TECHNOLOGY BRIEF

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EXECUTIVE SUMMARY

Intel is launching several new sixth-generation processors - new 350 and 400 MHz versions of the Pentium® II processor, and the Pentium® II Xeon™. The Pentium II 350 and 400 MHz versions were previously code-named Deschutes Slot 1 and the Pentium II Xeon was code-named Deschutes Slot 2. The Deschutes family of processors expands on the capabilities of previous Pentium II processors and adds features such as a faster system bus, support for larger memory configurations, and faster core frequencies. The new processors are targeted for two different markets.   Deschutes Pentium II processors are designed to enhance price:performance for mainstream servers and workstations. The Pentium II Xeon processor is designed to provide outstanding performance for high-end servers and workstations. As always, Compaq has engineered our servers and workstations to provide customers with the optimal system performance from platforms based on this new processor technology.

This technology brief provides a processor roadmap, a description of the new features, and relative performance information for the new Deschutes Pentium II and Pentium II Xeon processors.

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Deschutes Family Processor Technology

I NTRODUCTION

Intel has announced new 350 MHz and 400 MHz versions of the Pentium II processor. This processor was previously known by the code name Deschutes Slot 1. In addition, Intel has pre-announced details of the Pentium II Xeon processor, previously called Deschutes Slot 2. The Deschutes processors are part of Intel's newest sixth-generation processor family based on 0.25-micron technology. Deschutes processors will replace the Pentium Pro as the processor of choice for high-end systems and will continue the Pentium II line in workstations and mainstream servers. This technology brief outlines the current processor roadmap from Intel, describes the significant features of the Deschutes processors, and provides some relative performance information comparing the new processors with older versions.

Note on naming conventions: Intel is continuing the Pentium II brand name to include the newest Deschutes processors. Pentium II processors with processor speeds of 350 MHz or more are based on Deschutes technology. Pentium II processors with speeds equal to 300 MHz or less are based on older Klamath technology. In order to differentiate the newest versions of the Pentium II, this technology brief will refer to Deschutes-based processors as Deschutes Pentium II and Pentium II Xeon. This brief refers to older versions of the Pentium II processor as Klamath Pentium II processors.

P ROCESSOR R OAD M AP

Figure 1 illustrates Intel's processor roadmap from 1995 into early 1999.
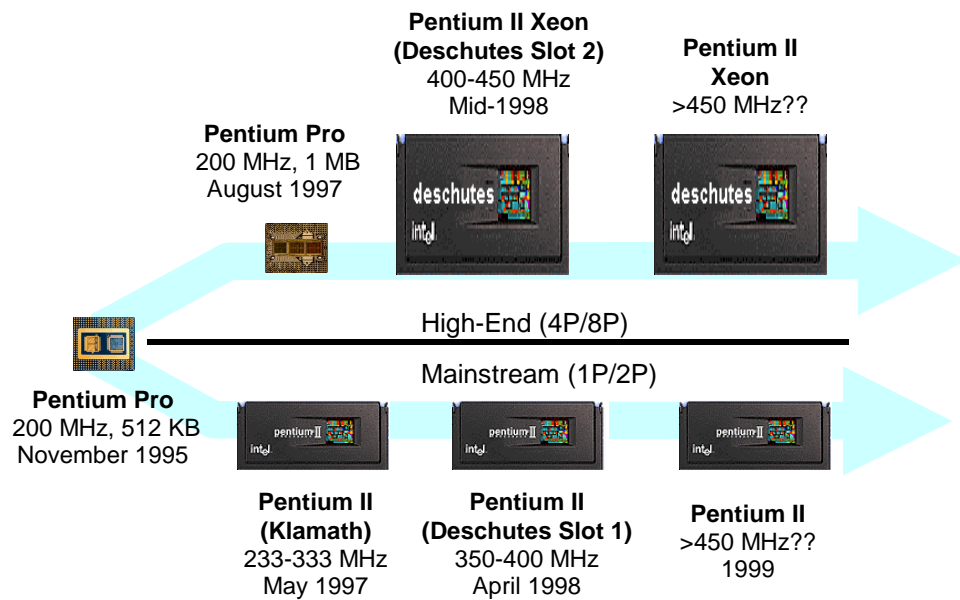
Figure 1. Intel 32-Bit Processor Roadmap – 1995 through early 1999.

The current Pentium Pro processor is reaching its end of life. Intel does not plan any speed or cache size improvements beyond the current 200-MHz model with 1-MB level 2 (L2) cache. The Pentium Pro will be phased out over the next year. Intel's strategy calls for segmenting the processor market by targeting different processors to different markets. The Klamath Pentium II processor was launched in 1997. It was designed to replace the Pentium and Pentium Pro processors in the desktop, consumer, mainstream server, and mainstream workstation markets. However, Klamath Pentium II processors have several limitations that make them unsuitable for high-end applications. For example, the processors are limited to two-processor (2P) symmetric

multiprocessing (SMP) configurations, a maximum of 512K L2 cache, and have a 512-MB memory cacheability limit.

Deschutes is the code name for a new family of processors that have increased bus speed and other enhancements. Intel is releasing several new Deschutes processors in 1998. Intel has announced the first of the new Deschutes-based processors – 350 MHz and 400 MHz Pentium II processors. The Deschutes Pentium II processors are based on sixth-generation core logic and industry-standard 32-bit Intel Architecture (IA32). The Deschutes Pentium II processors are packaged in the same Slot 1 form factor as older Klamath Pentium II processors, but are not a drop-in replacement for Klamath Pentium II processors in most cases. Compared with Klamath Pentium II processors, Deschutes Pentium II processors have increased speed, expanded system memory support, and other enhancements, but they still do not support greater than 2P SMP.

Intel has also pre-announced some of the details of a second type of Deschutes processor, called the Pentium II Xeon. Although the Pentium II Xeon carries the Pentium II brand name, the Pentium II Xeon differs significantly from both older Klamath Pentium II processors and the newer Deschutes Pentium II processors. The Pentium II Xeon processor will be packaged in a new, larger cartridge-style package, and it will have a greatly enhanced level 2 (L2) cache subsystem. The Pentium II Xeon will also support four processor (or greater) SMP configurations. The Pentium II Xeon will become the main processor for high-end products after its announcement in the middle of 1998.

In late 1999, Intel plans to launch a 64-bit (IA64) processor code-named Merced. Merced, however, will not mark the end of the IA32 processor line. Intel plans to continue the IA32 architecture concurrently with the Merced line.

The following two sections summarize the current details of the new Deschutes Pentium II and Pentium II Xeon processors.

DESCHUTES PENTIUM II

Understanding the feature set of a Deschutes Pentium II processor can be confusing because Intel has introduced several Pentium II processors that have some, but not all, of the attributes of a full-featured Deschutes Pentium II processor[1]. A full-featured Deschutes Pentium II processor has the following attributes:

- Pentium II processor core technology (IA32)

- Processor speeds of 350-, 400-, and 450-MHz

- 100-MHz GTL+ system bus

- Slot 1 cartridge

- 4 GB of cacheable memory space

- MMX technology

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[1] In January 1998, Intel announced a 333-MHz Pentium II processor. This processor has the Deschutes logic core but retains all the other features of the Klamath Pentium II introduced in May 1997, such as a 66-MHz GTL+ bus and 512-MB system memory limit. In 2Q 1998, Intel announced a 333-MHz Deschutes Pentium II processor that still has the 66-MHz GTL+ bus but extends support for up to 4 GB of system memory.

Pentium II / IA32 Architecture

Both the Deschutes Pentium II and Pentium II Xeon processors use the same basic architecture as previous Pentium II processors. The Deschutes family continues the same IA32 technology line; it is fully software compatible with all previous Pentium Pro and Pentium II processors. Like the Pentium Pro and Pentium II, the Deschutes family uses Dynamic Execution techniques and a dual independent bus structure. The dual independent bus structure provides a separate independent bus between the processor core logic and the secondary L2 cache. See the technology brief *Pentium II Processor Technology*, document number ECG046.0897 for more details on the IA32 architecture and the Pentium II.

350-, 400-, and 450-MHz Processor Frequency

Full-featured Deschutes Pentium II processors were introduced in April '98 with 350- and 400-MHz versions, with future enhancements expected to increase to 450 MHz. These frequency increases should provide a direct performance boost to CPU-intensive applications.

100-MHz GTL+ System Bus

Another performance enhancement is the move from the current 66-MHz GTL+ bus used by the Pentium Pro and Klamath Pentium II processors to a faster 100-MHz GTL+ bus. This provides a faster pipeline between the processor and main memory, and between the processor and system peripherals.

Slot 1 Cartridge

The Deschutes Pentium II processor comes in the same Slot 1 cartridge used in previous Pentium II processors. Due in part to this form factor, the Deschutes Pentium II processor is still limited to no more than 2P SMP configurations.

4-GB Cacheable Address Space

Deschutes Pentium II processors are able to access up to 4 GB of system memory. The Klamath Pentium II only accesses up to 512 MB of cacheable memory. This memory size limitation is one of the key reasons that previous Pentium II products have not been deployed into memory-intensive environments such as online transaction processing and other database applications that sometimes use up to 2 GB or more of memory.

Note: While the processor will be able to support 4 GB of system memory, the actual maximum for the system may be less, depending on the memory chipset and number of available memory sockets.

MMX Technology

Like previous Pentium II processors, the Deschutes Pentium II processor supports MMX instructions. MMX instructions allow certain applications to operate on multiple data locations with a single instruction call to the processor. The MMX functions are primarily used in multimedia applications such as audio and video manipulation; however, increasing numbers of specialized business applications are being written to take advantage of MMX capabilities.

PENTIUM II XEON

In addition to the features of the Deschutes Pentium II processor such as 100-MHz GTL+ and MMX, the Pentium II Xeon processor will have these features:

- Processor speeds starting at 400 MHz and expected to increase to 450 MHz and beyond

- 512-KB, 1-MB, and 2-MB L2 cache configurations

- Full-speed L2 cache bus

- Slot 2 cartridge

400- and 450-MHz Core Processor Frequency

One of the most significant differences between the Pentium II Xeon processor and current Pentium Pro processors will be the much faster processor speed. Pentium II Xeon processors are expected to announce with 400 MHz versions, to reach 450 MHz by the end of 1998, and to increase beyond 450 MHz in later versions.

Larger Cache Sizes

The Pentium II Xeon processor will support larger L2 caches than previous Intel processors. Current Intel information states Pentium II Xeon processors will be available initially in 512-KB and 1-MB versions, with a 2-MB configuration announced later this year, compared with the maximum 1-MB cache available on the Pentium Pro. The larger data caches are expected to provide a significant performance boost, especially in SMP configurations and systems used in memory-intensive applications such as on-line transaction processing.

Full-Speed L2 Cache Bus

Pentium II processors have a half-speed L2 cache bus connecting the cache memory and the CPU core. This means a 266-MHz Pentium II actually transfers data between the L2 cache and CPU core at 133 MHz. However, the Pentium II Xeon processor will have a full-speed cache bus – a 400-MHz Pentium II Xeon processor will transfer data between the L2 cache and processor core at a full 400 MHz. The combination of the full-speed cache bus and the larger cache sizes will greatly enhance the performance of the Pentium II Xeon processor relative to the current Pentium Pro and Pentium II processors, especially in SMP configurations and memory-intensive applications.

Slot 2 Cartridge

Like the Klamath and Deschutes Pentium II processors, the Pentium II Xeon processor will be packaged in a cartridge form factor. However, the Pentium II Xeon cartridge, called Slot 2, will be larger than the current Slot 1 cartridge. Compared with the Slot 1 cartridge, the Slot 2 cartridge has

- A higher pin count.

- Support for a four-processor (4P) multiprocessing bus.

- Load/signal integrity modifications.

- Capability of delivering more power to support the larger, full-speed L2 cache.

The larger cartridge and corresponding motherboard connector require a higher pin count. The additional pins on the Slot 2 cartridge provide support for a 4P multiprocessing system bus. Load and signal integrity modifications in the new design allow a Pentium II Xeon processor to drive up to four main loads on the GTL+ bus – three other processors and a chipset. This allows the Pentium II Xeon to scale to 4P SMP configurations with little external logic circuitry. The pins

also provide incremental power and ground connections needed to support the larger, full-speed L2 cache and may improve signal integrity.

PERFORMANCE

The new Pentium II processors provide a strong performance boost over previous processors. Table 1 shows SPECint*95 performance benchmarks for current Pentium II processors[2]. The Pentium II 350 MHz and 400 MHz are full-featured Deschutes processors. Benchmarks for a 200-MHz Pentium Pro with 512-KB L2 cache are included as a comparison. Please keep in mind that the SPECint*95 benchmark is designed to reflect processor performance and does not necessarily reflect actual *system* performance.

Table 1. Pentium II Processor Performance Benchmarks (higher = better)

Processor	SPECint*95	SPECfp*95
Pentium Pro 200 MHz/512 L2	8.58	6.48
Klamath Pentium II Processors		
Pentium II 233 MHz/512 L2	9.38	7.4
Pentium II 266 MHz/512 L2	10.7	8.17
Pentium II 300 MHz/512 L2	11.9	8.82
Pentium II 333 MHz/512 L2	13	9.55
Deschutes Pentium II Processors		
Pentium II 350 MHz/512 L2	13.9	11.2
Pentium II 400 MHz/512 L2	15.8	12.4

Over the years, Compaq has developed tools to make accurate predictions of processor and system performance even before the hardware designs are complete. Although the Pentium II Xeon processor has not been formally announced by Intel, Compaq engineers have used this expertise to model the performance of Pentium II Xeon systems. Figure 2 shows predicted performance of a Pentium II Xeon system compared with the performance of current Pentium Pro systems.

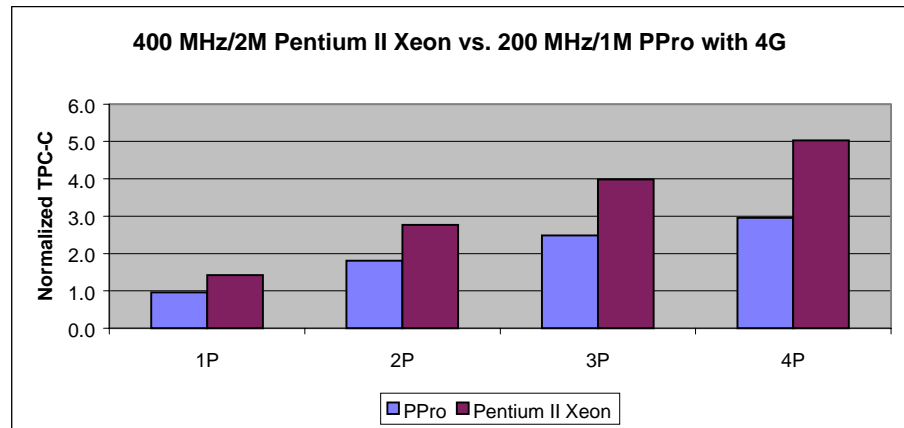[2] Performance numbers from Intel information obtained at www.intel.com

Figure 2. Projected performance of a 400-MHz Pentium II Xeon processor with 2-MB L2 cache vs a 200-MHZ Pentium Pro with a 1-MB L2 cache. (Higher = better)

CONCLUSION

The new Deschutes Pentium II and Pentium II Xeon processors, scheduled to announce in mid-1998, are an extension of the Pentium II family, and keep the same IA32 architecture used in previous Pentium II processors. However, both processors, and especially the Pentium II Xeon processor, will have speed, cache, and other enhancements that will boost their performance well past performance levels previously available from Pentium Pro or older Pentium II processors. In fact, four-processor Pentium II Xeon SMP servers are projected to outperform 8P Pentium Pro servers. The Deschutes Pentium II processor will be deployed in workstations and mainstream servers starting in 2Q 1998. The Pentium II Xeon will replace the Pentium Pro processor as the workhorse processor for high-end systems beginning in mid-1998.