Samsung to Supply Alpha Chips

Memory giant Samsung Electronics has chosen to enter the microprocessor business by licensing Digital's Alpha processors, starting with the 21164. The Korean manufacturer has become one of the largest semiconductor vendors in the world almost exclusively through its DRAM and SRAM offerings. Except for a few 4- and 8-bit microcontrollers, the Alpha chips will be Samsung's first microprocessors.

The company will initially produce the 0.35-micron version of the 21164, which Digital now builds at clock speeds of up to 500 MHz *(see* **100901.PDF***)*. Samsung's 64M DRAMs are built in a 0.32-micron process, but this process is optimized for memory and does not include the dense metal layers needed to build high-performance microprocessors such as the 21164. Samsung's best logic-oriented process is for 0.5-micron ASICs. The company expects to be able to match Digital's 0.35-micron process with an undisclosed amount of help from Digital.

Samsung hopes to sample 21164 parts in 1H97, with volume production by the end of that year. In the future, the company expects to produce other high-end Alpha processors as well as low-end derivative devices. Samsung will not, however, second-source the low-cost 21164PC *(see* **1005MSB.PDF***)*; Mitsubishi will apparently be the exclusive second source for this device.

It isn't immediately clear to whom Samsung expects to sell Alpha processors. The market for Alpha chips outside of Digital is nearly nonexistent. Both Samsung and Digital believe the growing interest in Windows NT, combined with Alpha's performance superiority, will convince some major system makers to produce Alpha systems. Samsung also plans to use Alpha processors internally in high-end embedded applications (such as telecom switches) and possibly in its own line of Alpha NT systems.

This announcement is eerily reminiscent of Mitsubishi's licensing of Alpha *(see* **0704MSB.PDF***)*. The Japanese vendor had hoped to catch the NT wave but is still dead in the water: in three years, Mitsubishi has not shipped any significant volume of Alpha processors. The presence of three chip vendors should soothe any system vendor's concerns about the availability of Alpha chips; now, Digital and its partners just have to convince them there is a volume market for Alpha systems.

Intel Accelerates 0.25-Micron Efforts

Shortly after Texas Instruments announced its plans to ship 0.25-micron processors in 1H97 *(see* **1008MSB.PDF***)*, Intel quietly indicated it has accelerated its plans to reach that level. Previously, the x86 giant said it would not ship 0.25-micron devices in volume until 2H97; now it expects such production in the first half, matching TI, IBM, and other leading vendors.

The 0.25-micron process is key for Intel to significantly improve the performance of its P6 family. We expect Intel to roll out Klamath in 1Q97 using 0.28-micron CMOS, but that process will probably support only 233-MHz operation, providing just a small performance boost over the 200-MHz Pentium Pro. This gain is limited by the elimination of the bipolar transistors from Intel's 0.35-micron process. In addition, the 0.28-micron shrink does not affect the metal interconnect layers, which are critical to reducing die size.

Intel's 0.25-micron process is a full generation beyond the 0.35-micron version and includes a significant improvement to the metal layers as well as to transistor speed. This combination should boost the clock speed of the P6 core to 300 or even 333 MHz. In addition, the die size of the part will shrink, reducing cost and increasing output. The 0.25-micron process is required to reach the cost and volume levels needed to bring the P6 into the PC mainstream. It will also enable the notebook market to shift to the P6. These changes will happen sooner under the new plan.

AC '97 Defines Audio I/O Standard

The new Audio Codec '97 specification attempts to solve a key problem facing PC audio designers: while integrating digital logic with analog circuitry can lower cost by reducing chip count, mixed-signal ASICs are difficult to design and can be expensive to manufacture. AC '97—developed by Analog Devices, Creative Labs, Intel, National Semiconductor, and Yamaha—defines the analog half of a two-chip audio subsystem for the mainstream PC market plus the digital interconnect between the two chips. The specification is on the Web at *www.intel.com/pc-supp/platform/ac97*.

The AC '97 analog component includes 48-kHz ADCs and DACs with 16–20-bit resolution and a mixer subsystem with up to 16 input and 8 output channels. Support for a soft modem interface is optional, along with 3D audio, separate headphone outputs, tone control, and other features that will help vendors differentiate their products. The analog component also contains a significant amount of digital logic, with up to 128 bytes of register space used to control the audio mixer and other analog portions of the device.

The interface between the digital and analog chips, called AC-link, is a bidirectional five-wire bus carrying 12.288-MHz serial data. Twelve channels of 48-kHz 20-bit data are time-multiplexed onto the serial input and output. Two channels are used for control, two for audio, and one for the optional modem. The remaining seven channels in each direction are reserved for future use and could eventually be used to support evolving standards like Dolby AC-3.

The AC '97 digital component could be a dedicated sound controller like Yamaha's OPL-3, but other options are possible. An MPEG-2 decoder chip could gain audio capability by adding control logic and an AC-link interface.

The AC '97 analog component will be produced in only two pinouts. The smaller version, in a 48-pin package, is intended for baseline motherboard audio support. The larger version, with 64 pins, will support higher-quality audio and future expansion, making it a better choice for high-end motherboards and expansion cards. No vendors have announced specific product plans, but early samples are expected in 3Q96, with full production by 2Q97. Volume pricing for AC '97 chip sets (combining both the digital and analog components) is expected to be in the $8–$10 range, depending on their capabilities.

The AC '97 specification more than meets the needs of today's computer audio market. The available bandwidth surpasses that of compact discs, and the selection of mixer inputs and outputs should be adequate for any conventional PC. Future extensions, however, must consider the requirements of AC-3 and DVD audio.

The specification opens the door for significant changes in audio-subsystem design. Intel and others are likely to incorporate the digital portion of AC '97 in their chip sets, leaving traditional sound-chip vendors only the analog component, a $3–$4 device. On the other hand, the new specification opens the door for moving the analog component completely out of the PC and into smart speakers and home stereos, increasing the size of the audio codec market.

Hyatt Rejected as Inventor of Microprocessor

The U.S. Patent Office recently released a ruling overturning a key portion of Gilbert Hyatt's patent 4,942,516, which Hyatt had used to establish himself as the inventor of the single-chip computer, or microprocessor. Based on this patent, Hyatt has attempted, with some success, to collect royalties from several microprocessor vendors. Hyatt himself never constructed or commercialized a single-chip computer, but such work is not required to receive a patent.

The '516 patent was filed for in December 1970 but for various reasons was not granted until July 1990 (see MPR 11/28/90, p. 15). Shortly thereafter, Texas Instruments challenged Hyatt's claim through a process known as interference. TI engineer Gary Boone had filed a patent relating to a single-chip computer in July 1971, after Hyatt's but before other such patents.

TI noted the broad single-chip claim in '516 did not appear in Hyatt's 1970 application but was added in 1977, after the implications of the microprocessor were widely known and after Boone's 1971 filing. Hyatt's original application contained a somewhat different claim: "an electronic data-processing system including read-only memory means, alterable memory means and program means, said system being implemented on a single integrated-circuit chip."

In resolving the interference case (a ruling made last September but only recently disclosed), the Patent Office found the clause "implemented on a single integrated-circuit chip" applied to the memories and not the complete system, thus describing a single-chip memory, not a microprocessor. The ruling went on to recognize Boone as the "prior inventor" of the microprocessor. TI did not, however, gain a patent on the microprocessor; for legal reasons, the company had converted its patent into a statutory invention registration, which does not permit the company to collect royalties. Thus, neither Hyatt nor TI now has a valid patent on the microprocessor, but no other party can gain one.

In an interview with *Microprocessor Report*, Hyatt said he is preparing to appeal this "interim decision" to a federal court. Based on the odd interpretation of the wording, he may have a case. Another roadblock, however, is that the processor described in '516 would have required about 44,000 transistors to build. By comparison, the Intel 4004, a state-of-the-art device released in 1971, contained only 2,100 transistors. Patent law requires the device be buildable by "one skilled in the art" using the technology of the day. Thus, even if Hyatt can convince a federal court to reinterpret the wording of his claim, the court may rule that Hyatt's single-chip computer was unbuildable and thus unpatentable.

NEC Spins 4101 Processor for PDAs

NEC Electronics has developed a version of its R4100 processor for PDAs. The R4101 is the first spinoff from the company's low-power MIPS processor *(see* **090403.PDF***)*. The 4101 is priced "below $20" in 100,000-unit quantities and is sampling now; production is scheduled for August.

The 4101 PDA processor integrates a 33-MHz 4100 core with 2K instruction and 1K data caches, real-time clock, DMA controller, audio driver, and serial port along with keyboard, infrared, and touch-screen interfaces. The chip does not include control logic for PC Cards, DRAM, or an LCD panel. Its TLB supports eight page sizes ranging from 1K to 256K; the tiny page sizes are optimal for handheld organizers that must manage small databases, such as phone lists, in a minimal amount of memory. The 3.3-V device consumes about 250 mW (typical) during operation, enabling reasonable battery life.

Two PDA operating systems have long been rumored to be in development for MIPS-based CPUs: Magic Cap and Microsoft's Pegasus. General Magic seems to have pushed its OS into the shadows in favor of a new Internet agent strategy. Microsoft has not publicly confirmed any details regarding Pegasus, although others have speculated the successor to WinPad is being developed for alternative microprocessors in addition to—or instead of—the x86. NEC's focus on the nascent PDA market indicates the company foresees some volume potential for portable computing appliances.

Errata: PA-8000 Photo, 1-GHz DAC

Our item on PA-8000 workstations *(see* **1008MSB.PDF***)* inadvertently referred to a photograph of the processor that the vendor failed to deliver. We apologize for not removing the reference. In our item on IBM's SiGe process *(see* **1007MSB.PDF***)*, we incorrectly identified the designer of the 1-GHz DAC. Analog Devices designed that SiGe chip. M