Windows NT Establishes New PC Platforms

Intel 486 and MIPS R4000 Systems Running NT; DEC Alpha Coming

By Michael Slater

Last issue, we gave an overview of Windows NT and its potential impact on the desktop computing world. In this article, we describe the requirements for NT systems.

The Windows NT developer's kit includes versions of the operating system for both the 386/486 architecture and the MIPS architecture. Not all systems based on these processors can run Windows NT, however.

Unlike DOS, which provides essentially no isolation of application software from low-level hardware, Windows NT is designed to isolate the two. A software layer, called the HAL (Hardware Abstraction Layer), provides the required isolation; it communicates with the low-level hardware resources and provides a standard set of services to the NT operating system. The HAL has complete control over all interrupt, timer, and DMA activity, freeing hardware designs from the rigid constraints imposed by compatibility with DOS.

In principle, Windows NT can run on a wide range of systems, given a customized HAL and device drivers for each system. (Device drivers are required to handle non-standard disk controllers and other I/O devices, which are beyond the scope of the HAL.) Microsoft will supply the required HAL and device drivers to support PC-standard 386- and 486-based systems.

Many high-end systems, however, use non-standard displays or disk controllers that require custom device drivers. These device drivers will have to be rewritten before such systems can be used for Windows NT. A few developers have received early versions of the driver development kit, but it will not be generally available until sometime this fall. Non-standard I/O devices such as fax boards and scanners cannot be supported until NT drivers are developed for them.

Displays supported by the pre-release version of Windows NT include standard VGA (640 × 480 × 16 colors), XGA (1024 × 768 × 256), SuperVGA boards from Headland, Orchid, and Tseng Labs (800 × 600 × 16 or 1024 × 768 × 16), and Dell's "DGX" frame buffer (1280 × 1024 × 256). Display support for 8514, S3, ATI, other SuperVGAs, and boards using graphics coprocessors (TI 340x0) are promised for future releases.

In the near term, system makers are unlikely to build machines that don't include the PC-standard interrupt and DMA controllers, but they could include supersets to provide greater capabilities for NT. For example, the NT kernel assumes that DMA operations can occur over any range of addresses in the 32-bit address space; it is up to the HAL to cope with the clumsy, 1975-era DMA controller—with tacked-on logic to accommodate the upper address bits—that is standard in PCs. If a full 32-bit DMA mode is available, the HAL can ignore the PC-standard garbage and deal directly with the modern hardware.

Windows NT brings workstation-level capabilities to the PC arena, and it also brings corresponding system requirements. For example, the x86 version will theoretically run with "only" 12M of RAM, but 16M is recommended and many users may require even more to efficiently run multiple applications. Microsoft intends to reduce the minimum requirement to 8M for the final release, but systems with less than 16M are unlikely to be effective.

MIPS-Based Systems

The range of MIPS-based systems supported—at least initially—will be limited. The only MIPS systems supported directly by the current NT release are those based on the MIPS reference design, which is used in the MIPS ARCStations and has been licensed to Olivetti and Acer. (This design, also known as "Jazz," has its roots in a design created by Microsoft to provide a standard platform for NT development.) With a custom HAL, other R4000 systems can be supported; Silicon Graphics showed NT running on the new R4000-based Indigo system, using an SGI-developed HAL.

MIPS/SGI, Acer, and Olivetti are all offering special package prices for Windows NT development systems. For example, the Olivetti M700-10 with a 50-MHz R4000PC (no secondary cache), 16M RAM, 210M hard disk, and a 17", 1280 × 1024 × 256 color display lists for $16,500 but is offered to developers for only $6,500. (Call 800/633-9909 if you're interested.)

While the MIPS ARC design includes an option for 1024 × 768 graphics for lower-cost systems, only the higher-resolution 1280 × 1024 display is currently supported. Note that with the exception of the Dell DGX system, the highest resolution currently supported on the x86 platform is 1024 × 768. In comparing the MIPS and x86 systems at the developer's conference, the display resolution was the most striking difference; the higher-resolution displays on the MIPS systems made them look far better.

The current NT release does not support R3000 systems, even though early versions are running on DEC's R3000-based workstations. Support for the R3000 requires different MMU and cache control software that

goes beyond the scope of the HAL, so it would require a different version of the kernel. The HAL is designed to abstract differences in system implementations using a given processor type, but it does not abstract processor-specific features such as memory management.

Microsoft expects to remain focused on the R4000, since that is where all the new system activity is centered. This means that DEC's current line of MIPS-based workstations, which DEC has promoted as "ACE-compliant," probably will not be usable with Windows NT—a fact that may displease parts of DEC's installed base. DEC is clearly lagging in its MIPS support, with R4000 upgrades not due until next year and no commitment to support NT on these systems. The key reason for this lackluster support of the MIPS line, of course, is DEC's intention to move its customers to Alpha.

The lack of R3000 support in NT is also bad news for IDT and Performance Semiconductor, which hoped that their integrated R3000/R3010-based processors with on-chip cache (IDT's R3081 and Performance's PIPER) would find a market in low-end ARC systems, as well as in high-end embedded applications. Now, however, it seems that there will be no general-purpose systems built with these chips, despite the fact that they are far cheaper than the R4000. In part, this is because low-cost derivatives of the R4000 are expected to ship next year, offering higher performance than the integrated R3000/R3010 chips at comparable prices.

Alpha PCs

DEC displayed a non-functioning circuit board for an Alpha PC at the NT developer's conference. The boards were claimed to be up and running VMS, but a DEC spokesperson said they thought it would be inappropriate to show VMS at a Windows NT show. The NT port to Alpha is being done primarily by DEC engineers, and DEC claimed to be within a few weeks of having Windows NT running. DEC cautioned that the PC boards shown were prototypes, not final products, and that the final systems would have different configurations. They said that the clock rate and cache size had not yet been determined.

Given the clearly immature state of these systems, what was the point of showing them? Apparently it was to give DEC an opportunity to express its commitment to building Alpha-based PCs to run Windows NT, and to demonstrate that it is possible to put an Alpha processor in a PC-type package.

The wording here is important—DEC was talking about Alpha-based *PCs*, not Alpha-based *workstations*. Alpha-based PCs will use the EISA bus for expansion cards, have lower-performance graphics, and typically will be configured with less memory and smaller caches. Of course, they will also be priced lower. The dual product line is a clear sign of DEC's intent to push Alpha as aggressively as possible into a wide range of applications, with Alpha PCs running Windows NT as the high-volume/low-price end of the spectrum.

DEC plans to use Intel's PCI bus (see µPR 7/8/92 p. 7) in its Alpha PCs. DEC is developing a PCI chip set for use with the Alpha processor, and it will provide this chip set on the merchant market. DEC is already a major supplier of mail-order x86-based PCs, and given the company's massive commitment to Alpha, you can expect to see big ads in the PC magazines touting Alpha PCs for Windows NT sometime next year. DEC promised that it would ship systems when the end-user version of Windows NT was released, which Microsoft is promising for late this year or early next year.

Multiprocessor Systems

Windows NT includes support for multiprocessor systems. All tasks awaiting execution are divided among the available processors. With multithreaded applications, even a user running only a single application could realize a benefit from a multiprocessor system, so multiprocessor systems could become popular for desktop computers as well as for servers.

All multiprocessor-specific functions are contained in the HAL, allowing a wide variety of multiprocessor machines with up to 16 processors to be supported by providing a custom HAL. NT does require that the processors be fully symmetric: each processor must have identical access to I/O devices and memory, and each processor must be able to interrupt any other processor. This requirement means that many existing multiprocessor systems, such as those based on Corollary's C-Bus architecture, will not be able to run NT. (Corollary's C-Bus II, designed to support the P5, is fully symmetric and will support NT.) At the developer's conference, Microsoft demonstrated NT running on multiprocessor systems from NCR, Wyse, Compaq, and ALR.

Conclusions

The memory requirements of Windows NT place it out of reach for users of entry-level systems, and Microsoft expects Windows 3.x to continue to be the mainstream standard. Within a few years, however, even 32 Mbytes won't seem like a great deal of memory—it requires just four 64-Mbit chips—and the 486 will be an entry-level processor. So, while NT requires leading-edge PC hardware today, this won't be true for long.

Windows NT will finally free the PC world from compatibility constraints from which it has suffered since 1981, bringing PCs into the modern age while still maintaining a reasonable degree of compatibility with existing PC software. At the most fundamental level, it eliminates the need for an x86 processor, giving the MIPS and Alpha architectures a chance to make good on their claims of superior price/performance. ♦