Most Significant Bits

NexGen Pushes 586 to 93 MHz

Leaping into the Pentium-class market at the top, NexGen has begun volume shipments of its Nx586 processor *(see **080403.PDF**)*, which is manufactured by IBM. The company originally said that its design would operate at 60 and 66 MHz, the same speeds as Intel's low-end Pentium processors, but the frequency yield of IBM's process has proved to be dramatically better than expected. In fact, the minimum speed of NexGen's new parts is 70 MHz, while the fastest parts achieve 93 MHz.

These unusual speed grades are the result of a new marketing approach by NexGen to help end users understand the performance differences between its 586 and Pentium. At lower frequencies, the performance of the two CPUs is roughly equivalent on a variety of benchmarks. Above 66 MHz, however, Intel runs the external cache at two-thirds of the CPU clock rate, while NexGen continues to clock the cache at the same speed as the CPU. As a result, the Nx586 outperforms Pentium on a clock-for-clock basis, based on the Winstone 1.0 benchmark developed by Ziff-Davis.

To portray this effect, NexGen has named its chips with a suffix showing the equivalent Pentium clock speed required to achieve the same performance, as the table below shows. The 93-MHz part, for example, is called the Nx586-P100, meaning that its performance is equivalent to that of a 100-MHz Pentium. NexGen has calculated these equivalences based on testing Nx586 and Pentium systems using Winstone 1.0.

	Clock Speed	NexGen 10K Price	Intel 1K Price
Nx586-P100	93 MHz	$777	$964
Nx586-P90	84 MHz	$539	$707
Nx586-P80	75 MHz	$477	n/a
Nx586-P75	70 MHz	$404	n/a

The new naming system is intuitive for end users and helpful for industry watchers. Other companies preparing Pentium-class chips, specifically IBM/Cyrix and AMD, will be watching to see how it is accepted. There is some danger, however, in allowing a vendor's marketing department to essentially self-certify the performance of its processors. Based on some independent testing, NexGen appears to have rated its parts fairly; the onus is on other x86 vendors to do the same.

NexGen's published prices, as the table shows, are about 20% lower than Intel's for competitive parts, but the difference is less than it appears. One key difference is that the Nx586 does not include a floating-point unit. Most applications today do not take advantage of Pentium's FPU, but this will change over time, particularly as animation becomes more popular. For users concerned about the future, the NexGen part has a lower perceived value.

NexGen originally planned to offer a 587 FPU chip as an option but now says it will not offer this device as a standalone product. Rather, the company will introduce a new product in 1Q95 that includes the 586 and 587 chips in a single PGA package. This yet-unnamed device will use the same pinout as the Nx586, making it easy for system makers and even end users to upgrade their systems for floating-point. IBM, experienced with multi-die packages, should have no trouble building the proposed module.

When comparing NexGen and Intel prices, another consideration is that the 586 does not connect to standard PC system logic and must be used with NexGen's $80 VL-Bus chip set. Note also that NexGen is quoting 10,000-unit prices while Intel publishes 1,000-piece pricing; NexGen says that it provides "market development funds" to its customers that allow even the smallest buyers to pay less than the 10,000-unit price through the end of this year.

Although NexGen still has no major system customers, a variety of third-tier vendors have announced products. One of the most aggressive is a $1,799 Tangent box that uses the P75 version of the CPU.

Not sitting still, NexGen plans several new products in 1995. Nearing completion is a redesign of the 586 that takes advantage of the five metal layers in IBM's CMOS-5L process; the current design uses only three metal layers. This redesign will significantly reduce the die size (and thus cost) as well as boost the clock speed by about 33%. This version may begin shipping in 1Q95.

Following that effort, the company hopes to introduce a 686 part around the same time as Intel's next-generation P6. NexGen's 686 will probably use a similar core design as the 586 but add superscalar x86 instruction decoding, doubling performance from the 586. The 686 may also take advantage of IBM's more advanced CMOS-5X process to achieve a further speed increase. If the company can roll out these new designs while demonstrating the compatibility of its current parts, some top-tier PC vendors will begin to take notice.

AMD Samples Half-Micron 486

In a move aimed to significantly boost its limited production capacity, AMD is converting its sub-micron development center (SDC) to a new 0.5-micron CMOS process called CS-24. The company expects to complete this conversion by 1Q95, increasing the SDC's capacity for 486 processors by 60% or more.

In the CS-24 process, the die size of the 486DX is just 56 mm^2, 37% smaller than the 0.7-micron version.

The shrink allows more die per wafer and also improves yields. At 12,000 wafers per month, we estimate that the SDC can produce 1.6 million 486 chips per quarter using CS-24, compared with about 1.0 million currently. As the new manufacturing process matures and defect densities drop, the output could approach 2.0 million.

The SDC is AMD's sole source of 486 chips; production will increase further as Digital begins producing Am486 chips later this year. Adding still more capacity, AMD's new Fab 25 is scheduled to begin volume production in 2Q95, although much of that production will be devoted to the forthcoming K5 processor.

The first 0.5-micron 486 is a 100-MHz clock-tripled part, which AMD is currently sampling. This part is otherwise identical to AMD's current 486DX2 chips, using the same 8K write-through cache. The company expects to ship the new product by the end of this year.

Intel's 100-MHz DX4 uses a 16K on-chip cache to help maintain performance as the CPU clock speed increases without a corresponding boost in bus speed. With its smaller cache, the AMD part will have somewhat lower performance than the DX4: about 5% in systems with a fast external cache and worse in poorly designed systems or those with no external cache at all. In 1H95, AMD plans to roll out parts with larger write-back caches, possibly reaching 120 MHz with the new process. For now, the smaller die size of the 8K cache makes it more attractive to the capacity-limited vendor.

Mitsubishi To Build Faster 21066 Alpha CPU...

Confirming its status as a second source for Digital's processors, Mitsubishi has announced availability dates for its first Alpha chips. The company had previously said it would start with the low-end 21066 design, but the surprise came in the clock frequency: 200 MHz, a speed faster than Digital has yet announced. Mitsubishi says that its 200-MHz 21066 will achieve about 85 SPECint92 and 130 SPECfp92, about 20% better than Digital's 166-MHz version but still less than the integer performance of a 90-MHz Pentium.

The fast 21066 will use a 0.5-micron CMOS process rather than the 0.6-micron process used for the original 21066. The new processor reduces the die area to 154 mm^2, 26% smaller than Digital's 21066. This shrink yields an estimated manufacturing cost of $122, according to the MPR Cost Model *(see **081203.PDF**)*, 17% better than Digital's estimated manufacturing cost. Despite the higher clock speed, power dissipation remains at about 20 W.

Mitsubishi expects that its 21066-equivalent, the P64, will sample in 4Q94 but will not reach volume shipments until 3Q95. The company did not announce pricing for the P64. Because Mitsubishi simply builds from the same masks as Digital, we assume that the U.S. vendor will eventually announce a 200-MHz 21066 as well, but no such announcement has been made. In fact, Digital has not yet announced any 21066-based systems, perhaps due to its focus on faster-than-Pentium performance (see "Mailbox" sidebar). A few small Alpha vendors plan to use the part. Perhaps Mitsubishi is delaying volume production in the hope that volume customers become available.

...While Olivetti Considers Dropping Alpha

The dearth of Alpha customers may worsen if Olivetti decides to abandon the architecture. The Italian vendor has sold relabeled Alpha systems for the past two years but is now reportedly in discussions with Apple to license the Power Macintosh platform. Apple is interested in expanding the Macintosh market share in Europe, where

From the Mailbox

Your recent editorial *(see **0811ED.PDF**)* missed important facts about the Alpha program at Digital and the long-term prognosis for Alpha. First, more than 1,700 software applications are committed to Windows NT on Alpha, with more than 650 shipping today. Alpha has virtually the same number of applications already committed to Windows NT alone as the entire applications pool available to Macintosh, around which Apple has built a business.

Digital can easily afford the required investments to maintain the Alpha family as the fastest microprocessors in the world for many years to come. On the manufacturing side, Digital Semiconductor recognizes that it must stay at the state of the art and that to be economically viable, foundry partners (for example, AMD) must be enlisted, particularly at the early stages of market ramp. In this way, we will maintain full loading in our manufacturing facilities, regardless of where the demand for Alpha happens to be at any given point in time.

The other key aspect of Alpha development is the design investments required for new implementations of the architecture. Digital does not need to offer the wide range of price/performance points that an Intel does. Our strategy is to focus on Alpha microprocessors that offer performance beyond what is possible with x86 at a given point in time, offering our systems partners the opportunity to extend their client and server x86 products with Alpha at the high end. Alpha chip designers and their support represent well less than one-half of 1% of Digital Equipment's headcount, even after downsizing is complete.

The expense of developing Alpha processors simply is not going to break the back of the corporation, particularly when that expense provides the corporation and our external customers with a key strategic differentiator: the world's fastest microprocessors.

—David Fair, Manager of Product Marketing
—Digital Semiconductor

MPR welcomes letters to the editor, which we may edit for clarity and brevity before publishing. Write to the editor at our editorial office.

New Analyst Joins MPR Staff

Starting with this issue, Jim Turley joins our staff as the senior editor of the *Microprocessor Report*. Jim has 15 years of experience in designing microprocessor-based systems. Most recently, he was the systems engineering manager at Adept Technology, following a long stint as a designer at Force Computers. Jim also brings an extensive writing background to the post, having authored several books, including *Advanced 80386 Programming Techniques*. This unique combination of writing and engineering skills will allow him to deliver clear and knowledgeable analysis to our readers.

With Jim on board, our team of senior analysts has grown to three, affording us the luxury of some specialization. Jim, whose first article appears in this issue, will focus on embedded processors, while Michael concentrates on x86 and I cover RISC microprocessors. Of course, due to the dynamic market, we will all be covering a range of issues at various times. If your company is announcing a new product, you may direct your information to the person covering that area, or feel free to contact me and I'll take it from there.

Our new team will continue to deliver the best available coverage of the microprocessor industry and related issues. If you have any feedback, please contact us. Thanks!

—Linley Gwennap, Editor in Chief

Olivetti is a major PC player. Olivetti undoubtedly realizes that the prospects for Power Macintosh sales are much greater than those for its Alpha systems.

It is possible that the deal has already been made. Digital recently sold its stake in Olivetti, which it purchased when Olivetti adopted the Alpha architecture and dumped MIPS. Olivetti was also conspicuously absent from the list of system vendors backing the new 21164 processor *(see **081201.PDF**)*.

Another Alpha system vendor, Kubota, recently dropped its Alpha line as part of a major financial restructuring. Kubota had used 21064 chips in high-end graphics workstations, but apparently this business was not profitable enough to sustain. If Olivetti joins Kubota in forsaking Alpha, it would leave Cray as the only major vendor of Alpha systems outside of Digital itself; Cray has already said that it is considering alternative processor vendors for the follow-on to its 21064-based T3D machine. Without these big players, Alpha's future as a multivendor architecture would rest in the hands of tiny companies like Aspen, Carrera, and Nekotech.

AMD Deploys Embedded 186, 386

Diving into a perceived hole in the embedded x86 market, AMD has announced two derivative versions of its 186 and 386 processors. Both devices leverage the company's existing CPU core designs and CMOS process. Shunning DOS compatibility, both processors are aimed at low-cost embedded applications that don't require—or desire—a PC-compatible I/O structure.

The Am186EM offers several improvements over a baseline 80C186. The chip includes logic for a glueless interface to DRAM, ROM, and standard peripheral I/O devices. A new nonmultiplexed bus allows the 186EM to run twice as fast as a traditional 186 using memory chips of the same speed. At 25 MHz, the part will cost $13 in 10,000-piece lots when it reaches volume production in 1Q95, according to the company.

The Am386EM is similar to the 186EM but with a 386 CPU core. Instead of including PC-compatible I/O devices, as Intel did with its 386EX *(see **071405.PDF**)*, AMD added 186-style I/O, positioning the 386EM as the only compatible 32-bit upgrade for 186 designs. The 386EM is also attractive to designers who need 386 processing speed without the byzantine DMA and interrupt logic of Intel's version.

AMD expects the 25-MHz 386EM to achieve volume production in 3Q95 with a list price of $25. Although the price/performance of the 386 is significantly worse than for 32-bit RISC microcontrollers, the new chip should do well as an upgrade to existing 186-based designs.

VLSI Shrinks ARM6 Core to 0.5-Micron

Continuing a rapid expansion of its ARM product line, VLSI Technology has introduced a new version of the ARM6 core that operates as fast as 45 MHz, 35% faster than the previous version. This core is the fastest available from any ARM vendor; at 38 MIPS (on Dhrystone 2.1), it outruns even VLSI's 40-MHz ARM7 core *(see **0811MSB.PDF**)*.

The improvement is achieved through the use of VLSI's most advanced manufacturing process, a three-layer-metal 0.5-micron CMOS process. In addition to boosting the speed, the smaller geometries reduce the core size to just over 4 mm^2, about one-third the size of the original 1.0-micron ARM6 core. The new design achieves its peak frequency when operating at 3.3 V, keeping power consumption to a miserly 110 mW.

At this time, the 0.5-micron ARM6 is available only as a core (dubbed the VYF86C06-004) in VLSI's library of standard ASIC cells. ASICs using the new core should be attractive for manufacturers of video games and other consumer devices. VLSI may create standard products with the new core if there is customer demand, but many customers will rely on the ARM7 core, which will eventually regain the performance lead when it, too, is shrunk to the 0.5-micron process. ♦

