine IBM PC compatibility.

PROBLEMS

Although the machine seemed to perform acceptably fast in the short time I had access to it (see "Caveats"), its behavior was definitely inferior to other 8086- and 68000-based windowing computers in its move-window and grow-window operations. In all cases, I measured a delay of between 1 and 1¼ seconds

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Telephone-on-a-chip hybrid IC

512K RAM

2764 EPROMs

Connector to backplane

Video gate array

Address gate array

68010 processor

Data gate array

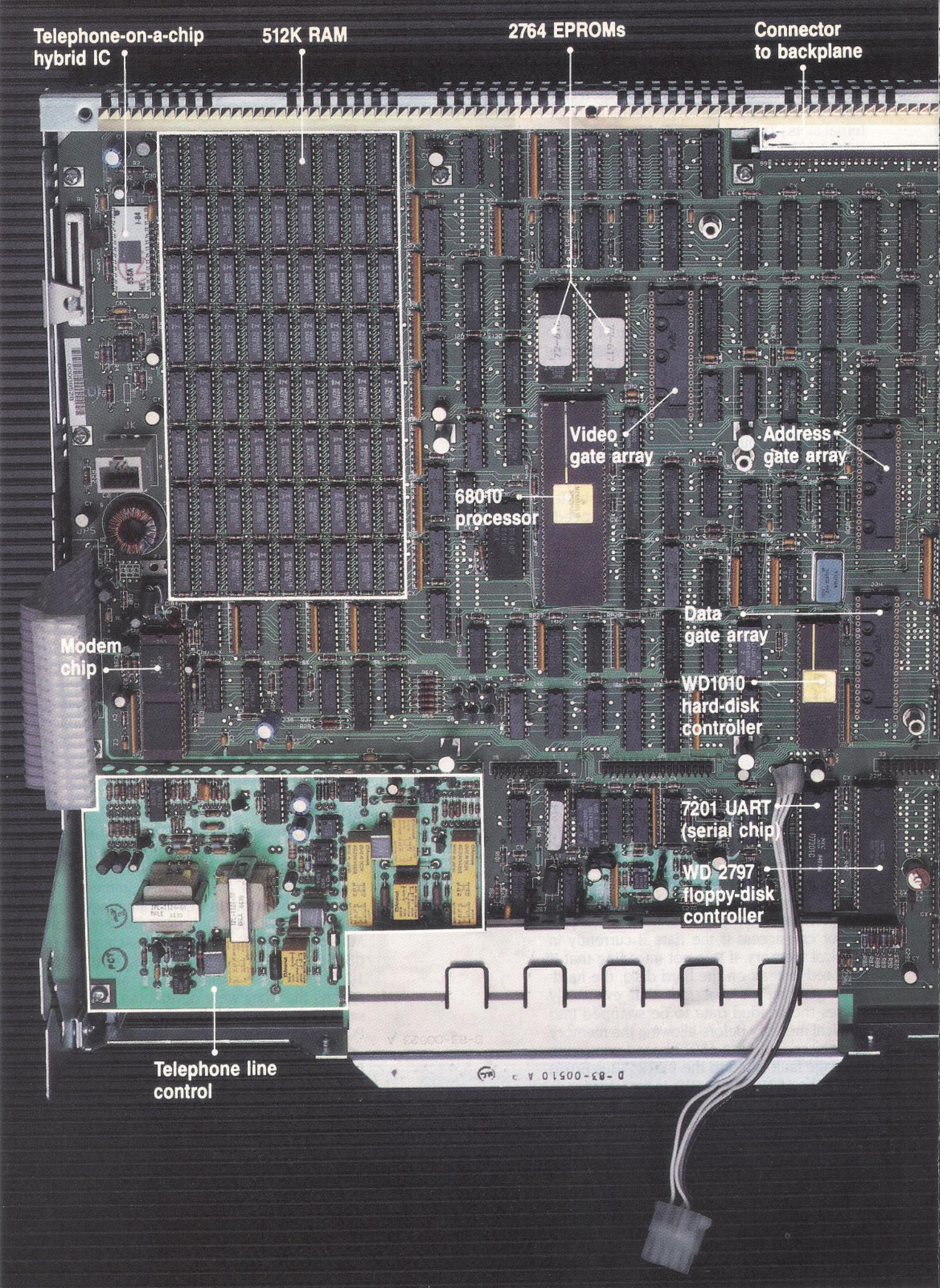
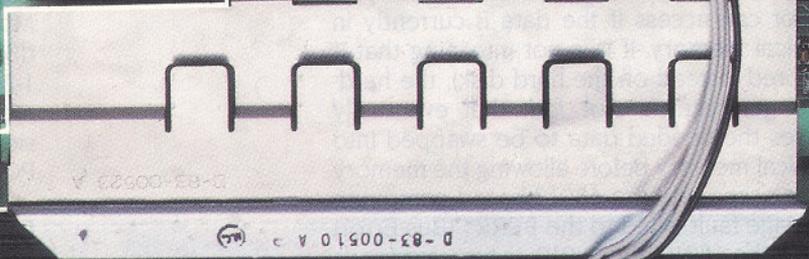
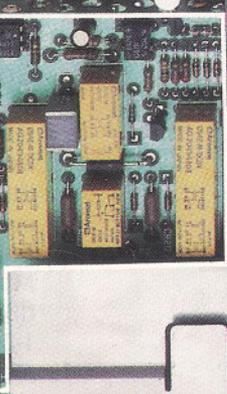
WD1010 hard-disk controller

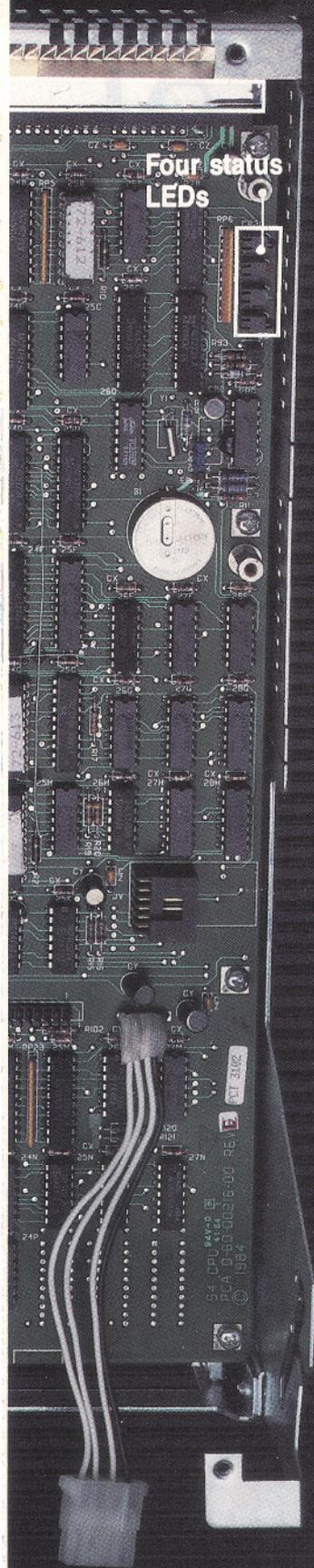
Modem chip

7201 UART (serial chip)

WD 2797 floppy-disk controller

Telephone line control





Four status LEDs

Photo 4:
The UNIX PC motherboard; the front of the board is at the bottom of this photograph.



Photo 5:
The pan assembly and motherboard. Here, the pan assembly (which holds, left to right, the floppy disk drive, the 10-megabyte hard disk, and the power supply) is hinged upward to allow access to the motherboard.

between the time the left mouse button was pressed and the move or grow operation (indicated by the "W" icon) started. The ghost outline of the window's new dimensions begins at the window's current outline when the "W" icon appears. If the mouse pointer has been dragged to a new location before the "W" appears, the ghost outline may lag the mouse pointer's position by over three-quarters the length and width of the screen, thus limiting the amount the window can change before the pointer reaches the edge of the screen. (The ghost outline of a Macintosh window, in contrast, always stays with the mouse pointer.) Though this does not prevent the use of the UNIX PC, it definitely interrupts the flow of work and mars one's perception of a machine that otherwise seems to be quite fast.

Another thing that disturbs me at first impression is the designers' positioning of the floppy-disk drive, which, given the necessity of periodically using it for hard-disk backups, seems awkward to me. However, the final vote on that should come from the first people who actually use the machine for several months.

CAVEATS

I wrote this report after two days of conferences with AT&T engineers and officials, a few hours of demonstrations and hands-on experience, and considerable study of six user- and repair-oriented manuals. The machine I used was a preproduction model that used discrete logic chips to emulate the three gate arrays. The machine had the 10-megabyte hard disk and ran the finished version of the software; I did not see the machine supporting more than one user.

COMMENTARY

Although I would have liked to have had more time to study the machine, I feel confident in describing it as "quietly impressive." No one feature—menu-driven UNIX, true multiprocessing in a windowed environment, telephone functions, virtual memory—really excites me, although each one is an important "first" in the micro-computer world. Its success as a UNIX software-development workstation is assured (although it really needs a megabyte of memory for this), but its fate in the business community is promising but uncertain. Further details will be available in the full product review of this machine, which will appear in a future issue of BYTE. ■