

# EO Announces First Personal Communicator

## Hobbit-Based System Due to Ship in 1Q93

By Michael Slater and Linley Gwennap

EO, a secretive AT&T-backed start-up formed in mid-'91, has announced its first products—the Personal Communicator 440 and Personal Communicator 880. These products mark the start of a new system category that could rival the personal computer in its influence on society and in the size of the market it will create. From a microprocessor perspective, it is especially significant because it creates a new standard platform that could establish AT&T's Hobbit microprocessor as the heart of this new product type.

EO's Personal Communicators are pen-based computers, but they go beyond existing products in their light weight, built-in software, and communication peripherals. They are messaging-oriented, rather than computing-oriented, and integrate a more complete set of features than any previous products.

Both models are based on AT&T's Hobbit microprocessor and system-logic chip set (see [061403.PDF](#)). The software is based on GO Corp.'s PenPoint operating system, which is stored in ROM—for the first time—along with several key applications. The mail and fax applications are from GO, while phone, sound, calculator, and security applications were developed by EO. Two of the built-in applications are licensed from third-party software vendors: PenTOPS (PC connectivity) from Sitka and Personal Perspective (calendar, address book, to-do list, and note-taker) from Pensoft.

The two models differ in their size, speed, and storage capacity but provide the same capabilities. The EO 440, which measures 10.8" × 7.1" × 0.9", is a bit smaller (but thicker) than a pad of paper and weighs a mere 2.2 lbs. It is far from pocket-sized, but it can easily be carried like a notebook. Unlike a notebook PC, it does not need to be opened up to be used.

The 640 × 480 display (with a portrait orientation, unlike typical PC displays) measures 5.9" × 4.3", providing a high pixel density of 110 dpi for exceptionally crisp characters. It is not backlit. A 1.3", 20M internal hard disk is available as an option.

The EO 880 provides a larger, backlit display and a faster processor at the price of almost twice the weight: 4.0 lbs, which is still lighter than most full-function notebook computers. The overall size is 13.0" × 9.0" × 1.1", and the screen measures 7.6 × 5.7"; it has the same resolution as the smaller unit, so the pixel density is lower (85 dpi). A 1.8", 64M internal hard disk is available as an option. The EO 880 also provides a VGA output for use with an exter-

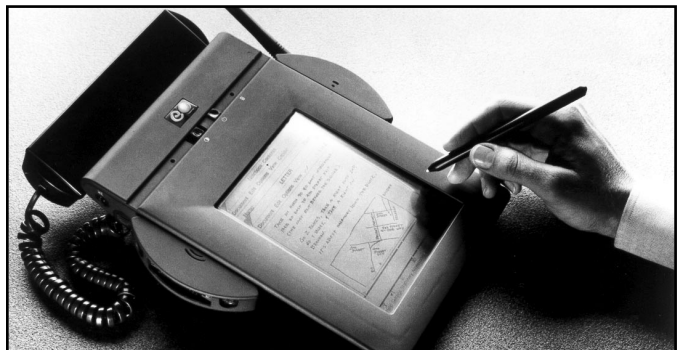
nal CRT monitor (primarily for presentations) and a SCSI II interface for hard drives.

Both models include a serial port and software for transferring data to and from IBM-compatible PCs. Surprisingly, no Macintosh connectivity will be offered in the initial product. A parallel port provides the printer interface, and it can also be used to interface to an optional, external floppy disk drive. A keyboard port allows a standard PC keyboard to be connected. A built-in microphone and speaker support voice annotation of documents but are not used for the optional cellular phone, which comes with its own handset. For use with a wired telephone line, the EO system is connected in parallel with a standard telephone.

The EO 440 includes a single Type-II PCMCIA slot, and the EO 880 includes two slots. These slots can be used for memory expansion, network interfaces, or other functions. There is a separate ROM-card slot for applications software or system software updates, and also a JEDEC-standard DRAM card slot for memory expansion.

The EO 440 is a 3.3V system and runs at 20 MHz. EO estimates the performance to be two to three times that of a 20-MHz 386SL. The EO 880 is a 5V system that runs at 30 MHz, yielding performance comparable to a 33-MHz 486SX. Both systems have the same quoted battery life: four hours of constant use, rechargeable in only 90 minutes. (The EO 880, of course, requires a larger battery to achieve this same battery life.)

Many other hardware configurations are possible. A smaller unit would be easier to carry around, but the limited display area would make fax reception difficult and limit the number of applications that could be used effectively. Nevertheless, a small version probably makes sense for some users; with a built-in cellular phone, a small unit could be thought of as a smart phone with a built-in address book and limited e-mail capabilities. At



EO 440 Personal Communicator.

## EO's Origins and Backing

EO, Inc. was initially backed by the venture-capital firm of Kleiner Perkins Caufield & Byers, which was the lead investor in GO Corp. (see *060201.PDF*). GO originally planned to be in the hardware business, but after developing a prototype system and even starting pilot production, the decision was made to focus solely on software. Ten members of GO's hardware design team formed the original design group at EO.

EO was formed in July 1991 by Kleiner Perkins partner Bernie Lacroute, who assembled the management team and began establishing the corporate partnerships. He now serves as chairman. The president of EO is Alain Rossmann, who was a cofounder of C-Cube Microsystems and Radius. Before founding Radius, he led Apple's efforts to recruit software developers for the Macintosh. Another key figure at EO is Hermann Hauser, whose Active Book company in the U.K. was acquired by EO. Hauser was previously a founder of Acorn Computers, where he designed the ARM architecture. He serves as EO's chief technical officer and heads its development operation in Cambridge, England. EO has a total of approximately 90 employees.

According to Rossmann, EO's founders realized early on that it was going to take more capital and other resources to get the personal communicator market started than the venture capital community was willing to provide. EO has established partnerships with AT&T, Matsushita, and Marubeni, each of which has an equity stake and also provides other resources. AT&T previously worked with Matsushita and Marubeni on the "Safari" notebook computer. Total funding has not been disclosed but is said to be "several tens of millions of dollars."

AT&T, of course, is the largest communications company in the world. AT&T plays a critical role at EO, providing not only the Hobbit microprocessor and system-logic ASICs but also the communications infrastructure. EO's engineers have access to technologies developed throughout AT&T, including Bell Labs. In addition, AT&T Microelectronics will market the complete Hobbit chip set, facilitating the development of compatible systems from other vendors. AT&T will also market EO systems in the United States.

Matsushita, with worldwide revenues of \$56 billion and 240,000 employees, began 75 years ago by making batteries and radios. The company continues to excel in these areas, as well as in miniaturization and cellular technologies. It is now the largest consumer electronics company in the world, best known by its Panasonic, Quasar, and Technics brands. Matsushita will manufacture the EO systems at its Illinois factory. The company will also develop a Japanese version of the product, supporting Kanji language and Japanese communication protocols, and market it in Japan.

Marubeni is a global trading company in products from steel to network data services. It will be responsible for procuring components for EO's systems, including providing a line of credit for these purchases. Marubeni will also assist in the worldwide distribution of the finished products.

Although EO has a small R&D operation in the U.K. (remnants of the Active Book Company), it is seeking a major European partner to balance its global network. A company like Philips, with expertise in computers and consumer goods, would be an obvious choice, but other large communications or consumer companies would also fit. EO hopes to announce its European partner by early next year.

the other extreme, a version designed to sit permanently on a desk could replace the desk telephone; it would be cheaper to produce than a unit that was designed for light weight and battery operation.

## Communications

The built-in modem is technically an option, but most users are likely to want it. Users that might want to omit it include those who plan to use other wireless communication devices connected to the serial port, or that will connect to PC networks via an I/O port or a LAN interface installed in the PCMCIA slot. The modem provides 14.4 kbps data and 9600 bps fax transmission and reception, and it supports V.32bis protocols, V.42 error correction, V.42bis data compression, and MNP compression levels 2 through 5.

An optional cellular phone module is integrated with the mechanical design of the unit, making it a complete wireless communication system. The cellular phone option adds only 1 lb to the weight of the system. The internal modem connects to the cellular phone and provides 9600 bps data communication in a good cell, or 4800 bps in a typical cell. It is also possible to connect a standard cellular phone to the phone port, although a special adapter (costing \$200 to \$300) is required.

EO believes that the standard cellular network, rather than separate packet-switched data networks, will be the best solution for data transmission. AT&T has recently announced software for the modem chip set that EO uses, however, that supports the RAM Mobitex network, so this could be supported by the EO system with additional software and the appropriate RF transceiver.

Included with the EO products (and with all future PenPoint systems, whether x86 or Hobbit based) is access to AT&T Mail through AT&T's EasyLink Services. There is no startup or fixed monthly charge, but there is a per-message fee of about \$0.54 per page for fax and \$0.40 per 1000-character e-mail message. AT&T Mail includes gateways to all major mail systems, including the Internet, CompuServe, GE Info Services, MCI Mail, SprintMail, Novell MHS, and cc:Mail.

In addition to providing traditional e-mail services, EO has arranged for AT&T's "electronic mailbox" to provide a fax store-and-forward service. (This service is not, so far, part of the standard offering for other PenPoint users.)

Correspondents can fax messages to an AT&T 800 number, and they are stored on the AT&T system until the recipient calls to collect fax and e-mail messages. Fax, phone, and voicemail messages all go into a single in-box on the EO system. So far, AT&T is not offering a voicemail service as part of its electronic mailbox, but correspondents with EO systems can send voice messages as e-mail.

When sending e-mail, faxes, or even voicemail from the EO system, items wait to be sent in the outbox. When the user connects to a wired phone line or enables the optional cellular phone, the items in the outbox are sent.

Faxes received on the Personal Communicator can be viewed on-screen at various magnifications. Using the pen, faxes can be annotated and retransmitted.

All applications in PenPoint are tied into an object-oriented database. When a user enters a name in the calendar or to-do list, for example, the database is checked for that person. If no match is found, the system prompts the user to create an entry, providing address and phone information. The database includes a log of communications with each person. Calling someone who is in the database is as simple as drawing a "D" (for Dial) over the name anywhere it appears—on a to-do list, in a calendar entry, on a notepad, or in any other application.

Many other communications-oriented applications are possible, awaiting only the appropriate software—which third parties are likely to provide. One obvious software component that is missing is an answering machine, which would allow the EO system to collect voicemail messages. The ability to download messages from a company voicemail system would also be desirable.

An example of a more sophisticated application is "interactive paper," allowing users to share drawings with another party during a telephone conversation. Many types of on-line databases, ranging from business information to restaurant reviews, are likely to become available, integrated with viewer applications that make them easy to use.

## Hardware Design

Figure 1 shows a block diagram of the EO 440. The system is based on the Hobbit chip set, which was designed in collaboration with EO. The only part of the chip set that is not used in the EO design is the ISA peripheral interface chip; to eliminate the need for this chip, EO attached the disk drive to the PCMCIA interface.

The system makes extensive use of microcontrollers, bringing the total number of processors to six—quite remarkable for a 2.2-lb product. The modem uses an AT&T DSP32 processor and a Z8-family microcontroller; the voice I/O and cellular phone interface are controlled by another Z8-family microcontroller; a very-low-power Sharp microcontroller controls the power supply and battery charging; and a Mitsubishi microcontroller handles the digitizer for pen position sensing. The optional cellular

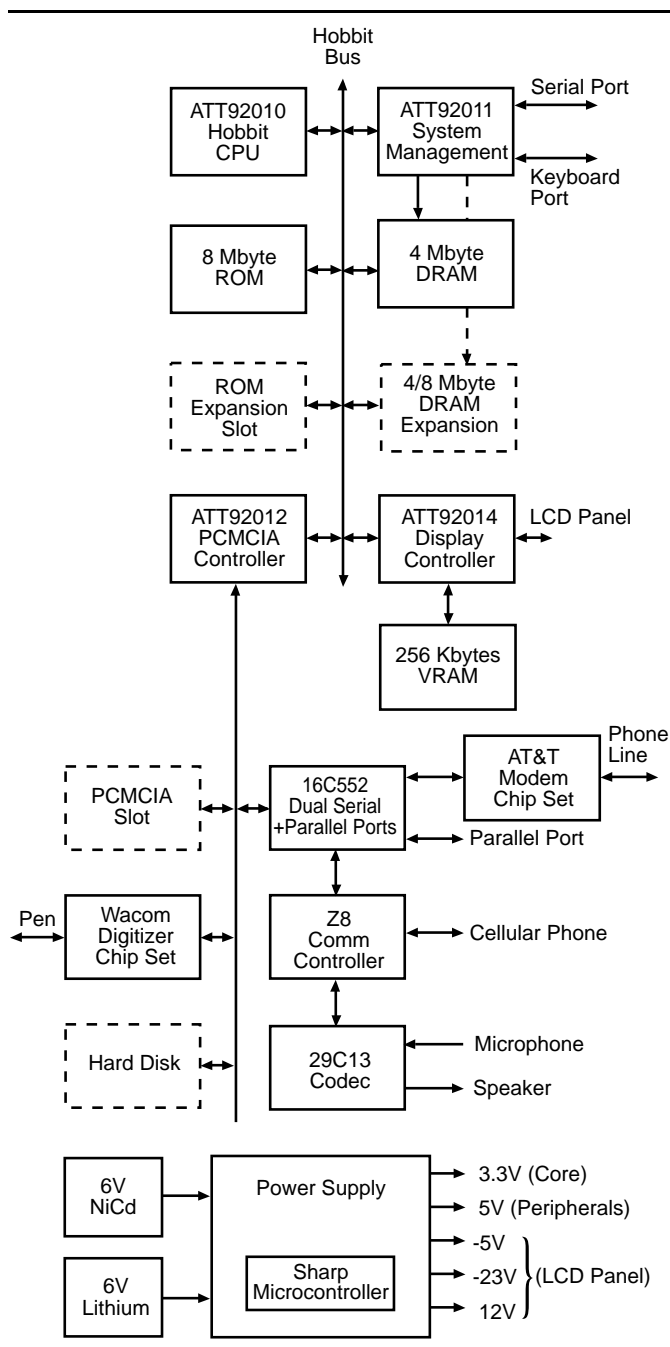


Figure 1. Block diagram of the EO 440 Personal Communicator.

phone adds yet another processor.

In a basic system (with no hard disk), the only storage is the DRAM. It is therefore critical that the DRAM contents always be retained, even when the system is "off." (There is no real off state, just on and standby.) The EO design uses self-refresh DRAMs, which eliminate the need for any refresh circuitry and allow the rest of the system to be shut down when not in use, reducing the standby power consumption by a factor of four. The system is normally powered from a 6V NiCd battery, but a 6V lithium battery is also included as a backup to preserve the DRAM con-

## Other Hobbit Supporters

In addition to EO, NEC and Toshiba have announced plans to build Hobbit-based personal communicators. Products are planned for 1993 introduction, but no details are available.

As of press time, negotiations were underway for a second source for the Hobbit processor, but the identity of the company has not been revealed.

Software developers that have committed to developing for the Hobbit/PenPoint platform include Ink Development, Notable Technologies, PenMagic, PenSoft, Intuit, Slate, Sitka, Lexicus, and Paragraph International. MetaWare will provide a C compiler for Hobbit.

tents for up to two months even if the main battery is exhausted.

EO decided on a 3.3V design for the model 440 to provide the greatest battery life with the lightest possible battery. This caused numerous headaches. Availability of 3.3V self-refresh DRAMs has been a particular problem; the prototypes use 5V, 70-ns DRAMs that have been recharacterized as 3.3V, 90-ns parts. For production, true 3.3V, 80-ns chips are expected to be available from Mitsubishi and Hitachi.

ROMs were also a problem; the prototype systems have six wait states on ROM accesses because the fastest 3.3V ROMs available have a 300-ns access time. For production units, EO expects to have 200-ns ROMs, allowing the system to run with only three wait states. (The beta-test systems actually use flash memory, rather than mask-programmed ROMs; the code for the ROMs will be frozen in January.)

Other items that normally are taken for granted become a challenge in a 3.3V system. Finding a source for the clock oscillator was difficult, as was finding a crystal for the real-time clock that provided guaranteed specifications with the smaller voltage swing. According to EO's VP of hardware engineering Celeste Baranski, the most difficult part of the entire system design was the power supply.

It was not possible to build a pure 3.3V system. The serial and parallel ports, the hard disk, the LCD display, the frame buffer, and the digitizer interface all run at 5V. The modem also runs at 5V; although AT&T now offers a 3.3V version of the modem chip set, it was not available in time for EO to use it.

The systems include 4M of DRAM soldered on the system board. A connector is included for an 8M DRAM expansion card, allowing a maximum system DRAM of 12M. Note that the system doesn't require as much RAM as a typical disk-based system since programs are executed directly out of the 8M of ROM and don't need to be copied into RAM. This limits the amount of data that can

be kept in the system, however, unless the optional disk drive is installed.

The ROM-based software results in some performance penalty, since ROM is slower than RAM, but the greatly decreased latency for starting a new application actually makes the machine "feel" faster in many circumstances. As faster ROMs become available and future version of the Hobbit processor increase their on-chip cache, the performance penalty will shrink.

EO used a number of subcontractors to design parts of the system to reduce their risk and speed time-to-market. The industrial design (packaging) was done by frogdesign, which is famous for its work on Apple's Macintosh, the NeXT "cube," Sun's SPARCstation, and many Sony televisions. The modem design was done by DataRace, and the optional cellular phone was designed by an unnamed Japanese supplier. The digitizer interface uses a chip set from Wacom, which includes three ASICs and a microcontroller.

## The Personal Communicator Market

When estimating the size of the personal communication system (PCS) market, EO and AT&T like to point to the telephone itself, which is present in over 96% of all American homes. Although the domestic market is clearly saturated, the worldwide number of telephone subscribers is expected to triple over the next decade from the current 500 million. More recent analogies are the explosion in the number of fax machines (28 million installed in the U.S. alone), pagers (12 million), and cellular phones (8 million). In 1991 alone, 3 million cellular phones were sold.

The initial market will be mobile business users, who make up the vast majority of current pager and cellular phone users. Businesses are willing to pay high prices to improve productivity, but at \$2500 for a basic unit and \$3300 for a system with wireless capability, the initial PCS products are too high-priced for most consumers. As technology improves and volumes increase, the prices should drop to the \$500 range, attracting more consumers, but this could take years. EO hopes that PCS devices will have over 100 million users by the end of the decade; although this figure seems very optimistic, it is probably achievable over a longer period. A key reason for EO's partnerships with deep-pocket corporations was the recognition that the PCS market will take time to develop, so staying power will be a critical asset.

AT&T is interested in this market because the bulk of the revenue will go to the service providers. The average cellular phone user pays more in service charges in one year than the entire cost of the phone itself. This is true for standard phones as well, and it will probably be true for the PCS. The usefulness of the PCS will require a variety of communication services, along with software applications to access them.

## The Future of Computing?

EO believes that the PCS is the fourth wave of computers, following the mainframe, the minicomputer, and the personal computer. Each new wave has resulted in products that are smaller, cheaper, and easier to use than its predecessors. Because of these factors, each new wave has increased the penetration of computers in American society. To overcome the final hurdle of users' computer anxiety, EO hopes the PCS will become a "computerless computer," so easy to use that people forget it is a computer.

Behind the hype is a clear market opportunity for mobile computing and communication devices. Apple, General Magic, and others will join EO in a battle for this market. By addressing the needs of users who do not have computers today, or who may purchase a mobile device to complement their desktop system, the opportunities for growth are enormous. New technology and new standards will be driven by the need for low power, low cost, small size, wireless communication, and ease of use.

The two major competitive platforms for this class of product are 386/486-based systems running PenPoint or Windows for Pen, and Apple's Newton (using the ARM processor). So far, no vendors of x86-based PenPoint systems have had the degree of focus on communication that EO has. Most of the current 386-based pen computers are also heavier, slower, and more expensive than the EO systems, although this could change quickly with the introduction of 486SX- and 486SL-based systems with designs more closely resembling EO's. A big factor in EO's favor is its collaboration with AT&T and their emphasis on messaging-oriented applications. In theory, at least, the Hobbit processor also has a significant price/performance and power/performance advantage over x86 processors.

Apple has not yet revealed details of its Newton products, but the demonstrations given so far concentrate more on personal organizer functions than on communication. This is not necessarily representative of what the final products will be, however. Perhaps the most significant difference between the EO and Apple approaches is that the Hobbit platform is truly open: the processor, system-logic chips, and application software are available to all comers. EO has some proprietary value in certain aspects of its system design and some of the built-in applications, but it is not prohibitive for others to enter this market with compatible products; EO and AT&T will not artificially constrain the number of system suppliers.

Apple, on the other hand, is following a very conservative licensing strategy. In comparison to the Macintosh, Apple's plans for Newton appear to be relatively open: the key technologies will be licensed to other companies. Unlike the Hobbit/PenPoint platform, however, they are not available to any company that wants them. So far, Apple has licensed only one company, Sharp Corp., which will manufacture Apple's first Newton product for Apple

## Price & Availability

Beta-test units will be available next month, with general availability in 2Q93. The EO 440 will be available early in the quarter, while the EO 880 will follow later in the quarter. The EO 440 with 4M RAM, an internal modem, and no hard disk is priced at \$2499; with 8M RAM, it is \$2799. The EO 440 is also available without the modem for \$1999. The EO 880 is priced at \$2999 for a 4M system with the modem but no hard disk, or \$3299 with 8M RAM. The hard disk options have not yet been priced. The cellular phone module is \$799, bringing the entry price of a complete wireless communicator to \$3298.

AT&T will also be private-labeling the EO products and selling them through AT&T Phone Center stores.

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and will also sell a similar product under its own name. At the Microprocessor Forum, Apple VP Larry Tesler explained Apple's strategy: "We don't think that the market for these devices is going to grow fast enough to warrant having five or ten companies trying to compete for the same small number of customers that are there in the early years. Our strategy is to grow the number of licensees very deliberately over a period of time as the market warrants the need to have more products."

While Apple's strategy makes a certain amount of sense, it all but forces prospective personal communicator makers to adopt the Hobbit/PenPoint (or x86) platform unless they happen to be one of Apple's chosen few. As a result, the number of makers of Hobbit/PenPoint systems is likely to be much greater than the number of Newton system makers, creating a broader range of products and a more competitive pricing environment. This is disturbingly reminiscent of how the PC and Macintosh markets evolved, and a similar lopsided split in market share could occur. The market probably will be too small to support many vendors in its early years, but there are sure to be more companies than Apple is willing to license that want to be early players and are ready and able to make years of investment while the market grows.

Until the real Newton products are unveiled, however, it is impossible to really compare them to EO's systems, and the features may be different enough that there will be distinct markets for the two devices. Other players, notably General Magic and Motorola, have yet to reveal their plans. We are witnessing the birth of a new product category and new standard platforms, and while it is too early to tell how successful EO or the Hobbit/PenPoint platform will be, they are clearly among the leading contenders. ♦