

THE PUBLISHER'S VIEW

The Inexorable March of the Microprocessor

Relentless Pace of Improvement Makes Industry Dynamics Unique

Lost in the day-to-day frenzy, we easily lose sight of what a remarkable industry we are privileged to be a part of. Headlines give the impression of an industry fraught with problems: chips with bugs, operating systems that won't be delivered when expected, application programs that are bloated and slow, handheld devices that disappoint, and communications infrastructures that aren't ready. To be sure, the computer industry has its share of troubles.

The fundamental dynamic of this industry is so different from that of any other, however, that we need to look at it very differently. Much of the thinking in and about our industry is crippled by attempts to apply rest-of-the-world paradigms to our unique business.

What makes the computer industry unique is the pace of change—change that is almost uniformly for the better. Processing power inadequate for your application? Not enough memory? Communications too slow? Wait a year or two and you'll have twice as much, for the same cost. No other industry has the benefit of this kind of sustained, dramatic improvement in its basic attributes.

Microprocessors and memory chips, driven by advances in semiconductor process technology, are the prime drivers of the computer industry. Other key peripherals have done remarkably well at keeping pace, however. Today, a 1-Gbyte disk drive sells for less than the price of a 10-Mbyte drive a decade ago: a hundred-fold improvement, matching the advance in CPU power. Modems have increased from 1,200 bits per second to 28,800 bits per second—a mere factor of 24. When true digital connections become common, communication bandwidth will increase even more rapidly than CPU power, enabling a vast range of new applications.

Displays have progressed relatively slowly in many respects. But remember how, not so many years ago, a portable computer with a color display drew crowds at trade shows? This year, virtually all new notebook computers will have color displays.

Because of the rapid pace of change and intensely competitive environment, PC companies tend to focus on the very near term; long-term planning extends no further than the Comdex after next. The industry is almost entirely focused on development, with very little research. But the longer-term implications of continuing, dramatic advancements in the underlying technology are profound.

Today's personal computers, for all their sophistication, represent a very early stage in the development of

computing. It would be folly to think that the desktop form factor, or the keyboard interface, or any of dozens of other characteristics will continue to dominate.

Prevalent attitudes toward handheld computers are typical of the shortsighted view. Sure, today's devices are horribly limited. But think about what they could be like with ten times as much computational power, storage, and bandwidth. Unlike other industries, this isn't blue-sky fantasizing; this is a reality you can count on. Electronic tablets will eventually replace many forms of paper, revolutionizing the way information is communicated and the way people interact with electronic devices; it is only a matter of time.

Set-top boxes are another important example. Some observers have criticized Silicon Graphics and Time Warner for their \$3,000 set-top boxes in the Orlando trial, but this is exactly the right thing to be doing if you want to learn about what you can deliver in five to ten years. This project could be, if all goes well, the set-top equivalent of the pioneering Alto from Xerox PARC. By building personal computers that cost something like \$70,000 each—clearly absurd sum for individual use—Xerox researchers were able to invent the interface paradigm that has revolutionized personal computers. Building \$300 set-top boxes today may meet a current opportunity, but it is going to vastly undershoot the capabilities needed five years from now.

In the past decade, the inexorable march of digital technology has taken over audio, and video is now being converted as well. This shift, combined with the rapidly growing importance of electronic communication, the success of video games, and the explosion in educational CD-ROM titles will forever change the world of consumer electronics—not only home computers, but also televisions, telephones, cable boxes, and much more.

Having succeeded in revolutionizing the world of computing, microprocessors are about to do the same for a much broader range of applications, changing even the social and economic fabric. Microprocessors are at the heart of every digital device, controlling every node in the information infrastructure. The impact of the microprocessor clearly will be as great as any other invention in history. I can't imagine a more exciting time to be chronicling the evolution of this vital technology. ♦

