

MICROPROCESSOR REPORT

THE INSIDERS' GUIDE TO MICROPROCESSOR HARDWARE

AMD K7 Rechristened Athlon

Chip Shipments Begin; Claimed to be World's Fastest x86

by Michael Slater

AMD has given the name "Athlon" to its eagerly awaited K7, seeking to create a new brand image that establishes it as a performance-oriented processor and distances it from the economy-oriented K6 family. AMD also announced that shipments to select OEMs have begun, but it did not make a full product announcement. The company is keeping many product details under wraps until a formal launch later this summer, when Athlon PCs are in the channel and ready for consumers to buy.

The new name follows Intel's strategy of moving away from numeric designations and should enable AMD to create a brand clearly distinct from the K6 family. Although the name may at first conjure up images of running shoes and sports gear, it will soon seem no stranger than Pentium.

Athlon will ship initially at 500, 550, and 600 MHz, using an enhanced version of the 0.25-micron process used for the K6. The two lower speed grades are priced at about one-third off the price of Intel's Pentium III at the same clock speed. The 600-MHz speed grade, for which Intel has no offering yet, costs about 6% less than Intel's 550-MHz part.

The Goal: Leadership Performance

A final evaluation of Athlon's competitive position must await shipment of production systems, but if AMD's preliminary results (shown in Figure 1) hold up to scrutiny, Athlon will be the fastest x86 processor available. With both processors at 550 MHz, according to AMD's tests, Athlon outperformed the Pentium III by about 9% on SPECint95 (base) and 46% on SPECfp95 (base). The 600-MHz version increases AMD's lead, of course.

AMD measured 3D-graphics performance using 3D WinBench 99 version 1.2 with a null driver, which eliminates the graphics card from the equation and shows the processor's performance on its portion of the 3D task. Compared with a 550-MHz Pentium III, the 550-MHz Athlon was an impressive 40% faster. AMD used version 6.1A of Microsoft's DirectX, which exploits Intel's SSE

instructions for Pentium III and AMD's 3DNow instructions for Athlon.

AMD did not give results for other benchmarks, such as the widely used Winstone and SYSmark suites. The advantage of Athlon is unlikely to be as great on typical applications as it is on the benchmarks AMD used, but it does seem very likely that Athlon will be faster than Pentium III. It is also clear that, unlike the K6, Athlon will excel in FP and multimedia performance.

Intel's delay in shipping Coppermine (see MPR 7/12/99, p. 4) is great news for AMD, as it makes it unlikely that Intel will be able to outdistance AMD on clock speed during the initial months of Athlon shipments. Intel's delay also means that AMD may be as little as a month behind Intel in rolling out 0.18-micron chips for desktop PCs.

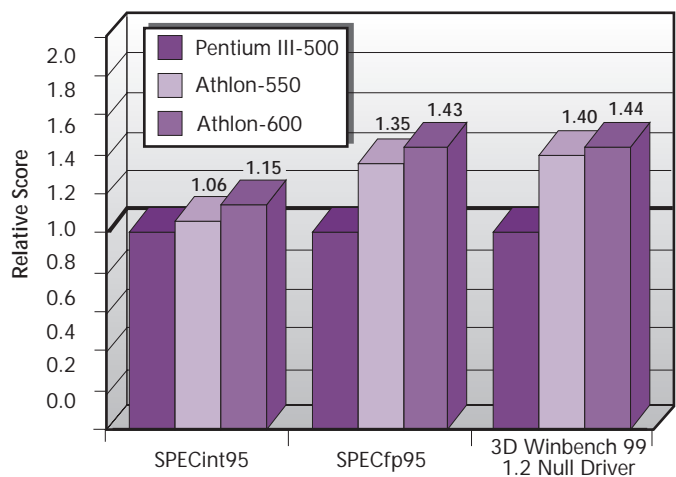


Figure 1. AMD's preliminary benchmark results show Athlon pulling modestly ahead of Pentium III in integer performance and far ahead in floating-point and 3D performance. (All systems had 512K half-speed backside L2 caches, 128M of SDRAM, a Diamond 770 graphics card, and a Western Digital 41800 EIDE disk. The Athlon systems used an AMD chip set and motherboard; the Pentium III system used an ASUS P2B motherboard with an Intel 440BX chip set.) (Source: AMD)

Architectural Performance

Given the Athlon microarchitecture (see MPR 10/26/98, p. 1), it isn't surprising that the chip would outperform Pentium III. Its three symmetric instruction decoders give the chip higher decode bandwidth (Pentium III can decode three instructions per cycle only if two are "simple"), and its ability to issue nine internal operations per cycle (vs. Pentium III's five) gives it a lead in issue rate. Another significant advantage is the 64K L1 caches, four times the size of Pentium III's.

Athlon's strong lead in floating-point performance comes from its fully pipelined superscalar FPU. Whereas Athlon can issue both an add and a multiply every clock cycle, Pentium III can issue only one or the other, and multiplies can be issued only every other cycle.

Pentium III's core is showing its age. Intel has extended the three-and-a-half-year-old P6 core twice, but a full new core won't appear until Willamette debuts in the second half of 2000. Willamette, arriving more than a year after Athlon, is likely to leapfrog AMD's chip in microarchitectural sophistication. AMD hopes to maintain a performance lead, but sustaining this lead will be more challenging after Willamette debuts.

3DNow Extended

The multimedia instructions in Athlon include extensions beyond 3DNow. There are 19 new MMX instructions for integer calculations and cache control, plus five new DSP instructions designed to speed applications such as MP3, AC-3, soft modems, and soft ADSL interfaces. The new MMX instructions are fully compatible with the "new media" instructions that are part of Intel's SSE (that is, the SSE instructions that are not for vector FP). The five new DSP instructions go beyond what Intel has offered. AMD has not yet disclosed the definitions of these instructions.

AMD remains committed to 3DNow and points to the 3D WinBench score for Athlon as evidence that 3DNow can deliver better performance than SSE. Whether this turns out to be true for a range of 3D applications remains to be seen. The real question, however, is how the software support for 3DNow and SSE will compare. So far, AMD seems to have good support, although Intel has been more active in driving Internet software using SSE. AMD can't match Intel's budget for promoting SSE, but it has the advantage of a larger installed base of processors with its extensions. Intel has shipped SSE only in relatively expensive processors, while AMD's K6-2 makes 3DNow available in the least-expensive systems. Nevertheless, we expect the SSE installed base to exceed the 3DNow base by the end of this year.

Building the Slot A Platform

AMD said its initial chip set will support only uniprocessor operation, with dual-processor solutions following later in the year and broader multiprocessing capabilities in the future. AMD will scale the Slot A bus, which initially will run

Price and Availability

AMD has begun production shipments of K7 processors to a few key customers. The formal announcement and system availability will occur in the third quarter.

Pricing for the 500-, 550-, and 600-MHz versions is \$324, \$479, and \$699, respectively, in 1,000s.

Full specifications have not yet been disclosed; see www.amd.com/products/cpg/k7 for the information that is currently public.

at 200 MHz, to 266 MHz in 2000 and eventually to 400 MHz, enabling a bandwidth of up to 3.2 GBytes/s. AMD's initial chip set will use SDRAM; versions for Direct RDRAM and DDR SDRAM are planned for shipment in 2000.

Chip-set makers ALi, SiS, and VIA have all signed up to build chip sets for Athlon, seeking a chip-set market Intel doesn't dominate. In addition, chip sets developed for Alpha by Alpha Processor (see MPR 6/21/99, p. 19) will be usable with Athlon. Startup HotRail (see MPR 7/12/99, p. 12) is developing a multiprocessor chip set based on a switched fabric. Sustaining this new chip-set infrastructure adds to AMD's execution challenge for Athlon; if the chip sets aren't competitive, the processor's advantages could go to waste.

Starting a New Family

A 0.18-micron version of Athlon is promised for the fourth quarter and should boost the clock speed to well above 800 MHz. Initially, the 0.18-micron chip is likely to be a simple shrink, but AMD says it will introduce multiple new versions in 2000, with various cache configurations. For the mainstream, AMD will need a version with an on-chip L2 cache that eliminates the need for the module. To pursue the server and workstation markets, it will also need a version that uses an off-chip L2 cache to enable larger cache sizes. This version could use the recently defined Slot B form factor (see MPR 6/21/99, p. 19).

Until an Athlon family member with on-chip L2 cache is ready, the chip is likely to be focused on the high-end market, competing with Pentium III. The K6-2 will continue to be positioned against Celeron. The K6 III seems likely to get largely squeezed out, providing neither the lowest cost nor the best performance. By mid-2000, AMD may be able to drive an Athlon family member into the Celeron space.

AMD's challenges are far from over: the company must ramp up Athlon production, make a smooth shift to 0.18-micron technology, and bring up the Dresden fab. It also must extend its market success with cost-focused consumers and small businesses to performance-oriented consumers and larger businesses. But Athlon clearly gives AMD a more powerful weapon than ever before, setting the stage for an escalation of the PC-processor battle. 