The Fifth Era of Computing

In the Era Beyond PCs, the Keys Are Displays, Memory, and Connectivity

It is now nearly 20 years since Don Estridge and his team in Boca Raton created the IBM Personal Computer. Although it was not obvious at the time, this machine ushered in the fourth computing era: the domination of the Intel/Microsoft standard. It brought to an end the hobbyist era that the microprocessor spawned, which followed the eras of big iron and minicomputers.

The IBM PC, and the de facto standard it created, totally reshaped the computing industry. After a 20-year run, however, during which the standard was extended again and again, the PC has matured—even stagnated. The system architecture is riddled with historical baggage that causes configuration problems and adds needless complexity. Furthermore, the entire industry seems stuck: it has been years since a real breakthrough software application emerged, and industrial design is mired in a world of bland boxes. Usability improvements come at a snail's pace.

Nothing that is selling 100 million units a year and carries with it an enormous industry fades quickly. But the future of computing is going to be much more diverse, and it may be surprisingly soon that the standards that anchor today's PC industry are far less relevant.

Intel and Microsoft both are working to eradicate as much of the legacy baggage as possible while retaining all the benefits of compatibility—and, of course, keeping as proprietary a lock as possible on the processor and the operating system. Through these efforts the PC standard will evolve, and its future generations are likely to dominate the desktop and notebook computer worlds for many years to come.

The big change that is upon us, however, is the proliferation of computing into many different kinds of devices. The driving applications are communications and entertainment: Web access, e-mail, and games, with video delivery starting to join the roster. Computing devices can't take on these roles in a pervasive way as long as they are bulky, ugly, hard to use, and unreliable—as they are today.

Ironically, microprocessor advances will not be the driving force behind the transition to the fifth era: ubiquitous computing. Faster, cheaper, and lower-power microprocessors will help, but today's microprocessors are adequate for a vast range of new devices. The critical technologies instead include displays, storage, and communications.

Desktop computer displays have remained remarkably unchanged in the past two decades. The recent debut of affordable desktop LCD panels (under $1,000 for a 15" display) marks the beginning of an enormous shift. As desktop LCDs move into the mainstream, access to computing will become far more convenient, and the systems less intrusive. What a household needs for computing to be more integral is not a faster PC, or even more PCs, but more points of access: a display in the kitchen, a display at the dining table, a display by the bed. Some might have keyboards, some might have touchscreens; some might be large, some small.

Increasingly large disk drives also will play a role. As drives with tens of gigabytes become mundane in the next few years, it will become practical to keep entire photography and music collections on disk. In another few years, digital video libraries will become economical.

Faster links to homes clearly will change the nature of the Web dramatically; less obvious are the changes that full-time connections will bring. When Internet connectivity is an assumed, constant resource, homes routinely not only will collect data from the Internet all the time but will make data available to it as well. It will be easy, for example, to check on your house when you are traveling, and you'll be able to access your personal data (i.e., photo, video, music) from anywhere.

Most of the hardware technology to make computing ubiquitous is already here, and the remaining key developments are all but certain to occur in the next decade. Far less certain is that there will be software to allow normal people to use all these new devices without them becoming as much of an annoyance as an enhancement to people's lives.

The challenge of creating great software for embedded computing devices is, in some ways, just as great as for PCs (see MPR 9/14/98, p. 23). It has the advantage, however, of starting from scratch; PC software has the additional handicap of being mired in two decades of featuritis.

With Windows CE, Microsoft is making a strong play to control the software infrastructure, whether a device is a PC or not—and whether it uses an Intel processor or not. The microprocessor landscape in the new era will be much more diverse; it will be free of the proprietary lock-in that has characterized the PC industry. The x86 architecture is handicapped by its inherently poor price/performance and power/performance, though there are applications where it will succeed nonetheless. Intel, furthermore, won't have to base all its success on the x86: with StrongArm, which the company acquired essentially by accident, Intel has a capable architecture for competing in the new era. M

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