

Class of '94 Has Mixed Success

New Cores Slow to Follow 21164, UltraSparc, PA-8000, R10000, and PPC 620



At the 1994 Microprocessor Forum, an impressive juxtaposition found Digital, Hewlett-Packard, MIPS, PowerPC, and Sun all disclosing new RISC processor cores within the space of two hours. At the time, all expected great things from their new processors. At the time, we expected all five vendors to follow up with new cores in 1997, given the rule of thumb that it takes three years to design a RISC processor from scratch.

Since then, the vendors have had varied success in bringing their progeny to market. Worse yet, several have fallen off the pace in delivering the next generation of performance, due about now.

Digital's 21164 was the first member of the Class of '94 to graduate, shipping in 2Q95 at a speed of 300 MHz. The Alpha chip arrived on schedule and at its target speed, a rarity in this business. With its classmates still in school, the 21164 opened a huge performance lead. After design tweaks and IC process improvements, the chip is now shipping at 600 MHz; there are still no processors with a better SPECint95 score, although HP is giving Digital stiff competition.

Digital introduced its impressive 21264 design at last year's Microprocessor Forum, but after delays in reaching tapeout, the processor now looks to be a 2Q98 product. Still, that puts it on a three-year schedule from the 21164 and makes it likely to be the first core of its generation to debut. As with the 21164, this advantage should give the 21264 a large performance lead when it first ships.

The next member of the Class of '94 to appear was Sun's UltraSparc, which began shipping in 4Q95, a few months late but meeting its target of 167 MHz. This timely entry briefly vaulted Sun into the number-two performance position, but the relatively modest throughput of its in-order core proved to be a hindrance; once UltraSparc's contemporaries reached the market, Sun again fell behind.

The next new core in Sun's line is UltraSparc-3 (see [MPR 10/27/97, p. 29](#)), appearing as expected at the 1997 Microprocessor Forum. (UltraSparc-2 used the same core as UltraSparc.) Although it hasn't taped out yet, UltraSparc-3 looks as if it will ship around 1Q99, only a few months later than the three-year rule predicts. It should again boost Sun in the performance race, but the in-order processor isn't likely to challenge the more aggressive 21264 design.

The complex out-of-order designs of the R10000 and PA-8000 kept those products from shipping until 1Q96. Both met their clock-speed targets, but the initial R10000 bench-

marks were disappointing. The problems were an unoptimized compiler and weak system designs; by the end of 1996, Silicon Graphics had released new compilers and systems that came close to the R10000's initial performance targets. In contrast, the powerful PA-8000 immediately seized the performance lead from Digital and has since been dueling the 21164 through a series of speed enhancements.

The PA-8000 is the last PA-RISC core; the follow-on product will be Merced, the first IA-64 processor (see [MPR 10/27/97, p. 1](#)). Given the difficulties of developing a new processor, a new instruction set, and a new design philosophy all at the same time, the three-year design cycle has been extended. Merced is now expected to appear in mid-1999, three-and-a-half years after the original PA-8000. With the advantages of its new architecture, Merced has a good shot at gaining the performance lead, even though the 21264 and UltraSparc-3 will probably beat it to market.

The follow-on to the R10000, code-named Beast, was originally expected to debut in late 1998, but the complex processor was pushed back to late 1999, then canceled completely, leaving MIPS without a runner in this race. Beast has been replaced in SGI's roadmap with the R12000, which has only minor improvements over the R10000. This failure will leave MIPS falling further behind in the performance race. Salvation is now seen in a processor known as the H2, due to appear sometime in 2000.

The tale of the PowerPC 620 is almost too sad to tell. Three years after its announcement, the processor has yet to appear in systems, but manufacturer Motorola swears the 620 isn't dead. An unconfirmed report claims the Elvis-like chip was spotted in a Groupe Bull system roadmap just last month. Whether the 620 ever appears or not has been rendered nearly moot by IBM's decision to switch to its internally developed Power line and by the lack of other PowerPC server vendors. The next high-end PowerPC part, known as the G4, is still a figment in a Somerset CAD system; it isn't expected to ship before 1999.

Sun found getting to market early to be a good strategy. Digital found getting to market early with a fast chip to be a better strategy. SGI found breaking the only egg in the basket to be a poor strategy. The PowerPC vendors found getting to market at all a strategy that proved elusive. HP could find partnering with Intel to be the best strategy of all. □