Digital Discloses 21164PC

Pushing the price of an Alpha system to new lows, Digital unveiled its 21164PC processor at last week's Microprocessor Forum. The new chip, codeveloped with Alpha partner Mitsubishi, contains the same processor core as the 0.35-micron 21164 but eliminates the complex two-level on-chip cache of that part, substituting a 16K primary instruction cache and retaining the 8K primary data cache. One improvement is the addition of new motion-video instructions *(see* **101402.PDF***)*, which Digital says add only 0.6% to the die area.

Stripping away 88K of the 21164's on-chip cache trims the die size to 138 mm^2, a 34% reduction. Power dissipation is reduced slightly, to 20 W (maximum) at 450 MHz. Digital hopes to produce 21164PC processors at the same clock speeds as the 21164, which reaches 500 MHz today. The package size is reduced from 499 to 413 pins by paring the maximum system configuration and eliminating a bunch of power and ground pins left over from the original 50-W 21164 design. As a result of these changes, we estimate the manufacturing cost of the new part to be around $100, two-thirds the cost of the full-blown 21164.

Digital did not announce a price tag for the 21164PC, which will also be built and sold by Mitsubishi, but the company expects the processor, chip set, and 512K of 100-MHz synchronous SRAM to sell for about $425 in volume. This price is lower than that expected for Intel's forthcoming Klamath processor with a similar chip set and cache, yet the Alpha chip should deliver significantly more performance. In fact, Digital's Pete Bannon claims the 21164PC, in this configuration, will deliver 90% of the SPEC95 performance of a 21164 with 2M of external cache. To achieve this performance, the chip contains an improved system interface that reduces the latency of cache and main-memory accesses.

Digital is now testing first silicon and expects 21164PC systems to appear in 2Q97, shortly after Klamath debuts. If the company delivers on its price promises, the new Alpha chip should fit into systems selling for $2,500 or even less. Although 90% of the PC market remains below this point, about six million systems per year sell for $2,500 or more, giving Alpha a much bigger market to shoot for. With Windows NT becoming popular in many corporations, the 21164PC provides Alpha with the potential for a significant increase in shipments over the next few years. —*L.G.*

FX!32 Outperforms Pentium Pro

Digital's FX!32, an emulation/translation program offering x86 compatibility on Alpha systems, is now available. Digital will ship FX!32 on all of its Alpha systems that use NT 4.0. In addition, the program can be downloaded for free from the Web at *www.service.digital.com/fx32*. FX!32 supports x86 applications written to the Win32 API and has been verified to work with more than 200 applications.

For the first time, the company has published performance data for x86 benchmarks running under FX!32. The data shows x86 code, represented by *Byte* magazine's Windows NT integer benchmark, achieving 65% of native Alpha performance on a 500-MHz 21164 processor. The Alpha chip was able to outperform a 200-MHz Pentium Pro by 48% on the same benchmark when both processors used x86 code.

According to the *Byte* benchmark, FX!32 delivers less than 40% of native performance for floating-point applications. Digital says emulating x86 floating point is more difficult than integer because of the need to maintain precise exceptions (not required in the Alpha FP model) and to mimic the x86's arcane FP stack architecture. Many FP-intensive applications, however, are already available in native Alpha versions, so this deficiency is not critical.

Byte Windows NT Benchmark	500-MHz 21164 Native	500-MHz 21164 FX!32	% of Native Perf	200-MHz Pent Pro Native	FX!32 vs. PPro
Integer	6.2	4.1	65%	2.8	+48%
Floating Point	7.3	2.7	37%	3.4	–21%
Wintune95					
Integer	n/a	457	n/a	415	+10%
Floating Point	n/a	131	n/a	110	+19%

The table above summarizes the *Byte* results and also shows scores from the *Windows* magazine Wintune95 benchmark. Because this benchmark is not portable, these results do not include native Alpha scores; the x86 tests show FX!32 maintaining a 10% performance advantage over Pentium Pro. For all tests shown, the Alpha scores were generated using the 21164 evaluation board with a 500-MHz processor, 2M of cache, 64M of memory, and a Matrox graphics card. The Pentium Pro was tested in a Digital PC with 256K of cache and the same memory and graphics configuration as in the Alpha system.

Digital did not publish scores for more popular application-based benchmarks such as Winstone or SYSmark NT. For maximum performance, FX!32 must be "trained" using several passes through a program *(see* **100302.PDF***)*, but these application benchmarks must be run each time from a clean install. Digital is working with Ziff-Davis and Bapco, respectively, to find a way around this problem.

Based on the *Byte* benchmark, Digital has come close to its goal of delivering 70% of native performance with FX!32. Applying this multiplier to SPECint95, the new figures imply a 500-MHz 21164 with FX!32 will deliver about the same x86 performance as a 200-MHz Pentium Pro. Of course, one can purchase a complete Pentium Pro system for less than the price of the 500-MHz Alpha chip alone. Digital hopes the 21164PC (see previous item) will bring Alpha performance to Pentium Pro price points, allowing FX!32 to help ease Alpha into the PC mainstream. —*L.G.*

MIPS Vanishes from NT Market

Microsoft has announced it will not include MIPS support in future versions of Windows NT. Although NT was originally developed on MIPS systems, and MIPS was the first RISC architecture ever supported by a Windows operating system, few system vendors committed to NT on MIPS. The last significant one, NEC, recently announced plans to phase out its MIPS-based product lines, including those supporting Windows NT. This announcement caused Microsoft to turn out the lights.

One of the goals of the old ACE consortium was to establish a standard low-cost MIPS platform that, combined with Windows NT, would move MIPS into the mainstream desktop market. Compaq withdrew from ACE before shipping any systems; Acer, another large PC maker in ACE, made a half-hearted effort with MIPS but quickly gave up. A handful of small companies, including Deskstation, NetPower, and ShaBlamm, offered NT/MIPS systems, but these companies have since moved to either Alpha or x86 processors, both of which also run Windows NT.

Perhaps the biggest roadblock in establishing NT on MIPS has been the disinterest of Silicon Graphics, the proprietor of the MIPS architecture. SGI, like Sun, continues to emphasize only Unix for its workstations and servers, whereas competitors Digital, HP, and IBM all offer both NT and Unix. While MIPS continues to do well in the embedded consumer market, its role on the desktop is now completely anchored by Unix. —*L.G.*

PowerPC 603e Jumps to 240 MHz

Outperforming their own expectations, IBM and Motorola have announced immediate availability of 225- and 240-MHz 603e processors. The 225-MHz chip delivers an estimated 6.0 SPECint95 and 4.4 SPECfp95 (base) with 1M of cache and a 75-MHz bus. The 240-MHz version actually scores slightly lower on SPEC95 because it uses a 68-MHz bus. Both processors deliver better SPEC95 performance than any of Intel's Pentium processors.

IBM's 1,000-piece prices for the 225- and 240-MHz 603e are $332 and $408, respectively. (Motorola's are slightly higher.) By comparison, a Pentium-200, at 5.5 SPECint95, lists for $509. Thus, the new processors offer a price/performance advantage over Intel's, but not a spectacular one.

The new parts use a slightly enhanced transistor compared with the 200-MHz version. The metal layers remain the same, so the die size does as well. In other ways, the new parts are identical to the current versions. The enhanced transistor is likely to be applied to the 604e in the near future, driving clock speeds to 240 MHz or so on that part as well.

Coincident with the announcement, both Umax and Power Computing rolled out Mac compatibles using the new chip. Apple, currently shipping 200-MHz systems, is expected to add the new part to its lineup in the next few months.

The PowerPC vendors are on a roll. Their previous roadmap *(see* **101103.PDF***)* had projected 240-MHz parts next spring, so they are now about six months ahead of schedule. The 603e has edged ahead of Pentium in integer performance, but the P55C is likely to close that gap early next year. With Intel planning to quickly increase the clock speed of the P6 next year and the PowerPC chip vendors planning the same for the 604e, these two chips are likely to stay near each other in integer performance during 1997. The PowerPC chips hold a floating-point edge, but so far they have been unable to translate this advantage into any significant benefit for mainstream PC users. —*L.G.*

AMD Extends Elan Family with 486 Core

AMD's Elan twins now have a big brother: the Elan SC400 replaces the 386 core of the Elan SC300 and SC310 chips *(see* **1005MSB.PDF***)* with AMD's 486 CPU, an 8K cache, and some new peripherals. The SC400 is not pin-compatible with the previous Elan parts, so customers must upgrade their hardware designs along with their software.

On the peripheral front, the SC400 adds support for matrix-scanned keyboards, a UMA frame buffer, Irda communication, and 23 additional I/O pins. The part's 66-MHz clock speed, write-though cache, and 32-bit external bus interface should increase performance severalfold over that of the SC300 and SC310, which peak at 33 MHz. AMD is quoting quantity prices of $39 and $44 for 33- and 66-MHz versions, respectively, in a 292-contact BGA package.

The history of integrated PC-compatible processors has been a rocky one, with Intel, Chips & Technologies, VLSI, and other companies all testing the market and subsequently withdrawing. While others have eyed notebook PCs and similar markets, AMD has stuck to its guns, slowly preening its Elan parts for embedded customers who want full PC compatibility. If this strategy continues to gain design wins, perhaps a K5-based Elan will eventually appear. —*J.T.*

Motorola Nabs Mitsubishi's Embedded DRAM

Motorola has announced it will swap its embedded CPUs for Mitsubishi's innovative embedded DRAM technology. The deal, which should be finalized within a few weeks and which extends for seven years, exchanges two properties from each company. Motorola acquires Mitsubishi's embedded DRAM technology and M32R processor core *(see* **100702.PDF***)* while Mitsubishi gains rights to all of Motorola's ColdFire and 68EC000 CPU cores.

Motorola will be able to offer embedded DRAM in any of its products, including its FlexCore ASIC library, standard microprocessors, and application-specific devices. The embedded DRAM is not limited to microprocessor-based parts and could appear in graphics chips, wireless products, and specialty memories, among others. The company listed imaging, storage, general business, and multimedia as primary targets for the technology.

Mitsubishi will, for the first time, gain access to a widely supported processor architecture. The company voiced no distinct plans for its new processor cores apart from making

them available in ASIC cell libraries.

Motorola has not disclosed which, if any, of its fabs will build the hybrid logic/DRAM devices, apart from asserting that the parts will not be built by Mitsubishi. The Japanese vendor builds the M32R/D using its standard 16-Mbit DRAM process, which is very different from the logic processes Motorola has implemented. A DRAM process is optimized to increase capacitance, for example; a logic process is designed to minimize capacitance. Motorola has no DRAM process technology in any of its current fabs.

Adding a processor to a DRAM has several advantages: memory capacities are not constrained to powers of two; small memories may be included economically; power consumption, bus traffic, and latency are all reduced; and PCB real estate is conserved. In market segments that value small size or low power consumption, a CPU/DRAM combination should give both companies a competitive advantage.

Other vendors have long recognized these advantages but have been largely unable to manufacture such parts economically. Mitsubishi has already demonstrated an ability to combine DRAM with a CPU core and now has access to Motorola's popular processors. It remains to be seen whether Motorola's kitchen can handle Mitsubishi's recipe. —*J.T.*

MIPS Rolls Out New Instructions

Perhaps more than any other instruction set, the MIPS architecture is getting pulled in several directions at once. At the high end, Silicon Graphics is deploying MIPS processors in parallel servers and ultimately in Cray supercomputers. Other vendors are putting MIPS chips into video games, network routers, and handheld computers. At last week's Microprocessor Forum, MIPS Technologies (MTI) unveiled its plan to flexibly meet these conflicting needs without fracturing instruction-set compatibility.

At the Forum, Earl Killian described the MIPS V instruction set, which extends the current MIPS IV with a few instructions that perform two single-precision floating-point operations in parallel, doubling throughput on many 3D graphics and scientific applications. MIPS V represents new growth on the main trunk of the MIPS ISA. It will first be implemented in the next-generation high-end MIPS processor known as H1, which is expected to ship sometime in 1998. Mainstream MIPS chips today implement MIPS II or MIPS III, and this is unlikely to change in the near future.

To satisfy specific applications, MTI will now help MIPS processor vendors develop extensions to the main ISA. This tactic is a response to the tangled growth created by individual MIPS processor vendors that added incompatible multiply-add extensions to meet customer demands. New application-specific extensions will be blessed by MTI and available to all MIPS partners.

The first two such extensions are MIPS-16, for low-cost implementations, and MDMX, for multimedia. The former, also known as TinyRisc, creates a 16-bit encoding for many MIPS instructions, reducing the amount of memory needed to store programs *(see* **101410.PDF***)*. MDMX, a.k.a. Mad Max, is an extensive set of multimedia instructions comparable to Intel's MMX or Sun's VIS, although MIPS has added a few twists, such as a 192-bit accumulator for parallel multiply-accumulates. *(We examine MIPS V and MDMX in* **1012MSB.PDF***.)*

MIPS-16 and MDMX can be viewed as branches off the MIPS trunk. These extensions are optional, so MIPS chip makers can design products tailored to the specific needs of their customers without tacking on extra unnecessary features. Killian hinted that other branches, such as instructions to accelerate Java programs, could sprout in the future. The new ISA structure will help MIPS vendors evolve their products to meet market needs. —*L.G.*

Trident Brings DVD, 3D to P55C Systems

By adding logic to handle motion compensation, the new 3DImàge 975DVD from Trident enables DVD playback on systems with P55C processors. Trident estimates motion compensation, if performed on the host, is responsible for 40–50% of the CPU load for DVD decoding. Intel claims a P55C-200 processor will support DVD playback at less than 20 frames per second (fps), but Trident says even a P55C-166 plus the 975DVD can achieve the full 30-fps rate with about 10% of the CPU's bandwidth left for other tasks.

This capability comes at a very low incremental cost, only $7.50 extra for the DVD version of 3DImàge. Upgrading the P55C to a Klamath, which should handle full 30-fps DVD playback in software, will cost hundreds of dollars in 1H97. The Klamath CPU will, of course, accelerate most other applications in addition to DVD.

The new chip, also available without the DVD accelerator as the 3DImàge 975, replaces the conventional 2D/3D graphics controllers in motherboard and expansion-card designs. Both versions include a dedicated 3D setup engine, further offloading the host CPU. Most other 3D chips in this price range lack a 3D setup engine, so these chips will not be able to match Trident's drawing rate of 1.2M polygons/s or fill rate of 60M pixels/s.

The 3DImàge 975 is scheduled to sample in 4Q96 with production in 1Q97; the 975DVD will be about a quarter later. Both are available in 208-pin PQFPs. Pricing is $25 and $32.50, respectively, in 10,000-unit quantities.

Trident comes late to the 3D party, announcing its first 3D accelerator after competitors like S3 and ATI have announced second-generation products. Trident, however, meets or exceeds the feature set of competing devices by supporting fast EDO, SGRAM block writes, and scaling to NTSC and PAL formats. The superior performance and special features of 3DImàge should help Trident gain a strong foothold in this critical market. —*P.N.G.* M