MICROPROCESSOR REPORT

THE INSIDERS' GUIDE TO MICROPROCESSOR HARDWARE

VOLUME 9 NUMBER 13 OCTOBER 2, 1995

Intel Accelerates Pentium Notebook Push

Mobile Triton Debuts—More Mobile Pentiums to Follow

by Linley Gwennap

Intel dropped the second shoe in its Pentium notebook push today, announcing its first Pentium notebook chip set, known as Mobile Triton but officially dubbed the 82430MX PCIset. Intel rolled out its first Mobile Pentium processor nearly a year ago *(see **081503.PDF**)*, but the high-end CPU has been slow to penetrate the notebook market. One of the reasons has been a lack of notebook chip sets for Pentium; Mobile Triton takes a big step toward solving this problem.

Another issue has been the limited number of price points in the Mobile Pentium line: currently, there are only two parts, the 75- and 90-MHz versions. We expect Intel to add as many as six new notebook Pentiums over the next year, with speeds up to 120 MHz in 4Q95 and up to 167 MHz in 1996. The latter boost will come from the forthcoming P55C Pentium, which will use a 2.5-V supply to keep heat dissipation within the existing Mobile Pentium specification.

Today's notebook market features Pentium systems at the high end, with the bulk of the midrange products based on DX4 processors. At the low end, particularly in the subnotebook range, some systems continue to rely on the 486DX2. In 1H96, we see Pentium solidly in control of the midrange while the DX4 goes to the low end. Pentium should dominate the entire PC notebook market by the end of next year.

Mobile Triton Delivers High Performance

Intel's first notebook Pentium chip set is based on Triton, its popular desktop chip set. The major differences are the addition of power management and a reduced pin count in the notebook version. Waiting for the Triton design, however, delayed Intel's entry into the notebook Pentium market. The desktop version began shipping in 1Q95, and it has taken several months to implement and verify the new features.

Leveraging the desktop design gives Mobile Triton the same strong PCI performance. Like its predecessor, the notebook chip set includes read prefetch and posted write buffers to improve concurrency on the PCI bus. The new chip set also supports PCI data streaming at up to 100 Mbytes/s.

First-generation notebook Pentium chip sets from other vendors do not include the buffering found in Mobile Triton, reducing their PCI performance. In addition, products like Opti's Viper-N are limited to a PCI bandwidth of 60 Mbytes/s. Just as the original Triton has set a performance standard for the desktop PC, Intel hopes that the mobile version will provide leadership performance for notebook systems.

As Figure 1 shows (see below), Mobile Triton uses a four-chip configuration, similar to the desktop Triton design. The chip set includes a system controller that provides cache, DRAM, and PCI control; two data-path chips that bridge the processor bus to PCI; and an I/O interface that provides an ISA-like expansion bus.

ISA Bus Simplified for Notebooks

Unlike the desktop Triton, the notebook version does not support full ISA protocols on the expansion bus. A notebook system, of course, has no need for ISA add-in cards, and Mobile Triton supports enough of the ISA design to connect with popular I/O chips for keyboard control, floppy-disk interface, serial I/O, audio, and other common peripherals.

The major difference between a standard ISA bus and Intel's "extended I/O bus" is that the Mobile Triton multiplexes 8 bits of data onto the address lines, leaving 8 bits of nonmultiplexed data. Register accesses and other single-word transactions are performed 8 bits at a time. The bus can still achieve its full 16-bit bandwidth on DMA transfers, as these use the address bus for only the first word. Since DMA transfers are the most critical to performance, the multiplexed design should have little effect on overall system performance.

The Mobile Triton also has no support for ISA bus masters and allows only 256K of memory on the I/O bus.

This limit is adequate for a BIOS ROM or flash chip. These simplifications reduce the pin count of the Triton I/O controller from 208 in the desktop version to 176 in the notebook chip. This change reduces both package cost and the footprint of the chip set.

The other "new" feature in the Mobile Triton chip set, power management, is not really new at all. The Triton power management is very similar to that in Intel's integrated 486SL processor *(see **061501.PDF**)*. It manages the CPU clock, includes six sets of timers for peripheral power management, and implements two suspend/resume modes. Triton's design is adequate but falls short of the aggressive power management implemented in some competitive products, particularly Cirrus Logic's PicoPower line.

Leaves Room for Innovation

Intel did not push the Mobile Triton design very far from its roots. Aside from adding power management and tuning the I/O system, the company made few changes from the desktop Triton, as Table 1 shows. One is that IDE bus mastering, which can significantly improve performance, is not included in the notebook version.

Intel did not integrate popular notebook features such as an LCD controller or a PCMCIA interface; these functions must be added with separate chips. Add-on chips give the system designer more flexibility in choosing a controller, but they increase cost and board space compared with a more integrated design.

The company says its chip set supports docking via a PCI connector, but it does not have a full docking solution yet. Cirrus leads in this area with its Vesuvius/Nile combination *(see **0911MSB.PDF**)*. Watch for Intel to deploy a similar solution in the near future.

Price is one area in which Intel does well, selling its chip set at $32.50 in quantities of 10,000. This price is only slightly more than that of the desktop version and is less than prices of competing notebook chip sets. Vesuvius, for example, carries a $45 list price.

In short, Mobile Triton combines high performance with the essential features needed for today's notebook systems, but it leaves room for other vendors to offer differentiated and even superior solutions. Its low price makes Intel's chip set quite competitive.

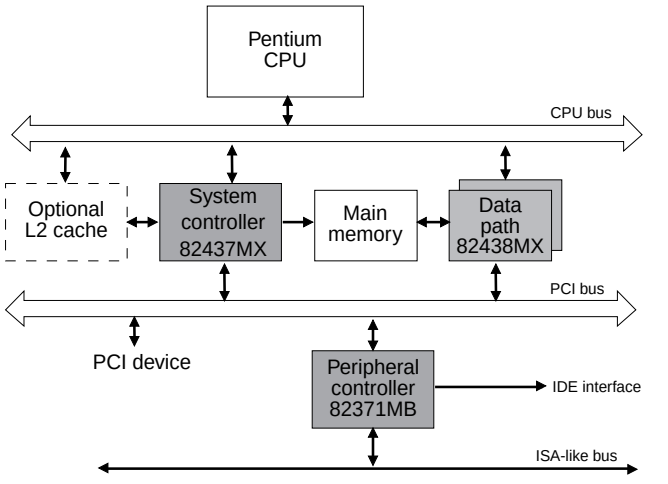

Figure 1. The Mobile Triton chip set includes a system controller, two data-path chips, and an I/O interface.

Mobile Pentium Roadmap

The other half of Intel's Pentium notebook push is to increase the range of mobile processors, covering low-cost and high-performance options. With the 75-MHz part now selling for $184, Intel has made good progress in lowering prices. But as desktop Pentiums have climbed to 133 MHz, the notebook parts have languished at a top speed of 90 MHz, making it impossible for notebook vendors to match the performance of high-end desktops.

Furthermore, the limited number of options keeps Pentium from moving too far down in the product line. Vendors that want to maintain performance differences among their low-end, midrange, and high-end systems must use 486s for their low end and possibly their midrange systems as well.

Intel plans to address these issues by introducing faster Mobile Pentiums later this quarter. One difficulty in extending the Mobile line is maintaining a reasonable power dissipation. Intel has attempted to balance power and performance with its 2.9-V "VRT" specification *(see **090702.PDF**)*. Using the lower voltage keeps the power dissipation of a 90-MHz VRT part the same as that of a 75-MHz Pentium at 3.3 V.

Even at 2.9 V, moving the clock speed to 100 MHz would push power dissipation beyond the current specification, however. The lower voltage also makes it difficult to yield processors at higher frequencies, and 100 MHz is near the limit for the 0.5-micron P54C.

A third problem with a 100-MHz Mobile Pentium is that notebook vendors, which are just beginning to master the 50- and 60-MHz buses required by slower Pentium processors, are not yet comfortable with 66-MHz designs. Because of the slower bus speed, a 100/50-MHz Pentium offers only slightly more performance than a 90/60-MHz Pentium, providing little incentive to upgrade.

Instead, Intel is likely to leap forward to a 120-MHz Mobile Pentium. By moving to 0.35-micron transistors, a 120-MHz VRT design would keep power dissipation to about the same level as the current Mobile Pentiums, avoiding the need for notebook makers to improve their cooling. Further simplifying the upgrade, a 120-MHz Pentium uses the same (60-MHz) bus speed as a 90-MHz part. This leap would also do more to close the gap between notebook and desktop performance.

Intel may eventually offer a 100-MHz Mobile Pentium when notebook vendors are comfortable with a 66-MHz bus. This product will probably use 0.35-micron

Price & Availability

Intel's 82430MX PCIset (the Mobile Triton chip set) is in production now. In quantities of 10,000, the list price for the four-chip set is $32.50. For more information, contact your local Intel sales office, call 800.548.4725, or check the Web at *www.intel.com*.

transistors to avoid increasing the thermal budget and to improve yield at 2.9 V. Or instead, the company could skip the 100-MHz part and proceed upward. A 133-MHz notebook device would also use the 66-MHz system bus, but even at 2.9 V and 0.35-micron geometries, this device would require a 10% increase in the thermal specifications of current notebook designs.

P55C: A Cool Notebook CPU

To achieve higher performance, Intel will turn to the P55C, an enhanced Pentium design expected to ship in 1996. The P55C is rumored to contain larger on-chip caches (32K total) and new multimedia instructions. The larger caches will improve performance in notebooks without an L2 cache. The chip will probably be offered at 150, 167, and 180 MHz. Intel has confirmed that the P55C will be built in a 0.28-micron CMOS process (which Intel calls a 0.35-micron process) *(see **090905.PDF**)* and will run at 2.5 V.

The P55C will dissipate significantly less heat than even the 0.35-micron Pentium, due to the lower supply voltage and the smaller transistors. In addition, the elimination of all bipolar transistors from the P54C design will further reduce power levels. On the other hand, the added features, in particular the larger cache, will consume slightly more power. Still, we expect that a 167-MHz P55C will fit in the same thermal envelope as the 90-MHz VRT Pentium.

Unlike previous Pentiums, the P55C will probably debut at about $500, due to the presence of Pentium Pro (the P6) at the high end. This price will fall rapidly as new Pro versions fill the high end and midrange in 2H96 and into 1997.

	Desktop Triton	Mobile Triton
CPU bus speed (max)	66 MHz	66 MHz
L2 cache size	256K–512K	256K–512K
Main memory size	4M–128M	4M–128M
Burst EDO support?	no	no
PCI bus speed	1/2 CPU clock	1/2 CPU clock
Plug-and-Play support?	yes	yes
IDE interface type	bus master	fast
IDE devices (max)	four	four
Power management	Intel SMM	Intel SMM, sleep, doze, etc
On-chip peripherals	DMA, timers, interrupts, NMI	DMA, timers, interrupts, NMI
Packaging	two PQFP-208, two PQFP-100	PQFP-208, -176, two PQFP-100
Production date	2/95	10/95
Price (10,000s)	$30	$32.50

Table 1. The Mobile Triton chip set includes most of the features of the desktop version plus a few notebook-specific features, mainly power management and a smaller package.

Seeking Out New Markets

Intel's aggressive attempts to dominate system-logic chip sets *(see **091101.PDF**)* had temporarily neglected the nascent Pentium notebook market. Vendors such as Cirrus (PicoPower), Opti, and VLSI have taken most of the first-generation Pentium notebook wins. With Mobile Triton, Intel is showing that it will not ignore this market forever.

Intel may have more difficulty leading the notebook chip-set market than the desktop. The company's desktop dominance is enhanced by its huge motherboard business as well as by being the first to market with a Pentium chip set. Notebook vendors, however, build their own motherboards, and Intel's lateness to market has given other chip-set vendors a foothold.

Nevertheless, Mobile Triton offers strong performance and is sure to be on the short list for many major notebook designs. Combined with a growing number of chip sets from other vendors, this announcement builds the infrastructure for the new Mobile Pentiums that Intel will roll out over the next year. By the end of 1996, Intel's Pentium thrust will relegate the 486 to small corner of the subnotebook market, at best. ♦

