THE EDITOR'S VIEW

Computer Makers Lead in High-End Processors

Economics of Systems Business Gives Computer Makers an Edge

By Michael Slater

With the emergence of personal computers in the 1980s, merchant-market microprocessors became the heart of the vast majority of computer systems. As microprocessor performance soared in the second half of the decade, microprocessor-based systems began taking over even high-performance computing systems. It is interesting to note, however, that the top-performing microprocessor-based systems—those from Hewlett-Packard and IBM—are based not on merchant-market microprocessors, but on processors designed and implemented by computer companies.

The key reason for this is economics: computer makers don't have to justify their processor R&D budgets based on chip sales. Companies such as HP and IBM can justify developing very-high-end processor designs, even though the unit volume will be small, because the profits per system are far higher than the profits per microprocessor chip. A semiconductor company must aim for high-volume markets, and this precludes development of processors aimed at the highest performance levels. System makers have additional advantages of being able to integrate the chip and system designs, and they can accept lower yields than would be acceptable for a high-volume microprocessor.

Another factor that has limited the performance of merchant-market processors is the desire of semiconductor makers to maintain compatibility with existing products. The development of RISC microprocessors was driven by computer companies, not by semiconductor companies, because the chip companies didn't want to consider such a radical departure from their existing products. Only after the MIPS and SPARC architectures began to be successful—and were licensed to other semiconductor companies—did the microprocessor volume leaders Intel and Motorola seriously pursue the technology. Both did so too late and in a half-hearted fashion, and their general-purpose RISC architectures—Intel's 860 and Motorola's 88000—have been largely unsuccessful.

Of the merchant-market microprocessors, the most successful high-performance chips have been those designed by computer companies and then licensed to semiconductor makers. TI's SuperSPARC, for example, has been heavily funded by Sun, which provided much of the design team; without Sun's backing, this chip would not have been developed. At least two other high-performance SPARC designs—Fujitsu's SPARC-H and LSI Logic's Lightning—have been canceled before coming to market because of lack of backing from Sun.

HaL Computer Systems is developing its own SPARC implementation that is expected to outperform merchant-market versions; Amdahl and Cray may do so as well. In the high-performance systems market, hundreds of systems a year is a big success, but developing processor chips for this market would not be a viable business proposition for a semiconductor vendor.

Semiconductor makers also lack the market clout to make an architecture successful—they depend on the efforts of system makers. The x86 architecture is dominant not because of Intel's efforts, but because IBM chose to use it. Motorola's 88000 family, on the other hand, has had limited success despite its technical virtues because of a lack of influential system makers.

In the 1990s, the dominant architectures in general-purpose computing will be those designed by computer companies, with one enormous exception: Intel's 386/486 architecture. The incredible volume that this microprocessor family has achieved has given Intel the revenue to invest in very-high-performance, highly tuned processor implementations.

Intel is motivated to develop a part with very high performance to demonstrate the headroom in its architecture, even if a less-expensive device with more modest performance might serve its primary markets better. Even so, it is unlikely that the x86 family will ever match the performance of microprocessors designed by computer companies.

While proprietary processor implementations will always have the highest absolute performance, merchant-market microprocessors provide far better price/performance. If the software challenges of using large numbers of processors to achieve high aggregate performance can be solved, massively parallel systems could enable merchant-market microprocessors to become the heart of the highest-performance systems. Even here, however, system makers may prefer to use their own designs, since merchant-market parts won't be optimized for this application.

So, while merchant-market microprocessors will dominate shipment volumes, proprietary implementations (but not proprietary architectures) will continue to dominate the high end of the computer market. ♦