Two of the computer industry’s important trends are the system on chip (SOC) and the information appliance (IA). Each trend represents both an important new direction for the industry and a potentially lucrative market for vendors.

Now, chip makers have announced that they have developed SOC technology for IAs. This means that these two trends may now depend on each other for success.

This convergence could be critical to the future of IAs—thin clients, smart phones, and other special-purpose computing and communication machines that provide Internet access. Many industry observers predict that IAs will become increasingly popular because they will be easier to use, less expensive, and smaller than PCs while still performing the basic tasks that many consumers want, such as accessing the Web and e-mail.

The promise of SOCs is that they could be used in appliances to save manufacturing costs and reduce space and power consumption. These are important factors for devices that must be small and relatively inexpensive.

The system-on-chip technology and the information appliance are proving to be a good match.

National Semiconductor made perhaps the most significant recent announcement of IA-on-chip technology when it released the Geode processor. Vendors have to add only a few additional memory chips and a handful of high-voltage components to the Geode to provide the functionality for their information appliances. Companies such as Compaq and Philips Electronics have also released their own versions of the IA on chip.

The IA-on-chip model could provide chip makers, such as National, with new markets and new ways to use their increasingly powerful products.

However, some observers have expressed concern about the SOC. For example, some say they are very complex and thus may be difficult to design and produce in a timely manner. Others say the SOC might not work optimally because the different types of technologies found on them progress at different rates. For example, if graphics technology progresses particularly quickly, older integrated chips may soon contain outdated graphics technology, while systems that use separate graphics processors could acquire chips with the latest technology.

Nonetheless, Max Barlow, an analyst with Cahners In-Stat, a market research firm, predicts that IA vendors will find SOCs useful for providing performance at low prices.

The SOCs have been a goal of chip developers for years. SOCs include commonly used functional cores—such as microprocessors and bus controllers—and other elements that can be customized to meet user requirements.

Basically, the SOC eliminates the need for many of the boards, cards, and peripheral chips—such as graphics controllers, Ethernet interfaces, super I/O chips, and SDRAM controllers—currently found in many computers. Modern chip-making processes, using smaller feature sizes, have let manufacturers fit more of this circuitry onto processors.

However, SOCs must also be powerful. According to Philips Electronics Research marketing manager Elizabeth Houck, IAs—including even small devices such as smart phones—will have to process audio, video, and graphics streams in real time, much like PCs must do today.

The SOC’s use of dedicated logic cores on a chip to perform specific functions differs from Intel’s traditional approach to integrating functions within the main system chip.

In Intel’s approach, the CPU itself performs complex tasks, such as running signal-processing software to perform video decompression or to transmit modem signals. Intel spokesperson Seth Walker said this approach would become more effective as CPUs offer more MIPS and as instruction sets improve and offer more functionality.

However, some say it is difficult to ask a single CPU to effectively perform more...
and more functions, many at the same time. National and other SOC vendors argue that it is more effective, less expensive, and less energy-intensive to implement functionality by adding hardware to the processor.

Nonetheless, designing SOCs presents several challenges. For example, it can be difficult to develop reliable operating systems for SOCs that include sufficiently advanced multimedia features, said Peter Glaskowsky, an analyst at MicroDesign Resources, a microprocessor-industry analysis firm.

It is also a challenge to put analog circuitry on a digital chip, he said. Many important functions, such as driving analog displays, are fully or partially analog. However, designing analog circuits for digital chips and reducing analog circuits’ electronics to smaller geometries may prove to be difficult.

Geode: A Case in Point

National’s recently introduced Geode is the newest of the growing number of SOCs designed expressly for information appliances. It also provides a good example of the technology used in such chips.

Technology. Geode combines a Pentium-class, CISC CPU and most of the circuitry required for a computer system, including those that provide system logic, memory management, and a host of storage and I/O functions, as shown in the figure.

Geode stands out from other SOCs because it has embedded MPEG encoding and decoding hardware for compressing, decompressing, and otherwise processing streaming video and audio. Geode offers other multimedia enhancements, such as an AC-97 audio interface and an audio processor for MPEG and Dolby AC3 audio.

In fact, Geode includes so many functions that vendors can turn it into a Windows-compatible computer just by adding some RAM, some ROM or EEPROM, and a few high-power components (such as power transistors) capable of supporting the larger voltages and currents required to provide power management and to run the display and audio drivers.

However, the Geode performs at only 266 MHz, too slow for today’s PCs. In addition, the Geode’s 1995-vintage MediaGX core lacks the large cache memory and some of the other features found in Pentium II and III processors. National thus perceives Geode’s primary market to be IAs.

Mike Polacek, vice president of National’s information appliances division, said much of the corporation’s reengineering effort has involved unifying the design rules and processes for all of its product lines. This enables virtually any function it sells as a stand-alone product to be easily assimilated as an embedded logic or analog core in a larger circuit.

Reusable logic cores help keep design cycles short enough to meet fast-paced consumer demand, he said. National could thus build the Geode just six months after completing the specification, because only six of its 43 design elements were new.

The marketplace. National spokesperson Paul Barbieri said the company expects to release beta versions of the Geode in January 2000 and to begin commercial production in mid-year. Geode is expected to cost $50 to $65, which would be perhaps 25 to 30 percent less than the cost of purchasing Geode’s functions separately.

Industry observers say National hopes the Geode will be in demand for information appliances and help make up for its failed effort to compete in the Intel-dominated PC microprocessor market. National bought Cyrix, which makes PC chips, but subsequently sold the company to Taiwan’s Via Technologies.
Barbieri said National is pursuing the Geode because “it’s about shifting the company’s direction and capitalizing on potential markets we see emerging.”

Under discussion are plans to use the Geode in thin clients and simplified desktop computers with Web browsers. In addition, hardware vendor Acer plans to use Geode as a key element in its X series of smart set-top boxes, which would include such features as broadband Internet access and interactive DVD. Rick Le, vice president and general manager of computer and consumer products for Acer, said the company chose to use Geode largely because of the suitability of its single-chip platform and performance

National’s Polacek said the Geode will not be suitable for several markets. For example, he said, video game machines require so many specialized processing capabilities that it would be impractical to add the necessary hardware to the Geode.

Competitors

Several other companies already have or are working on SOC designs for IAs.

Philips. This year, Philips plans to release an enhanced version of its TriMedia chip, primarily for smart set-top boxes and stand-alone IAs, such as thin clients. In addition to its 180-MHz, VLIW, RISC CPU, TriMedia has co-processors for video compression and audio processing, and a decoder for MPEG I and II images.

Motorola. Motorola has rolled out its MPC 823 for use in Web phones and handheld communicators. Its low power consumption makes it suitable for embedded, battery-powered products.

The MPC 823’s PowerPC RISC CPU is coupled with built-in I/O that lets it interface with most LAN or WAN connections. Embedded software lets the on-chip communication engine perform bridging, routing, filtering, and processing of traffic without taxing the CPU. The CPU can then handle the higher-level tasks associated with running an information appliance.

Intel. Intel acquired StrongARM SOC technology, originally developed by Digital. The StrongARM SA-1100 and SA-1101 are designed to provide portable applications with high performance and low energy consumption.

The driving force behind system-on-chip (SOC) technology may turn out to be information appliances (IAs), rather than PCs, as originally believed by many industry observers.

In many ways, the small, inexpensive SOCs are well suited for the small, inexpensive IAs. These computing and communication appliances can range in complexity from a small Web browser built into a smart phone or personal digital assistant (PDA) to a thin-client computer or set-top box. Generally selling for $100 to $500, IAs— which have a simplified user interface, Internet and/or network connectivity, and a single function or a narrow range of functions—are intended to give users some of the functionality of a traditional personal computer without the complexity and overhead of operating and maintaining a PC.

Peter Glaskowsky, an analyst for MicroDesign Resources, a microprocessor-industry analysis firm, doubts the information appliance’s viability as a stand-alone unit. Instead, he said, the real market will be in giving existing products, such as cellular phones or set-top boxes, Internet connectivity that lets them access Web pages, e-mail, or online databases.

However, MicroDesign Resources analyst Tom Halfhill said some of the information appliances could have sufficient functionality to present a serious challenge to the low-end computer market. Intel, Microsoft, and other companies are trying to keep the PC market alive and well by working on initiatives designed to simplify the PC and its operations.

Nonetheless, many industry analysts predict that while PC sales will continue to grow, IA sales will grow much faster and surpass the PC market in a few years. Chip manufacturers are thus scrambling to develop SOCs that will attract some of this market.

This is particularly the case for PC-chip makers, who are facing declining processor prices and less-than-explosive growth in PC sales. They want to reach consumers who don’t want PCs but who might be interested in easier-to-use IAs.

November 1999
The development of SOCs for information appliances could have important effects on the computer industry. Tom Halfhill, an analyst for MicroDesign Resources, said the arrival of SOC-based information appliances might significantly erode the market for low-end PCs. PCs, he said, would then be primarily for expert users.

System-on-chip designs could help increase the popularity of information appliances.

If this proves to be true, the increased popularity of information appliances would bode well for SOC vendors. However, said Will Strauss, an analyst with Forward Concepts, a market research firm, most chip vendors won’t be able to take advantage of this.

“Today,” he explained, “the SOC model only works for companies that have all of the cores and intellectual property required to do the job. And that’s few companies right now.” He said it will be another five years until there are tools and practices that let vendors freely buy and sell cores and intellectual property.

Even now, though, SOCs could help increase the popularity of information appliances. However, the appliances will not appeal to users unless they remain inexpensive, easy to use and maintain, and capable of transparently accessing the Internet, said Larry Weber, vice president and general manager of developer products for SunSoft, a business unit of Sun Microsystems.

If this happens, many industry analysts predict a bright future for both information appliances and SOCs.

Lee H. Goldberg is a freelance technology writer based in Princeton, New Jersey. Contact him at prestomeco@home.com or lgoldberg@chipcenter.com.

Industry Trends

Continued from page 12

Holographic storage

Researchers from a variety of companies are working to develop commercial holographic storage systems.

Holographic systems would store images of data via the same principles used to create holograms. A holographic system encodes a data set’s binary zeros and ones and turns them into an electronic bit stream. Lasers then store the stream as a holographic image by projecting it into a photosensitive crystal. Multiple data holograms could be stored in the same crystal, permitting very high storage volumes.

Holographic systems read data by shooting a laser into a crystal and projecting a hologram onto an imaging device. The angle of projection determines the specific hologram that is read.

Holographic storage systems would store and retrieve an entire data image at one time, which would be faster than trying to access data serially or in parallel.

The final challenge for researchers is finding a viable material for the crystal. Early research focused on exotic and expensive materials, but the Photorefractive Information Storage Materials (Prism) program has made progress with polymers, which would be less expensive to mass-produce.

Laser Tape

Another promising high-end storage technology is Laser Tape, under development by Lots Technology. Laser Tape has a higher storage capacity than standard magnetic tape because it is an optical medium, noted Joe Straub, Lots’ vice president of marketing.

Laser Tape has a storage density of 80 terabytes per cubic foot. Laser Tape would fit in the commonly used IBM 3480 magnetic-tape cartridge. One cartridge of laser tape could store a terabyte of data. One cartridge of magnetic tape, on the other hand, stores 20 gigabytes of data.

Laser Tape systems would read and write data very quickly by using a diffractive grating to split one laser into multiple beams, which could then read from and write to different parts of the same tape in parallel, Straub said.

The IIT Research Institute’s Kempster said the Laser Tape’s large storage capacity and widely used form factor make it well suited for major data-collection efforts.

Kempster believes the requirements of scientific and military research will demand and drive development of bigger and better storage technologies. However, he said, consumers will also need expanded capacity to store increasingly data-intensive multimedia content and to handle bigger applications and operating systems.

Forrester’s Howe even sees companies reshaping their IT architectures around storage. For example, companies could distribute storage servers throughout a large network to optimize all users’ data-access rates.

“If you are spending an increasing portion of your dollars on data,” Howe said, “you will probably want to focus your architecture the same way. That is particularly true in e-commerce. You will see a new data-centric model where computers are peripherals to data, as opposed to data-storage devices being peripherals to computers.”

George Lawton is a freelance technology writer based in Brisbane, California. Contact him at glawton@best.com.