Can Multiprocessing Go Mainstream?

Technology Will Be There—But Demand and Economics May Not

Ever since the creation of the microprocessor, there has been a natural fascination with the prospect of boosting performance by using more than one processor in a system. Today, multiprocessor (MP) systems have reached the mainstream of the server market, but they remain nearly nonexistent in the desktop PC market.

The technical barriers to multiple processors in mainstream PCs will soon be vastly reduced, but economic effects are likely to keep MP from becoming popular. Although it may seem, at first glance, that widespread use of multiprocessor systems would be great for Intel and other microprocessor suppliers—after all, it would mean that more processors could be sold—MP systems have the potential to destroy Intel's microprocessor pricing model.

First, let's look at the requirements for MP to be successful on the desktop. Windows NT provides the needed operating system support, but Windows 95 and Windows 98 do not. Around 2000, however, Microsoft will replace Windows 98 with NT Consumer. Thus, the OS part of the problem is solved today for high-end users and will be solved for everyone within a few years.

The next step is applications that benefit from MP. Servers, which serve multiple users, naturally have many parallel, independent tasks, making them a great fit for MP. Desktop systems are more challenging, however.

If a single application is written with multiple threads, it can transparently benefit from MP. If multiple applications are running, each with one or more threads, it is easy to gain some benefit from MP. The tough case is when performance on a single thread is all that matters.

Fortunately, many of the most performance-critical applications are amenable to multithreaded implementations. Geometry and lighting calculations for 3D scenes, processing of still images, compression and decompression of video streams, and voice recognition are all tasks that can be readily implemented with multiple parallel threads. Furthermore, as PC usage patterns become more complex, with communications functions and intelligent assistants running in the background, it will not be unusual for ordinary PC users to have multiple threads running.

Pentium II eliminates most of the hardware barriers for small-scale MP. With the L2 cache built into the processor module and an efficient MP bus, there is no inherent cost premium for MP capability. Although this may seem like a great benefit, it is also the heart of the economic problem.

Intel's fastest processor today delivers roughly twice the performance of its least expensive offering—but it is about eight times the price. Paying twice as much for a processor typically gets you only a small performance boost. A Pentium II-300 is about twice the price of a Pentium II-233, for example, but the typical performance gain is only 10% to 20%, and the maximum possible gain is 29%.

Now suppose the software environment evolved so many users could get perhaps a 50% performance boost from a second processor. This would make it more attractive to buy two less-expensive processors instead of one higher-end processor. Even four low-end processors would cost only half as much as one top-of-the-line processor.

A surge in popularity of multiprocessor configurations could thus lead to higher unit volumes for Intel but lower demand for its most profitable products. If processors were priced proportionally to their performance, either the low-end price would have to rise significantly or the high-end price would have to drop dramatically. The first option is not viable, especially in a competitive market; the second option would slash Intel's prices and require a major change in the company's business model.

The net result is that widespread multiprocessing is not in Intel's best interest. This may be a factor in why Slot 1 processors support only two processors per system, not four, and why the new Celeron processors won't support even dual-processor configurations. There is little long-term technical reason for these limitations; if Intel wanted to, it surely could create a low-cost processor that would support a four-CPU configuration. But by keeping dual-processor-capable CPUs from reaching entry-level prices and limiting four-processor-capable CPUs to high price points, Intel can prevent possible MP popularity from affecting its prices.

So far, Intel's competitors have no processors that are a good fit for an MP system. This is likely to change in 1999, however, as AMD introduces the "Slot A" K7 processor. The least expensive K7 systems won't support multiple processors, however, because the bus design does not support glueless multiprocessing. Cyrix, if it produces Slot 1 processors, might also have processors suitable for MP systems.

Even if the software, hardware, and economic challenges are overcome, MP may have limited success. The ultimate limiter may be a lack of demand for high levels of performance; today, there are few mainstream applications that strain the abilities of one processor, much less several. M

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