Vendors Clash on Low-Cost Computers

Game Machines, Network Computers, Low-End PCs Attack $500 Price Point

by Linley Gwennap

PC TECH FORUM It is a simple rule of economics: cutting the price of an item increases demand for it. But when PC vendors have tried selling systems at prices below $1,000, these units offered unsatisfying performance and did not sell well. With interest in the Internet and the World Wide Web now growing, several companies are making another run at this potentially large market for low-cost computers, this time using a network paradigm.

At the recent PC Tech Forum (PCTF), several vendors explained or, better yet, demonstrated their plans for this market. Acorn and Sun showed prototypes of their network computers based on ARM and SPARC processors, respectively. Diba discussed its software for "information appliances," and Sega explained how its new Saturn game player can be used to roam the Internet. The standard PC architecture, perhaps with a few modifications, could also be used at low price points.

A Market Opportunity for Low-Cost Systems

With an average price tag of about $2,000, the home PC has appealed mainly to users with an annual income of at least $40,000. This group also tends to be college-educated and thus better able to deal with the complexities of today's PCs. But in the U.S., 57% of these high-income households now own a PC, dampening sales growth. (In Europe and other areas, this income group is less saturated.)

A new low-cost computer could generate significant growth by attracting more buyers in the $20,000–$40,000 income range, where penetration is currently low. Addressing this market requires more than just low prices, however. Many of these buyers have less education and more unease about computers than those who own PCs today. A signifi-cant improvement in ease of use is needed to attract these potential buyers.

To create a complete value proposition, some desirable applications are needed. For many current PC buyers, a key purchase driver is the need to take work home. For people who don't use computers at work (or don't bring work home) the applications that encourage a computer purchase are (roughly in priority order) games, educational programs, and access to the Internet. Today, the most popular computing device in these middle-income households is a Nintendo or Sega game machine.

A corresponding opportunity exists in businesses. In a corporation, the purchase cost of a PC is less than the training and support cost required to keep that PC operating effectively. Computers that are much easier to use and maintain could save businesses huge amounts of money. For many corporate users, the key applications are e-mail, remote data access, and basic word processing, for which a low-cost system could provide adequate performance.

The Network Computer: Simplifying PCs

A group of vendors, of which Oracle has been the loudest, is promoting the concept of a network computer (NC). Although many have focused on the NC's potential $500 price tag, the key aspect of the NC is its lack of local storage—most programs and user data are stored remotely. If user-managed local storage is eliminated, all system maintenance can be performed remotely, greatly reducing the cost of maintenance and, at least from the user's point of view, making the NC easier to use than a PC.

This change in paradigm means that Windows 95 cannot be used as the NC operating system; the Microsoft OS assumes it is running from a local hard disk. Microsoft could create a product to address this new concept, but the software giant has so far shown little interest in the NC. This

Figure 1. At the PC Tech Forum, a number of industry representatives discussed low-cost computers, including (from left) Jim Louderback (*Windows Sources*), Joe Miller (Sega Soft), Steven McGeady (Intel), Mark Moore (Diba), Prabhat Mishra (Sun), Malcolm Bird (Acorn), and moderator Michael Slater (MDR).

leaves an opening for other software vendors; Oracle, the world's second largest, and Sun have stepped to the fore.

Oracle is developing a simple NC operating system as well as server software that would work with its popular database applications. Sun is building a Java-based OS for the client side. Both companies would benefit greatly from the increased sale of the servers required to support a large base of NCs as well as from client licensing fees.

From the hardware standpoint, the cost of an NC can be reduced by including less memory than in a PC, as the NC operating system would presumably be less complex than Windows 95. The vendors hope to further reduce cost by using an inexpensive non-Intel processor such as an ARM or, in Sun's case, a Java processor. With no local hard drive and, in some environments, a television instead of a monitor, an NC could be sold for $500 or less.

The drawback to eliminating the local hard disk is performance: application code and user data must be downloaded from the remote server through a relatively slow link. In a corporate environment, NCs could be connected to the server through a shared 10- or even 100-Mbps Ethernet link, providing reasonable performance if the network is not overloaded. A similar arrangement could be used in hotels, airports, and schools. For small businesses and particularly homes, however, the link would typically be through a 28.8-kbps modem or, at best, a 128-kbps ISDN line, limiting performance in many situations. If cable-modem service becomes widespread, these remote locations will eventually have access to higher bandwidth. In all these scenarios, users accustomed to hard-disk speeds may be disappointed.

Oracle, joined by Sun, IBM, Apple, and Netscape, recently announced the NC Reference Profile 1 (for a copy, see *www.nc.ihost.com*). While the specification is broad enough to encompass most PCs as well as any potential NC, it provides a framework for vendors to build clones of the Oracle NC as well as similar devices using different architectures. IBM, for example, said it will build an NC, based on its PowerPC 403 chip, for shipment by the end of the year; the unit, sans monitor, will sell for about $700.

Acorn Readies Platform for Oracle

Oracle, a software company, is relying on Acorn to develop the hardware for its ARM-based NC. Acorn Network Computing is a subsidiary of Acorn Computer, which made its name selling ARM-based PCs in the United Kingdom. The subsidiary was formed to adapt Acorn's set-top box, which is already going through trials in the U.K., for Oracle's use. As PCTF moderator Michael Slater noted, Acorn provides the hardware and "Oracle provides the hype."

Starting with a known platform accelerated Acorn's NC efforts. The initial version uses the highly integrated ARM 7500 processor *(see **081506.PDF**)*, which contains audio, video, and I/O interfaces along with an ARM7 CPU. It contains no hard drive, no CD-ROM drive, and only 4M of ROM for the boot code, operating system, and Web browser,

obtaining all other information from the server. (Some versions may contain other small applications in ROM.)

For home use, the system can directly drive an NTSC or PAL television and uses a 28.8-kbps modem to connect to the server. It can also be configured for business environments with an Ethernet adapter, connecting to a monitor instead of a TV. Both Oracle and Acorn say initial systems will begin shipping in September of this year from Acorn and other unnamed vendors.

At PCTF, Acorn's Malcolm Bird demonstrated a prototype unit downloading Web content and displaying it on an NTSC television. Bird noted the company had added anti-aliasing and other technology to obtain the appearance of a VGA monitor from a relatively low resolution TV screen. Indeed, the images seemed fairly sharp. The demonstration also included other basic tasks such as word processing, video, and audio playback.

Cirrus Targets NC with ARM 7500FE

A subsequent version of the Acorn NC will be built around the recently announced ARM 7500FE. This device, specified by Acorn and designed by ARM, is similar to the 7500 but adds support for EDO DRAM and hardware floating point. Cirrus Logic will fabricate and market the 7500FE.

The 7500FE is the first ARM chip to contain a floating-point unit. The double-precision FPU was designed by ARM years ago but shelved due to lack of interest. Acorn revived the FPU for the 7500FE, hoping to perform signal-processing tasks on the host CPU. A 20% speed boost from the original 7500, to 40 MHz, should also help performance. Cirrus expects to sample the 7500FE in 3Q96, with shipments by year end. The company has not yet announced a price for the new device; for comparison, the 7500 now sells for $24.

Acorn is also working on a StrongArm version of the NC and hopes to have prototypes complete this year. The StrongArm processor *(see **091504.PDF**)* offers six times the

Component	Cost
Java CPU	$50
4M DRAM	$80
3M Flash	$40
PCI Video	$70
Audio	$30
Ethernet	$60
Super I/O	$10
Misc. Logic	$50
PCB	$20
Enclosure	$20
Power Supply	$15
Total Cost	**$445**

Table 1. Sun's proposed Java-based NC totals $445 in materials cost. (Source: Sun)

performance of the ARM 7500, but current versions have none of the 7500's peripherals. The extra performance could speed signal processing, eliminating the need for some peripherals, and could improve the performance of the user interface and other software.

Sun Serves Up Java NC

As one might expect, Sun sees the main purpose of the NC as executing Java. In this scenario, NC users would do little other than surf the Web and perform simple tasks (e.g., word processing, e-mail, spreadsheets) using downloaded Java applets. Sun is counting on the availability of a wide variety of applets to handle these day-to-day tasks. Thus, while the Acorn NC supports Java, the Sun NC is awash in it.

Sun has little experience with the consumer market and at this time is mainly targeting its current corporate customers. Sun originally called its device the zero-administration client (ZAC), emphasizing the reduced support and maintenance costs for its system.

At PCTF, Sun's Prabhat Mishra demonstrated an NC prototype, this one based on a MicroSparc-2 CPU. Running a beta version of JavaOS, Sun's standalone Java environment, the system was able to display Web content. Based on the demonstration, however, the software did not appear as fully developed as Acorn's.

Sun expects to ship a system based on the lower-cost MicroSparc-2ep processor *(see* **1006MSB.PDF** *)* by year end.

Over time, Sun expects to reduce costs further by switching to one of its forthcoming Java processors *(see* **1002MSB.PDF** *)*. Mishra presented a potential bill of materials, shown in Table 1, that totals $445 for this system. Although this cost leaves

Figure 2. Diba's product ideas include (top) the Diba E-mail, (bottom from left) the Diba Kitchen, and the Diba Internet.

very little margin at a potential $500 price tag, the estimates in the table are quite conservative; we believe this system could easily be built for less than $300 in 1997.

Diba Partners with Zenith

Farzad Dibachi, who founded Diba last year along with brother Farid, was a senior vice president at Oracle's New Media Division and so is well acquainted with the NC. Diba is taking the NC concept a step further, promoting single-function information appliances so easy to use they no longer appear to be computers. The startup has developed a software environment for these low-cost systems.
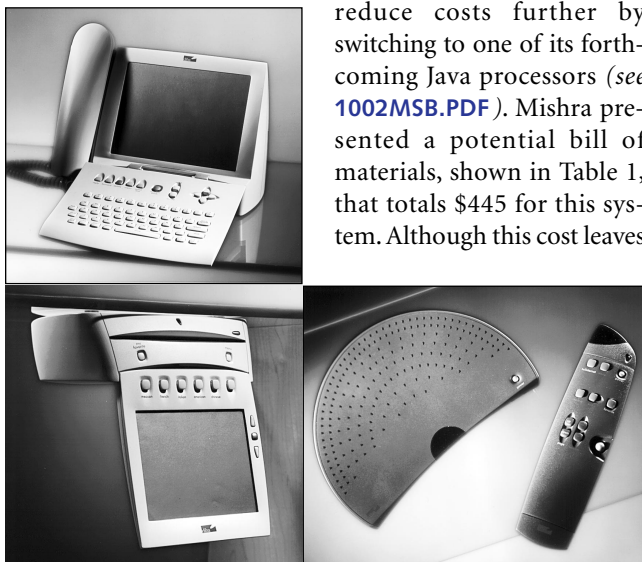
This software, which Diba calls its application foundation, is only about 300K in binary form but contains a real-time multitasking operating system, error handling, memory management, and standard graphics and I/O drivers suitable for these simple appliances. Diba has defined an API for applications to access the graphics and I/O in a hardware-independent fashion. The entire environment is CPU independent, although the initial development was done on a Motorola 68000-family processor.

Information appliances are targeted mainly at home users. Diba has lots of product ideas for the kitchen, for a set-top box, for e-mail access, for shopping, for schools, and other applications. It has even commissioned some provocative case designs, shown in Figure 2, created by the design firm Pentagram. Diba itself is not in the business of selling these devices; its role is to license its software and product ideas to other vendors that will build and market them.

The first vendor to take such a license is Zenith, which plans to incorporate Diba's software into a line of Internet-ready "NetVision" TV sets. These large-screen TVs will be coupled with a device similar to the Internet unit in Figure 2. Zenith expects the combination to sell in retail outlets by the end of this year starting at less than $1,000. Diba expects to soon sign several large Asian consumer-products vendors to build and market some of its other product ideas.

Diba has a clear focus on providing a simple interface to the user. At PCTF, Diba's Mark Moore repeated the company mantra: "the plastic is the application." In other words, each Diba system has a single target application (recipe book, e-mail, Web access, etc.), and the controls for that application are built into the plastic case. Operation of the device should be intuitive from the shape and design of the case; the user need not wade through complicated cascading menus to complete a task.

This focus on simplicity is needed in the consumer market. Diba must, however, find a compelling combination of price and features for its devices to succeed. The Web browser, for example, is only as compelling as the Web itself, which is still fairly daunting to the average consumer. The Kitchen system combines a CD player, a TV tuner, and a virtual cornucopia of recipes. With its licensing strategy, Diba can generate many ideas at a low cost, hoping to find at least one successful product.

Sega Offers Hot Games, Web Access

Sega may have the best near-term approach for home systems. The company is offering its Saturn game machine and a 28.8-kbps modem for $398. Saturn is built around three Hitachi SH processors and includes a CD-ROM drive, unlike the proposed NCs. The Saturn alone lists for $199, so consumers who already want a high-end game machine with lots of existing software can get on the Internet for an incremental cost of just $199, far less than the price of any NC.

Sega offers a dial-in service with unlimited connect time for $19 per month. The focus of this service is, predictably, game tips, multiplayer games, and tournaments, but the service includes Internet and Web access.

The economies of scale of its Saturn system allow Sega to offer its hardware at rock-bottom prices. The traditional model in the game market is to sell the hardware at cost, making profits solely on the software. This model could make it difficult for NC makers to compete with Sega for home users who just want to play games and surf the Web.

Another advantage of the Saturn system is its CD-ROM player. Although the system has the same bandwidth limitations as any diskless home unit running off a modem, users can load applications and other data from CD-ROMs much faster than in an NC. Saturn users could obtain large quantities of data by ordering a CD-ROM through the mail with a potentially higher bandwidth than by downloading such data across a telephone line.

Low-Cost PCs Could Also Fit the Bill

None of the aforementioned platforms offers compatibility with popular PC applications. At PCTF, MDR analyst Yong Yao presented a bill of materials, shown in Table 2, for a Pentium-166 system with no hard drive or monitor. He estimates such a device could be built in 2H97 for $290, easily supporting a $400–$500 retail price. This system would use the same client/server paradigm as the NC, keeping applications and user data on a remote server, but it would provide compatibility with full-fledged PCs. Thus, it could be used for working at home as well as for games, e-mail, Web access, and a wide variety of other applications. It could also be used in schools, hotels, and corporations.

A key enabler for this type of device, which Yao dubs the media computer, is for Microsoft to develop a "lighter" version of Windows 95 that is able to run directly from ROM. Keeping the operating system in ROM reduces the amount of DRAM needed and also avoids configuration errors. The new OS must also be much easier to use than the current Windows 95. Such a product could be derived from Microsoft's Pegasus project, an OS being developed for handheld computers, but Microsoft has not acknowledged any developments for an OS aimed at new low-cost systems.

Apple is taking a hybrid approach. Its Pippin platform, now marketed as the @World by Bandai at $599, is essentially a stripped-down Macintosh, with a CD-ROM drive but no hard disk, that uses a television as the display. Mac software

Component	Cost
Pentium-166-class CPU with MMX	$100
8M SDRAM	$50
4M ROM + MC operating system	$35
Core logic + video for USB and 1394	$25
2D/3D + video + 2M frame buffer	$30
Case, power supply, and other	$50
Total in 2H97	**$290**

Table 2. In 2H97, a diskless "media computer" using a Pentium-166 could cost as little as $360 to build. (Source: MDR)

can easily be modified to run on Pippin, and once modified, the new software can support both platforms. This similarity should jump-start the software market for Pippin and make it easy for users to share applications and data between the two platforms. Microsoft could take a similar approach and build an OS for low-cost x86 systems that offers some, but not full, PC compatibility.

There are significant issues for any of these client/server designs. In addition to the bandwidth problem, some users are concerned about the privacy and security of data kept on a remote server. At PCTF, Intel's Steven McGeady noted the monthly cost of supplying the client with the necessary applications and remote data storage has not been defined. NC backers assume this service can be bundled with the standard $19/month Internet access fee with little or no extra cost, making a diskless system attractive.

If there is a significant premium, however, this extra monthly cost would rapidly surpass the cost of a hard drive. In a corporate environment, this extra cost would appear in the form of large new server systems required to support the diskless clients; from this standpoint, the client/server architecture simply shifts costs from the client to the server. Other panelists pointed out, however, the goal is not so much to reduce hardware costs as it is to reduce support costs; the client/server approach is critical in this regard.

Birth of a New Platform

The NC backers hope they are presiding over nothing less than the birth of a new platform. With the first products already shipping and others expected this year, these vendors have more than vaporware, but it is too early to tell which approaches will succeed and whether any will approach the PC in popularity. For home use, an important enabler will be the inexpensive delivery of high-bandwidth infrastructure: ADSL, cable modems, or some other method.

The market needs being addressed—low cost and ease of use—could be handled by systems based on reduced-cost versions of Intel processors and Microsoft operating systems. Yet these two vendors, particularly Intel, don't seem interested in low-cost products, letting upstarts like Oracle and Sun drive this emerging market. If the NC market grows as these vendors hope, they could establish a new axis to rival the Intel-Microsoft duopoly. But there is still plenty of time for the PC giants to make their mark in the NC world. ◇