APPLIED INTELLIGENCE

Faster, Cheaper, Smaller Is Still the Trend in Hardware

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This is the first in a series of articles on key industry trends affecting computer hardware, software, database environments and communications environments. A subsequent series of articles will demonstrate how these trends are profoundly affecting the evolution of new computer architectures, development methodologies and tools.

Knowledge of the key industry trends and an understanding of their importance are critical to the successful introduction and management of high-productivity tools, technology and methodologies.

The rate of change in the computer industry today is higher than it has been since the IBM 360 was introduced 25 years ago. Major upheavals are occurring throughout the industry, and the roles of the traditional mainframes and minicomputers are diminishing. These familiar systems are being replaced by vast networks of desktop computers and file servers. The future belongs to organizations skilled in providing solutions for the desktop-computing environment, the database infrastructure and the network infrastructure.

Three general trends continue to characterize the development of computing hardware: faster, smaller and cheaper. Throughout the 1980s, the computing platforms used shifted from powerful mainframes to minicomputers to personal computers. That shift will continue as the rate of change in computing architectures accelerates.

The figure illustrates the dramatic increases in computing power that will become available for mainstream computers through the 1990s. As shown, in six years the processing power of a PC will be equal to that of today's mainframe computer.

By the end of this decade, each of these platforms will experience an increase of more than an order of magnitude in processing speed through an advanced chip design that uses submicron features. As a result of the newer architectures, these processors will come in more compact cabinets without a loss of functionality.

In the last few years alone, the PC has been transformed from a desktop appliance to a portable to a laptop to a notebook and now a slate.

Each transformation delivered essentially the same computing power as its predecessor but in a substantially smaller case. Similar size reductions are also occurring in powerful workstations, mainframes and artificial-intelligence (AI) inference engines.

While the power of hardware continues to increase, the relative cost is rapidly decreasing. The actual unit cost, however, remains relatively constant. For example, an early PC cost about $4,000 and was equivalent to approximately 0.3 million instructions per second (mips). Today, the cost of a 386-based PC or Macintosh is also about $4,000, but they're equivalent to about 2 or 3 mips. Thus, the relative cost for PCs over the last eight years has declined by almost a factor of 10—and the cost will continue to drop.

The advances in chip technology will lead to the following improvements in desktop machines:

- Much higher computing power on the desktop;
- Continuing improvement in ease of use;
- Multifunction PCs, automatic networking;
- Ultra-high-speed LAN connections;
- Multimedia PCs;
- Real-time processing of speech input;
- Megapixel, HDTV color display;
- Cheap, portable PCs with cellular communications; and
- Powerful, inexpensive knowledge-based processing.

Much of the improvement in processing power will be gained through parallelism. Many problems now tackled using serial techniques are inherently parallel. These include information searches, sorting, merging, joining, transaction processing, data collection, optimal routing, database processing, memory organization, image processing, structural simulation and CAD/CAM operations.

Various forms of computers will exploit parallelism. Multiple parallel processors will be used for transaction processing, search engines, database machines, knowledge-base machines, inference engines, image processors, vector processors and other parallel implementations.

Relative to serial machines, parallel computers provide much greater throughput, faster response time, lower cost and the ability to handle extremely complex problems. To make use of these new techniques, we need to exploit the inherent parallelism in many common applications.

Major breakthroughs in hardware will enable computers to head in fundamentally new directions, such as ultra-parallel processing, high-speed inference engines, neural nets, programming using powerful graphical icons, AI computing and ultra-parallel knowledge bases.

One result of the simultaneous increase in processing capability and decline in cost is the fading importance of the minicomputer.

Minis were originally significant because they permitted the distribution of computing resources in increments smaller than those possible in mainframes. With the introduction of PCs in the early 1980s, minis still retained an important role in a multitiered computing architecture. They were commonly used as a departmental computing platform, delivering facilities that were not technically feasible on the PC. But now, with the increase in local PC processing and networking capabilities, the need for minis is dissipating.

In the future, the current three-tier hardware architecture of mainframes, minis and PCs will be replaced with mainframes and networked PCs tied into file servers.

The higher performance and lower costs of hardware will lead to specialized processors that can handle complex computing environments. LISP-based coprocessors, neurocomputers and parallel-processing engines will be used for AI applications. These processors will be linked into the standard organizational computing environment through file servers (again, special processors) and high-speed communications networks (also serviced by specialized processors).

One of the most profound changes in hardware is the gradual demise of the traditional mainframe computer. Large, central computers, such as the IBM System/370, have been obsolescent for years. They require numerous systems analysts to maintain complex layers of software and their cost for mips is 100 times the cost of mips on a PC.

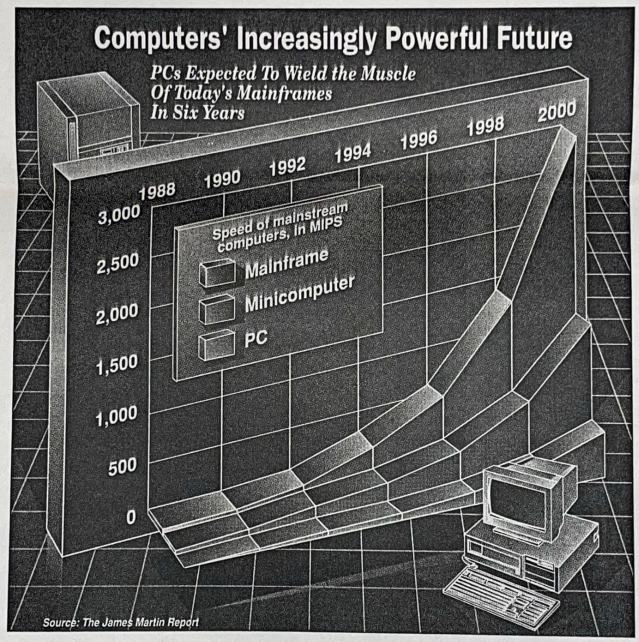
Organizations are increasingly recognizing that they can cut maintenance costs, improve response time and reduce the cost of additional mips of processing power by moving applications from the mainframe to the desktop.

PC Bound

Applications that are targets for downsizing to networks of PCs include transaction-processing applications and all software-development activities. In a few years, it will be inconceivable to use expensive mainframe mips for software development. All such development will move to the PC.

Larger central computers will still be needed for the sharing and distribution of large corporate databases, as well as for the control of extensive networks of PCs and file servers. To support very high-speed access to centralized data, these large central computers will be highly parallel machines, consisting of thousands of parallel processors. The mainframe will resemble a very large file server.

Next week, I will describe the major trends in computer software. ■



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The computing platforms used have shifted from powerful mainframes to minicomputers to PCs. That will continue as the rate of change in computing architectures accelerates.

The concepts embodied in this article are described in the High-Productivity Technology volume in The James Martin Report Series. For more information on this volume, call (617) 639-1958. For information on seminars, contact (in the United States and Canada) Technology Transfer Institute, 741 10th St., Santa Monica, Calif. 90402 (213) 394-8305. In Europe, contact Savant, 2 New St., Carnforth, Lancs., LA5 9BX United Kingdom (0524) 734 505.