Intel Prospers; Platform Progresses

Fall Forum Promotes Proposals for Consumer and Commercial Computing

by Peter N. Glaskowsky

With about 500 people working at the Intel Architecture Labs (IAL) in Hillsboro, Oregon, a lot of work can get done in just seven months. Since the last Intel Developer Forum (IDF) in February, IAL's engineers have made significant progress on existing initiatives and started others. The September IDF, at its new home in Palm Springs, California, provided IAL's engineers and marketing staff with an opportunity to describe this progress.

In addition to the first public disclosure of the Katmai New Instructions (see MPR 10/5/98, p. 1), IDF saw the debut of a number of new products and platform standards for every category of personal computer. These include the new G.Lite digital subscriber-line standard, a home phoneline networking specification, recommendations for the transition to Direct RDRAM, CPU enhancements for data security, and new physical form factors for servers and workstations.

Intel Takes Over, Takes Off

In just six years, Intel has evolved from a mere supplier of CPUs into the leading R&D firm for the whole personal-computer industry. When Intel describes its vision of trends in PC system architecture, PC makers listen. At IDF, Intel offered several such visions—increased integration at the low end through shared-memory graphics implementations (also known as unified memory architecture), increased differentiation among CPUs, and significant improvements in system performance enabled by technical advances in every major subsystem.

Intel's predictions tend to come true. Next year, Intel will reportedly offer the Intel 810 (code-named Whitney), a shared-memory graphics chip set for low-end PCs that joins similar products from SiS and VIA (see MPR 8/24/98, p. 4). Intel's new 1999 CPU roadmap shows new x86 processors for every market segment, with Merced to follow in 2000 and McKinley in 2001. Finally, of course, the work of the Intel Architecture Labs ensures that technical progress is made elsewhere in the system.

G.Lite Speeds Consumer Internet Access

Though it's probably too late to fulfill Intel CEO Craig Barrett's prediction of a billion connected PCs by 2000, IAL has been working hard to improve home-computer connectivity. IAL's most significant efforts are centered around finding new uses for existing telephone wiring, for both Internet connectivity and in-home networking.

For improved Internet access, Intel is helping to develop the G.Lite variant of digital subscriber-line (DSL) technology. The G.Lite specification—currently under development within the International Telecommunications Union, with Intel as the editor of the proposal—will permit speeds of 1.5 Mbps downstream and 512 Kbps upstream over existing phone wires using a relatively low-cost DSL modem. Of course, the local telephone-company switching system must use G.Lite-compatible equipment as well.

Intel chose to support G.Lite over other DSL variants because it eliminates the need for professional installation of line-isolation hardware at the subscriber's residence while still providing a substantial (30×) improvement over existing 56K-modem performance. Full-rate ADSL operates at 6.1 Mbps downstream and 1.5 Mbps upstream but requires line isolation and much more expensive modems. As component costs come down over the next several years, we expect to see G.Lite give way to full-rate ADSL, with intermediate modems capable of supporting both.

Interestingly, G.Lite—like most DSL standards—is based internally on asynchronous transfer mode (ATM) protocols, but it presents an Internet-Protocol (IP) interface to the outside world at both ends of the connection. This brings ATM slightly closer to the desktop and presents what we believe is an interesting opportunity for PC communications software to benefit directly from the quality-of-service guarantees and traffic-management features offered by ATM.

In-Home Networks Also Due for Boost

Within the home, Intel favors a phoneline-based local-area network based on the work of the Home Phoneline Networking Alliance (HPNA). The basic HPNA technology comes from Tut Systems (*www.tutsys.com*) and uses higher-frequency signaling that does not interfere with voice or DSL

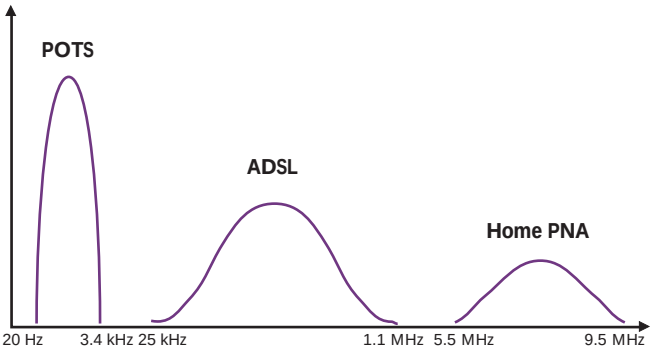

Figure 1. A single phone line can carry three distinct types of traffic. Analog voice signals operate at low frequencies. Digital subscriber line traffic uses higher frequencies, up to 1.1 MHz, while home phoneline networks use the 5.5–9.5-MHz band.

traffic, as Figure 1 shows. HPNA makes it possible for several computers in a large household to share a single Internet connection as well as networked peripherals such as printers and scanners.

The first HPNA chips operate at 1 Mbps. With protocol overhead, this is less than half the 2-Mbps aggregate bandwidth of G.Lite. A 10-Mbps version of HPNA currently under development will provide more headroom for G.Lite and other fast Internet access schemes.

At IDF, Intel introduced the 21145, a new multifunction network interface chip that includes 1-Mbps HPNA and conventional 10-Mbps Ethernet networking controllers. Covering the two most likely methods for home networking, this PCI-bus device should become common in home computers. The chip doesn't support Fast (100-Mbps) Ethernet, however, making it unsuitable for business systems.

A separate group within Intel is working on wireless home networking at least as fast as HPNA. The HomeRF initiative operates at a range of up to 50 meters at 1 or 2 Mbps. As such, the HomeRF technology overlaps somewhat with the 1-Mbps Bluetooth effort (see MPR 6/1/98, p. 22). Bluetooth requires significantly less power but provides much less range—just 10 meters; while Bluetooth is optimized for long-duration operation away from AC power sources, HomeRF is primarily designed to replace wired networks for relatively stationary line-powered devices.

Servers Stick With SDRAM

Intel's server design group has been very busy supporting the company's Xeon efforts. At IDF, Intel released a variety of guidelines for server memory and peripheral interfaces.

The Intel/Rambus Direct RDRAM effort is still on track for mid-'99 system shipments, with multiple vendors now having provided fully functional DRAM samples that operate at or beyond the targeted 400 MHz (800 Mtransfers/s). Even so, Intel is now recommending that server makers stick with 100-MHz SDRAM main memory until 2H00, since Direct RDRAM memory will not offer sufficient density when it arrives in 1999.

Intel's roadmap shows midrange servers will need to support up to 16G of main memory in the year 2000. This would require 128 Direct RDRAM memory modules based on 64-Mbit devices, or 64 separate Direct RDRAM channels—far more than any practical chip set or motherboard could provide. DRAM vendors are expected to produce two more generations of Direct RDRAM chips by the year 2000 to match the expected 1-Gbit density of SDRAMs and bring this device count into a more acceptable range.

With Gigabit Ethernet (GE) already emerging from the laboratory into corporate backbone applications, it won't be long before enterprise server designers need the ability to integrate GE directly into new high-end servers. The effective data rate of GE is greater than the sustained bandwidth of the current 32-bit, 33-MHz PCI bus. Intel is therefore recommending that high-end servers be equipped with a 64-bit, 66-MHz PCI interface, providing four times the peak rate of the commodity PCI bus.

Sources indicate Intel is working on a new server chip set code-named Carmel for introduction in 2H99; it will feature two Direct RDRAM controller channels and multiple 64-bit/66-MHz PCI interfaces. Carmel will work with the forthcoming Cascades processor (see MPR 10/5/98, p. 5) to implement 4-way servers. Some configurations are likely to use special repeater chips to connect Carmel's Direct RDRAM ports to larger arrays of standard PC-100 SDRAM.

For More Information

There was much more presented at IDF than we could cover here. For the rest of the story, Intel offers a complete set of the IDF keynote speeches, slides, and specifications at *developer.intel.com/design/idf*.

Intel Offers New Design for Workstations

IDF saw the debut of Intel's new specification for the WTX workstation form factor, available online from *www.wtx.org*. WTX provides a number of important features lacking in the mainstream desktop ATX specification. The new specification will be used for dual-processor Xeon and Merced systems, and it incorporates AGP Pro (see MPR 3/30/98, p. 14) for high-performance 3D graphics as well as a new Flex Slot interface for application-specific I/O.

The key to WTX is a new system form factor based on predefined zones for each element of the system. Four zones—for processors, memory, graphics and I/O, plus the Flex Slot—include components related to the WTX motherboard. Other areas within the case contain the power supply (attached to the hinged cover) and mass-storage devices. The WTX specification defines the shape, size, and thermal limits for each zone. OEMs are free to assign subsystems to different zones as long as these limits are observed.

Like Intel's server system recommendations, WTX moves memory off the motherboard onto riser cards. These cards will likely connect to Direct RDRAM interfaces on future Intel workstation chip sets. Through 2H00, we expect WTX workstations to use SDRAM memory chips to overcome the density limits of Direct RDRAM devices.

The Flex Slot is the most interesting new concept in WTX. Flex Slot cards will be used to adapt a WTX system to a particular target market. Digital-video workstations, for example, would include Flex Slot cards containing fast analog-video interface logic plus controllers for external disk-drive arrays. Though Intel has not yet decided on a bus interface for Flex Slot, we believe the interface is likely to be one of the 64-bit variants of the PCI bus to match the bandwidth demands of these advanced I/O standards.

WTX provides more flexible packaging options than ATX. WTX systems may be designed for rack-mount

applications, and the WTX motherboard uses a new mounting-hole pattern to reduce the number of reserved areas on the board, easing component layout and trace routing.

WTX does not include certain high-end reliability-enhancing features such as redundant power supplies or hot-swappable disk drives. These features are common in servers but were deemed unnecessary for most workstations.

Paranoia Prompts Improved Protection

Recently, the United States and Ireland signed a trade treaty by applying electronic signatures from smart cards to an electronic version of the document. While electronic contracts may be some time off for the common man, personal computers are already being used for critical functions for businesses and consumers, such as managing corporate and personal finances and electronic commerce. Clearly, issues of platform security are becoming more important to computer buyers.

Intel has been exploring ways to help meet this growing need. The company plans to provide more detail about processor security features in 1Q99, but Barrett's speech at IDF suggested future Intel CPUs may include a hardware random-number generator (RNG). An Intel presentation at the show described a specific type of RNG that could be integrated into a standard CMOS processor: a free-running oscillator with its frequency modified by the thermal noise in a resistor or diode. We also expect to see a hardware serial number to assist with hardware security and software piracy protection. With these functions in the CPU, it becomes possible to build stronger cryptographic software into applications and the operating system itself.

Intel is also working with consumer-electronics companies to develop copy-protection technology for digital media transmission over the IEEE 1394 bus. These companies believe this technology is required before 1394 interfaces are added to DVD players, digital VCRs, and similar devices that could otherwise be used to copy prerecorded movies and audio discs. Intel is contributing its expertise in host-based cryptography so that the new method, known as the digital transmission content protection (DTCP) protocol, can be implemented on mainstream PCs. The current version 0.9 specification is available from the DTCP working group at *www.dtcp.org*.

IPEAK Expands Into New Applications

IDF also saw the debut of a new set of hardware and software development tools in Intel's performance evaluation and analysis kit (IPEAK). The new I/O Monitor application tracks I/O requests through the new Windows Driver Model (WDM) stack in Windows 98 and Windows NT 5.0. Developers of WDM-compatible device drivers and peripherals, such as USB and 1394 controllers, can use the tracking data to improve efficiency and reduce bus and CPU loading.

The 1394 Integration Toolkit exercises and tests the WDM drivers that are provided by Microsoft, monitoring the performance of 1394 peripherals and the custom mini-drivers that interface these peripherals to Windows and applications. The Intel software will also help peripheral developers ensure that their products work correctly with the Windows Plug & Play mechanism.

Intel's DVD Qualification and Integration Toolkit (DQUIK) is designed to assist in the development of hardware to support host-based DVD playback. The toolkit observes the performance of individual system components involved in the playback process, including the audio, graphics, and video subsystems.

Progress Made on Older Initiatives

Other key efforts to advance the PC platform, the subjects of previous IDFs, are proceeding. The Instantly Available PC initiative, which allows desktop computers to rapidly enter into and return from a low-power suspend mode, should arrive in consumer systems in 1Q99. Business machines, slightly more complex due to support for remote-management features such as Wake-on-LAN, are expected one quarter later.

These systems are sure to be popular with all PC users, who will no longer need to leave their systems running just to avoid a lengthy bootup delay each time they check for e-mail. One-button, eight-second suspend-and-resume will go a long way toward persuading users to make PCs a more routine part of their daily lives. For Intel, increased consumer acceptance means increased market penetration, more sales, and more profits to support R&D into PC platform advances—a not-so-vicious circle the company is eager to continue.

A considerable part of the IDF program was devoted to Intel's efforts to integrate Digital's StrongArm microprocessor into its product plans. Barrett made it clear that Intel is considering the use of StrongArm in traditional i960 applications, such as the I_2O intelligent I/O controller initiative for PC-based server systems. Although Intel's own I_2O people remain committed to the 960, the handwriting is on the wall: if StrongArm proves to have better price/performance than the 960—and it is likely to—Intel's senior management may force the 960 partisans to yield on this issue.

IDF Showcases Intel's Innovations

Slow but steady may win the race, but that's not Intel's style. IDF comes twice a year now, with three days and multiple program tracks revealing a wealth of information on Intel's progress in developing PC platform technology.

New specifications and proposals such as G.Lite and HPNA will have a tremendous influence on the design and operation of tomorrow's personal computers. Intel's research into the needs of server and workstation vendors has led to important new proposals for those markets as well. In just over a year, IDF has surpassed Microsoft's WinHEC as the leading source of guidance for PC hardware designers. As Intel's engineers assume more responsibility for the future of the PC platform, we expect IDF to become even more important to the PC industry. M