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# Pentium II Debuts at 300 MHz

## *Better Integer Performance Than All But Fastest Alpha*

*by Linley Gwennap*

For the first time in 18 months, Intel has introduced a new high-end processor, Pentium II (PII), now shipping at clock speeds of 233 and 266 MHz. In addition, the company plans to ship a 300-MHz version of the chip this summer, further boosting its top-of-the-line performance. Even after that, Intel won't sit still for long; a 0.25-micron version of Pentium II, code-named Deschutes and due around the end of this year, will reach speeds of at least 400 MHz, according to the company.

Pentium II, formerly known as Klamath (see MPR 2/17/97, p. 1), is based on the P6 CPU used in Pentium Pro but adds Intel's MMX multimedia extensions and features to improve performance on 16-bit code. The chip includes 16K instruction and data caches, twice the size of Pentium Pro's primary caches, but uses a slower bus than Pentium Pro does to access the external L2 cache.

The 233- and 266-MHz parts are aimed at the PC market and offer better performance than any other x86 processor. The initial pricing for the parts is high: $775 for the faster part, $636 for the 233-MHz version, both with 512K of cache. But given Intel's typical rapid price cuts, we expect the price of the 233-MHz part to fall below $500 by the end of this year, making Pentium II attractive to holiday shoppers looking for a premium PC.

Intel will sell Pentium II only on modules that contain the CPU and level-two (L2) cache; the processor will not be available as a standalone chip. The module is functionally similar to Pentium Pro but uses a PC board instead of a ceramic substrate. Earlier plans for Intel to offer 256K and 512K caches have been simplified; the company will offer only the 512K version.

### Half-Speed Cache Has Minimal Impact

Pentium II nestles snugly at the top of Intel's product line. According to the SYSmark tests, the PII-233 is 9% faster than a PPro-200 when running Windows NT applications, while the PII-266 is nearly 20% faster than the PPro-200, as Figure 1 shows. Due to the new chip's 16-bit enhancements, the difference on Windows 95 is more pronounced; even the PII-233 outruns the PPro-200 by 19%, while the PII-266 delivers nearly 30% more performance.

Most of this performance gain is due to the higher clock speeds. Pentium II also benefits from its 512K L2 cache; the Pentium Pro was tested with only 256K of cache. (Pentium Pro is available with a 512K cache, but this version is mainly used in servers, not PCs, due to its high price.) Pentium II loses some performance due to its half-speed L2 cache, but on these PC applications, the slower cache results in a loss of only a few percent of performance.

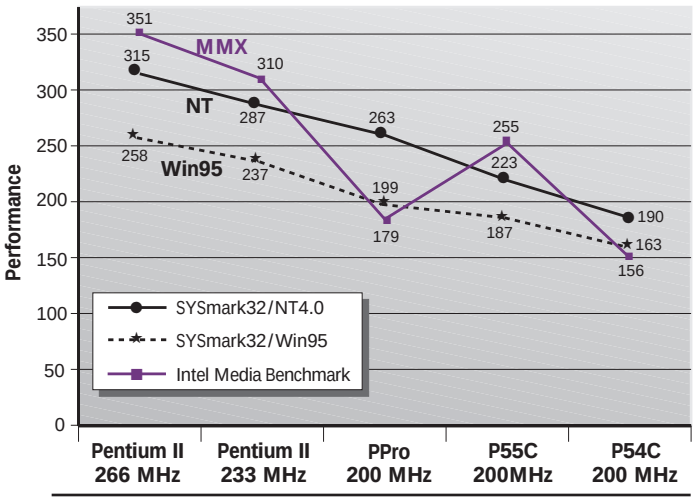


**Figure 1.** Even at 233 MHz, Pentium II outperforms Pentium Pro on a variety of benchmarks. Only the Intel Media Benchmark contains MMX code. All processors were tested with 512K of burst SRAM (except Pentium Pro had 256K), 32M of DRAM, a Matrox Millennium graphics card with 2M of WRAM in 1024 x 768 x 256 mode, and a Seagate ST32550W hard drive. The Pentium systems used a 430VX chip set and SDRAM; the P6 systems used a 440FX chip set with EDO DRAM. (Source: Intel)

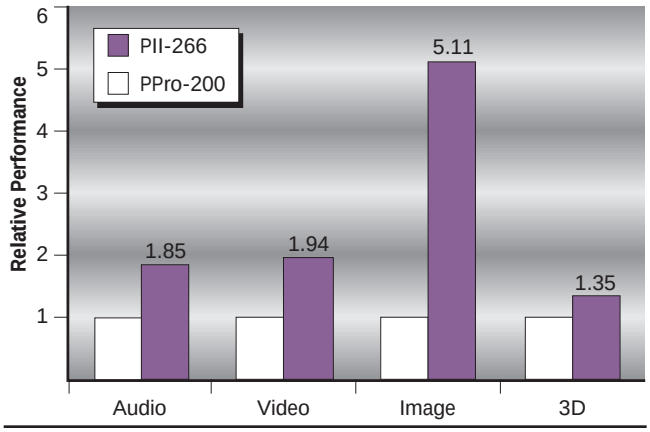


**Figure 2.** Individual components of the Intel Media Benchmark show a wide variation in the performance advantage of Pentium II over Pentium Pro. All but the 3D test use MMX. See Figure 1 caption for system configurations. (Source: Intel)

For applications that take advantage of Pentium II's MMX capabilities, the increase will be much more substantial. Based on Intel's Media Benchmark, the PII-266 delivers 80% better performance than a PPro-200, which doesn't implement MMX, and 38% better performance than a 200–MHz Pentium/MMX (P55C). As Figure 2 shows, however, the increase varies widely, depending on the type of application and how much it takes advantage of MMX.

## Coexisting With Pentium Pro

Although Pentium II would appear to supercede Pentium Pro, the two parts will coexist in Intel's lineup for the rest of this year. Pentium II is significantly more expensive than Pentium Pro, which today lists for $407 to $514, and will remain so for most of this year. Pentium Pro will continue to be popular in NT desktop systems and midrange servers, while Pentium/MMX serves as the mainstream PC processor throughout 1997.

Pentium II has other limitations that will prevent it from replacing Pentium Pro in high-end servers. The initial version is limited to single- and dual-processor systems. Although Pentium II, like Pentium Pro, could function properly in a four-CPU configuration, Intel feels the 66-MHz P6 bus doesn't have enough bandwidth to support the larger configuration with the faster CPUs.

## Pentium II Debuts New Package

Starting with Pentium II, Intel will ship its processors in the form of a module instead of as a standalone chip. This module is a daughtercard that contains the Pentium II CPU chip, the cache-tag chip, and the external L2 cache chips. This package, which Intel calls the single-edge contact (SEC) cartridge (see MPR 12/9/96, p. 4), plugs into a connector that Intel calls Slot 1. (Pentium processors plug into various sockets, the most popular being Socket 7.)

The bus between the CPU and the L2 cache is entirely contained within this module. The initial Pentium II modules operate this bus at one-half the CPU speed, up to 150 MHz for the 300-MHz processor. Intel is concerned that PC makers couldn't handle these bus speeds, at least not on a four-layer motherboard. If this is true, a daughtercard is a practical necessity, and Intel believes it can supply this module at a lower price than a PC maker could build it.

| | Pentium II Processor Modules | | | | |
|---|---|---|---|---|---|
| **Clock Speed** | 300 MHz | 266 MHz | 266 MHz | 233 MHz | 233 MHz |
| **L2 Cache Size** | 512K | 512K | 512K | 512K | 512K |
| **L2 Cache Type** | ECC | ECC | No ECC | ECC | No ECC |
| **Max Power** | 42 W* | 38.2 W | 38.2 W | 34.8 W | 34.8 W |
| **SPECint95†** | 11.6 | 10.4 | 10.8 | 9.1* | 9.49 |
| **SPECfp95†** | 6.79 | 6.36 | 6.43 | 5.85* | 5.91 |
| **List Price** | $1,981 | $805 | $775 | $666 | $636 |
| **Availability** | 3Q97 | 3Q97 | Now | 3Q97 | Now |

**Table 1.** The initial wave of Pentium II products includes clock speeds ranging from 233 to 300 MHz, cache sizes of 512K, and versions with either ECC or non-ECC cache. †baseline results (Source: Intel except *MDR estimates)

## Setting the Pace in the PC Market

The performance gap between Pentium II and the K6 is greater on applications that stress either floating-point or MMX instructions. Intel has put more emphasis on these areas to support emerging multimedia and 3D applications as well as the workstation market. Pentium II will also outperform the K6 when high cache and memory bandwidth is required; although Socket 7 and Slot 1 provide the same peak bandwidth, the K6 must share this bandwidth between the L2 cache and main memory, whereas Pentium II has a separate L2 cache bus and can devote the entire system bus to main-memory traffic. Thus, the K6 will not compete well in servers or for applications that have large data sets.

With prices above $500 for most of this year, Pentium II will not take the PC market by storm in 1997. The new chip will be a strong high-end offering and should quickly become the power user's processor of choice. Once the 0.25-micron version of Pentium II rolls out, we expect a rapid production ramp. During 1998, Pentium II will sweep the Pentium generation entirely out of Intel's line, with PII-233 pricing projected to fall below $150 by 4Q98. Vendors that offer Socket 7 processors beyond that date could be limited to small segments of the market. M

*Note: this article is excerpted from* Microprocessor Report's *in-depth article on Pentium II. For a copy of the full article, contact our customer service department at cs@mdr.zd.com or 707.824.4001 and ask to purchase a back issue of* Microprocessor Report, *May 12, 1997. The price is $29.*