Silicon Graphics, MIPS Part Ways

SGI Spurns Future MIPS Chips for IA-64, Spins Off MIPS Group

by Linley Gwennap

MIPS fans weren't sure whether to mourn or celebrate after hearing that Silicon Graphics will spin off its MIPS Technologies subsidiary after killing its next-generation MIPS core, the H2, and all subsequent CPUs. MIPS Technologies will serve the rapidly growing embedded market. In lieu of its own processors, SGI will use Intel's IA-64 processors, as well as some x86 chips, in its future systems.

The change should not slow MIPS's highly successful efforts in the 32-bit embedded-processor market. Last year, the company collected royalties on more than 48 million MIPS chips (see MPR 1/26/98, p. 14) and should increase that number in 1998. Freed from the distraction of designing computer processors, MIPS Technologies should be able to better focus on products for its high-volume markets.

The MIPS instruction set was born as an engine for general-purpose computers, however, and the end is in sight for that branch of the product line. Although SGI will continue to deploy MIPS-based systems for the next 2–3 years, the bulk of its efforts will soon be focused on IA-64, as Figure 1 shows. The company plans to port its IRIX operating system to IA-64 to help its current customers make the switch. SGI also plans to offer Windows NT on x86 and IA-64 (but not MIPS).

The announcement showcases a series of policy reversals for SGI. After years of pummeling Intel while promoting its own RISC architecture, SGI has formed a long-term relationship with the x86 vendor while dumping RISC. Similarly, SGI's management railed against Microsoft and Windows NT to such an extent that it undermined its MIPS-on-NT effort; now the company is a happy NT vendor. Finally, the company that once purchased MIPS Computer Systems is now spinning it back out as a standalone company.

Silicon Graphics Gains Focus

Not surprisingly, these turnarounds have occurred under a new management team, led by ex-HP VP Rick Belluzzo, now Silicon Graphics CEO. Belluzzo took over after a series of disappointing financial quarters left SGI seeking a new strategy. Designing entire computers from scratch—including processors, graphics, interconnect, and operating systems—became unprofitable for a company as small as Silicon Graphics. Indeed, with the exception of Sun and behemoth IBM, the computer industry has been moving away from this do-it-yourself model.

The new strategy focuses SGI on a few key competencies rather than a broad range of tasks. Once the company decided to select a few focus areas, the choices became obvious. Silicon Graphics is one of the best graphics firms in the world. In addition, the company, including its Cray subsidiary, has developed a series of fast computers that depend on multiple processors and high bandwidth to achieve outstanding performance. Thus, the areas of 3D graphics and high-performance system design will be SGI's major technical focus in the future.

To maintain this focus, the company will avoid investing in other areas, instead using commercially available components whenever possible. Instead of designing its own MIPS processors, SGI will begin to purchase its processors from Intel, starting with Pentium II this year
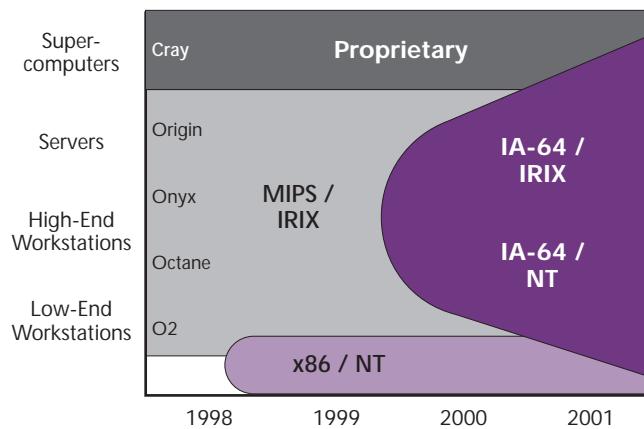

Figure 1. Silicon Graphics plans to migrate its system from MIPS processors to Intel processors over the next few years.

Inside: **Pentium II** ◇ **440BX, EX** ◇ **MPC555** ◇ **R3922** ◇ **EEMBC** ◇ **WinHEC**

and moving to Merced when it is available, presumably late next year.

Similarly, SGI now seems to view its IRIX operating system as an enabling technology rather than a core technology. It is happy to vend NT-based systems, although it will continue to maintain and sell IRIX to customers who demand a more robust operating system than Microsoft can provide. Given its large installed base of IRIX customers, SGI will undoubtedly support its version of Unix for years to come. But if NT ever fulfills its promise of matching Unix in features and scalability, we would not be surprised if SGI phases out IRIX as well.

This new focus should ultimately make SGI a stronger and more profitable company. Reducing its investment in developing its own processors will cut costs. In addition, the end result is likely to be more powerful systems, since Merced is likely to be much faster than any MIPS processor SGI could have delivered in 1999. Offering its customers a choice of Unix or NT is better than providing only a single, proprietary operating system.

The downside will be a substantial disruption of its customers' plans. Current MIPS system users must decide whether to convert to IRIX on IA-64 or NT on IA-64. In the former case, they must recompile their software (if they have the source code) or buy new applications. Since the installed base of IRIX on IA-64 is likely to be smaller than that of IRIX on MIPS, there is no guarantee that all software vendors will deploy IA-64 versions for IRIX. Switching to NT would improve the number of available applications but makes it more difficult to port internally developed code.

SGI says it will work with its customers to make the transition as smooth as possible. One tool that would help is a MIPS-to-IA-64 binary translator. HP is reportedly developing a similar translator for its PA-RISC customers, but SGI did not commit to this strategy. Once SGI converts fully to IA-64, its customer base should stabilize, but in the interim, it is likely to lose at least some customers.

MIPS Roadmap Hits Dead End

After releasing two different processor plans in the past year (see MPR 8/4/97, p. 4), the company finally realized that rearranging the deck chairs was not going to keep the ship from sinking. Despite substituting the R12000 for the late Beast project, the best the MIPS line is likely to provide in 1999 is about 25 SPECint95 and 40 SPECfp95 (base). We project these scores will trail the performance of all other RISC architectures at that time and will be roughly half the performance of Merced. This dismal performance contributed to SGI's decision to dump MIPS.

The company was banking on a new high-end processor, code-named H2, to close the gap with Merced in 2000. The investment to develop this processor would have been substantial, and there was no guarantee that it would ship on time or exceed Merced's performance. Thus, SGI made the tough call to cancel the H2 project and give up on trying to compete with Intel. Once the company started down the slippery slope of using Intel processors, abandoning MIPS was an unsurprising outcome (see MPR 10/6/97, p. 23).

To close out the MIPS line and bridge to Merced, SGI will continue work on the nearly complete R12000. That chip will appear by midyear in a 0.25-micron process, reaching speeds of 300 MHz. SGI expects its fab partners, NEC and Toshiba, will be able to move the R12000 to a 0.18-micron process in 1H99, boosting the clock speed to 450 MHz and reaching the performance levels noted above.

Ultimately, SGI has added a new device called the R14000 to its roadmap. The company said this will be a derivative of the R12000 but provided no further details. The chip is likely to have only minor changes, perhaps including a faster system bus, to boost performance. Like HP's PA-8700, the R14000 offers a hedge in case Merced is late, and it provides a crutch to IRIX customers who don't want to make a quick transition to IA-64. If the IA-64 transition goes smoothly, SGI may not even need the R14000.

Although SGI does not plan any layoffs at this time, the cancellation of its H2 project will undoubtedly cause many of its CPU designers to depart voluntarily. Given the hot job market in Silicon Valley, they will easily find other employment. (Some may wind up working on Merced.) Others will help with the R12000 shrink and R14000 or be reassigned to system-design projects.

The company will task its MIPS compiler team with developing an IA-64 compiler for IRIX. Despite being years behind the IA-64 efforts at HP and Intel, and despite lacking those companies' VLIW experience, SGI expects its compilers to give it an advantage in IA-64 performance. The compiler team will certainly be motivated; if they can't deliver an edge, they are likely to join the MIPS hardware engineers in seeking new jobs.

IA-64 Spurs RISC Exodus

Before its first processor has even taped out, IA-64 has eliminated two of the five major RISC architectures from the desktop. The shock wave preceding its entry into the market has already destroyed PA-RISC and toppled MIPS. Alpha is teetering on the brink, subject to the whims of its new master, Compaq. That could leave SPARC and PowerPC vying for the role of the last RISC architecture to succumb to Intel.

Sun has so far resisted the lure of Merced, although it is porting its Solaris operating system to IA-64 for other system makers to use. IBM, on the other hand, plans to deploy IA-64 workstations and servers along with PowerPC systems, putting it on the same slippery slope that trapped SGI.

Both Sun and IBM have large revenue streams, larger than SGI's MIPS business, dependent on their in-house RISC processors. These companies can afford the cost of developing their own processors. But if SPARC or PowerPC, like MIPS, falls too far behind IA-64 in performance, Sun and IBM may not be able to afford being uncompetitive in the marketplace.

Both Intel and SGI benefit from working together. SGI gets better processors without the in-house design costs. The company does lose control over its processor destiny, although SGI is already working with Intel to add features to future IA-64 processors. Intel benefits from these enhancements and from adding SGI as a major IA-64 customer.

The two companies also inked a patent cross-license agreement. This agreement gives SGI access to any Intel intellectual property needed to implement high-performance interfaces to Intel's chips. Intel gains access to SGI's portfolio of processor, system, and graphics patents. The last item will be particularly handy for Intel's burgeoning graphics business (see MPR 2/16/98, p. 1).

Embedded MIPS Spins Off

While the engineers working on the R12000 and R14000 will stay with SGI, the remaining employees of MIPS will be spun off into a separate entity. Although the entity has not been formally named, we refer to it by its old name of MIPS Technologies. With SGI firmly focused on high-performance desktop and server systems, its continued support for consumer-focused MIPS processors is a poor fit.

John Burgoin will continue to serve as president of MIPS, and most of his senior staff will remain in place. To become a standalone company rather than a subsidiary, MIPS Technologies will gain a few new employees to provide functions such as human resources and finance.

The new company's biggest asset is the revenue stream from MIPS architecture licensees. MIPS Technologies will own the MIPS instruction set and associated patents, allowing it to continue collecting this revenue in the future. The spinoff also retains rights to the R3000- and R4000-series CPU cores for use in future embedded designs.

The Intel patent cross-license applies to MIPS Technologies as well as Silicon Graphics, giving Intel access to the MIPS architecture patents. In return, MIPS Technologies has access to Intel's patent portfolio when developing future technology. Both SGI and MIPS Technologies are banned from building Intel-compatible processors, however.

Given the value of these assets, SGI has chosen to retain an 80% interest in MIPS Technologies while offering the remaining 20% in an initial public offering (IPO). SGI believes the new company will be worth more by itself than as part of a large computer company, given the high growth rate (130% last year) of embedded MIPS sales and the high valuation of other intellectual-property companies such as Rambus. Over time, SGI plans to sell its remaining interest in MIPS Technologies, eventually becoming a minority owner or perhaps keeping no interest at all.

MIPS Technologies will focus on developing technology for embedded MIPS processors such as the popular R4300, used in the Nintendo 64 and other high-volume products. Initially, the company's business model will stay the same: it will manage the MIPS instruction set and de-

SGI's Visual PC Initiative

The first expression of Silicon Graphics' embrace of merchant technology will be its so-called Visual PC. The name, which will probably be changed before the formal announcement this fall, describes the system's combination of standard PC technologies, such as Pentium II processors and Windows NT, with high-performance graphics designed by SGI.

The system will combine a high-end Pentium II processor with a proprietary SGI chip set. Eschewing AGP, SGI will provide its own high-speed graphics and memory systems, maintaining NT compatibility by supplying its own drivers. The system is likely to support standard PC interfaces such as PCI and USB for expandability.

By taking advantage of merchant technologies, SGI plans to sell the Visual PC at a lower price than its current low-end MIPS systems. We expect the systems to debut at around $4,000. They should help keep SGI customers from defecting to low-cost NT-based workstations from other vendors.

velop CPU designs while vendors such as NEC, Toshiba, and IDT produce and market MIPS-based products.

In the future, this business model may evolve to meet changing market conditions. Some of the MIPS licensees are chafing at the level of control applied by the architecture's owner, and one company, Lexra, has produced an unlicensed MIPS core. The new MIPS Technologies must find a way to placate its licensees while maintaining control; its lawsuit against Lexra (see MPR 4/20/98, p. 8) is a step in this direction. Alternatively, MIPS Technologies could decide to market its own chips in competition with its licensees.

The loss of its association with SGI will have little effect. The R1x000 family was unlikely to see much action in the embedded market, as the chips are simply too expensive and too power hungry, even after process shrinks. MIPS has more than enough momentum in the embedded market to prosper without a strong desktop presence, and the royalty stream is enough to support future development efforts. In addition, vendors such as QED are also developing MIPS CPU cores, fostering a robust MIPS market.

While the passing of MIPS on the desktop will cause some consternation among current MIPS computer owners, it will strengthen both Silicon Graphics and MIPS Technologies as the two companies go their separate ways. SGI will focus on delivering outstanding graphics and system performance using Intel processors and Microsoft operating systems, while the new spinoff will drive the MIPS architecture further into the embedded market. So we will shed a tear, raise a beer, and cry "hurrah!" Ⓜ