

# M I C R O P R O C E S S O R

www.MPRonline.com

THE INSIDER'S GUIDE TO MICROPROCESSOR HARDWARE

## FASTER DESKTOP CPUs FROM AMD, INTEL

*Athlon XP Debuts 333MHz Front-Side Bus; Celeron Hits 2GHz*

*By Tom R. Halfhill {10/16/02-04}*

AMD and Intel have introduced faster versions of their Athlon XP and Celeron desktop processors, including the first Athlon with a 333MHz front-side bus (FSB) and the first Celeron to reach 2GHz. The new Athlon XP 2800+ and 2700+ processors run at core clock

frequencies of 2.25GHz and 2.17GHz, respectively, and are priced at \$397 and \$349.

Samples are available now, but production parts won't ship until November—and then only in limited numbers. AMD says "limited-edition desktop systems" will begin shipping in late November from enthusiast-oriented PC vendors such as ABS, Alienware, Falcon Northwest, MicronPC, and VoodooPC. The new processors probably won't ship in larger volumes until January.

Intel is shipping the new 2GHz Celeron now. It's available in 478-pin packaging and costs \$103 in 1,000-unit quantities. Gateway was one of the first vendors to introduce desktop systems with the low-price chip in October, starting with the 300s model at \$899.

### AMD's Faster Bus Is Overdue

Both new Athlon XP processors have a 333MHz 64-bit FSB. The base frequency is 167MHz, but the bus transfers data on both edges of a clock signal, so the effective bus frequency is 333MHz. That yields about 2.7GB/s of peak bandwidth.

Although the faster bus is welcome, it's tardy—and not exactly a surprise, since Nvidia leaked the news at the nForce2 launch in July. (A PowerPoint slide in Nvidia's public presentation coyly said the nForce2 north-bridge chip with integrated graphics would support the "world's first 333MHz FSB.")

Other Athlon XP desktop processors with the "plus" designation in the model number have a 266MHz bus, double-pumped from a base clock frequency of 133MHz.

Most mobile Athlon XP processors for laptops still have a 200MHz bus, double-pumped from 100MHz.

AMD has been promising much faster bus speeds since first disclosing the Athlon's microarchitecture in 1998 (see *MPR 10/26/98-01*, "K7 Challenges Intel"). When the Athlon began shipping in 1999, its 200MHz FSB was the fastest on the market; Intel's best Pentium III processors had FSBs running at only 133MHz. Then Intel introduced the Pentium 4 in 2000 and catapulted bus speeds to an effective 400MHz by using four data phases per clock period (see *MPR 8/28/00-01*, "Pentium 4 [Partially] Previewed").

The Athlon's FSB has always offered the potential for faster speeds. AMD licensed the point-to-point EV7 bus technology from Digital, which designed the high-speed bus for the Alpha 21264 processor. In 1998, AMD said the Athlon's FSB could run as fast as 400MHz. However, other projects diverted AMD's attention and engineering resources, so the bus has made relatively little progress since then.

Meanwhile, memory vendors have been steadily introducing faster products. The fastest available DDR-SDRAM is PC3200 memory, which provides 3.2GB/s of bandwidth at 400MHz (double-pumped from 200MHz). Although PC3200 isn't yet a mainstream product, and some users consider it unreliable, PC2700 DDR-SDRAM has been widely available for several months. At 333MHz (double-pumped from 167MHz), PC2700 memory provides 2.7GB/s of peak bandwidth, the same as the new Athlon XP's FSB. Matching the frequency of the FSB with the system chip-set's memory

### Price & Availability

AMD's Athlon XP 2800+ costs \$397, and the 2700+ costs \$349, both in 1,000-unit quantities. Samples are shipping now, with limited quantities of production chips scheduled for delivery in late November. Intel's 2GHz Celeron costs \$103 in 1,000-unit quantities and is shipping now. For more information, go to [www.amd.com](http://www.amd.com) and [www.intel.com](http://www.intel.com).

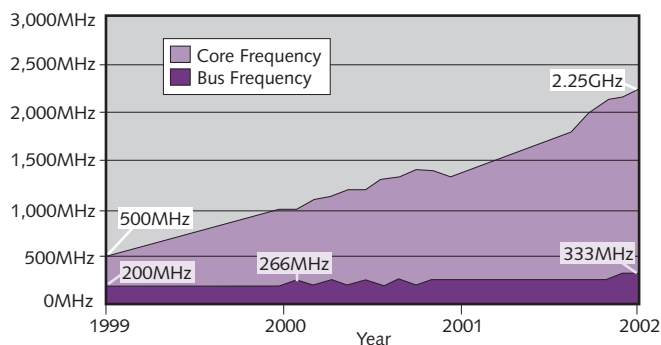
interface should nudge the actual data throughput closer to the maximum theoretical bandwidth, because there are fewer issues with synchronization, buffering, and clock jitter.

Nvidia, SiS, and VIA are all making Athlon XP chip sets that support the 333MHz FSB with PC2700 memory. Only VIA's Apollo KT333 and KT400 chip sets are shipping in quantity now. SiS is expected to deliver its 746FX chip set in late October, and Nvidia's nForce2 chip with integrated GeForce4 MX graphics should start shipping at about the same time as the new Athlon XP processors.

Chip sets for the 333MHz FSB aren't available in the large volumes that accompanied Intel's transition to the 533MHz FSB last May. Intel had 533MHz-capable 850E, 845E, and 845G chip sets for the 2.53MHz Pentium 4 available at launch (see *MPR 5/28/02-04*, "Pentium 4 Gets Bus Bandwidth Boost"). Given the more limited availability of Athlon XP processors with 333MHz buses, however, infrastructure support shouldn't be a problem.

### Bus Speeds Aren't Keeping Up

Even with the faster bus, the Athlon XP's memory-bandwidth gap continues to widen, and it still lags behind the core-to-bus ratio of Intel's Pentium 4—family processors. Although Intel's fastest FSB runs at a base clock frequency of 133MHz—20% slower than AMD's 167MHz base clock—it transfers four bits of data per clock cycle instead of two, so the effective speed is 533MHz. That provides 4.2GB/s of



**Figure 1.** AMD's 333MHz FSB is an improvement, but it still falls short of matching the rapid climb of Athlon core clock speeds since 1999.

peak bandwidth, 55% more than the new Athlon XP processors. However, neither AMD nor Intel has been able to cope with the growing gap between core frequencies and effective bus frequencies since 1999, as Figures 1 and 2 show.

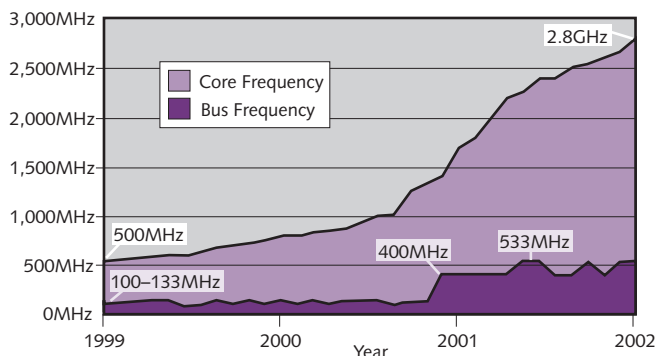
Until AMD and Intel endow their CPUs with buses wider than 64 bits, the core/bus clock-frequency gap may be academic, because memory vendors are pushing against similar speed limits. Only the fastest available PC1066 RDRAM can keep up with Intel's 533MHz bus. PC1066 RDRAM isn't an option with the Athlon XP, because no system chip set supports that combination.

AMD points out that the vast majority of desktop PCs use DDR-SDRAM, which makes Intel's faster bus less significant in the mass market, where AMD and Intel mainly compete. Nevertheless, PC hot-rodders willing to pay about 50% more for their memory and about 28% more for their CPU can find some relief for the tightening CPU-memory bottleneck by mating dual-channel PC1066 RDRAM with the fastest Pentium 4 (2.8GHz, \$508).

### Running Short of Cache


Price-conscious shoppers will be more interested in PCs with the new 2GHz Celeron, the first chip in Intel's low-price line to reach that clock-frequency milestone. It's based on the Pentium 4 NetBurst core, so it has a 400MHz FSB (quad-pumped from 100MHz) and SSE2 extensions.

One surprise is the small size of the new Celeron's on-chip L2 cache: only 128K. It indicates that Intel is downsizing Celeron processors more drastically than in the past. Historically, Intel has disabled or removed half the on-chip L2 cache to reposition a Pentium-branded processor as a Celeron. But the Pentium 4 core on which the new Celeron is based has a 512K on-chip L2 cache—four times as large. The relationship of cache efficiency to cache size is roughly exponential, so the drawn-and-quartered Celeron cache will probably suffer twice as many misses as a Pentium 4 cache.



**Figure 2.** Intel's quad-pumped 533MHz FSB provides 55% more peak bandwidth than AMD's 333MHz FSB, but core clock frequencies are still outrunning effective bus frequencies by a wide margin. This chart shows the trend since 1999 with the Pentium III and Pentium 4 families.

Few users who buy a low-price PC with a Celeron processor will notice the slight loss of performance caused by the smaller L2 cache. In compensation, the 2GHz Celeron costs 47% less than the slowest Pentium 4, which runs at

2.2GHz. It costs 70% less than a 2GHz mobile Pentium 4-M, the only other Pentium 4-family chip that runs at the same clock frequency. 

*To subscribe to Microprocessor Report, phone 480.609.4551 or visit [www.MDRonline.com](http://www.MDRonline.com)*

