Integration Approaches Diverge

Each Vendor Pursuing a Different Strategy, But Integration Is Inevitable

Today, most PCs use processors and chip sets with a similar level of integration: a processor, a north bridge, a south bridge, a graphics chip, and a super-I/O chip. A year from now, much more diversity is likely, with several strategies being pursued by the various x86 suppliers.

Intel has shown little interest in integrating additional functions on the CPU since the demise of its 486SL notebook processor. The 486SL and other early integrated processor efforts were designed to reduce chip count and power consumption in notebook computers. Today, however, there is another motivation: decreasing the cost of entry-level PCs.

Cyrix's MediaGX, which integrates the processor, north bridge, and graphics, has seen success in both desktop and notebook systems. Compaq originally used the chip in its first sub-$1,000 PC, but early this year it shifted the desktop design to AMD's K6 and introduced a notebook based on the MediaGX/MMX. The MediaGX, with its modest CPU core, is simply the least expensive PC processor available—and it comes with additional on-chip functions, essentially for free.

Late this year, Cyrix will roll out the next-generation MXi, which offers the same integration level as the MediaGX but with a much faster CPU core, a larger cache, and a 3D graphics unit. This chip will be the debut product for Cyrix's Cayenne CPU core. Cyrix might also offer a Slot 1 version of Cayenne, but the company plans to focus on the integrated line. Cyrix's parent, National, recently committed to delivering a complete single-chip PC in mid-1999 (see MPR 4/20/98, p. 4).

Intel prefers to use a single processor design across as wide a range of products as possible. Even with this year's proliferation of Pentium II and Celeron processors (see MPR 4/20/98, p. 14), most of the products will be based on the same Deschutes CPU chip, in various packages and tested to various specs.

Sources indicate that Intel's integration efforts in 1999 will focus on the system logic. By providing a P6-bus chip set with integrated north bridge, south bridge, and graphics, Intel could offer an efficient two-chip solution for low-cost systems. All the components are readily at hand, now that Intel is making graphics controllers as well as chip sets.

An integrated chip set would be simpler than today's multichip solutions. The AGP interface could be eliminated, saving many pins as well as some logic, with the graphics unit potentially connecting directly to the P6 bus. Such a design probably would drop support for the ISA bus. Since most of Intel's CPU competitors are unlikely to build Slot 1 processors, they would not have access to this chip set.

By focusing integration efforts on the system logic, changes to the CPU chip are avoided, and the same system-logic chip can be used with a variety of processors. This approach, however, misses one of the best opportunities for making the system more efficient: integrating the DRAM controller with the CPU. By eliminating the chip-crossing delays, a full clock cycle (or more) can be trimmed from the DRAM latency, improving performance. With a large on-chip cache (one or two levels), a DRAM interface will be a better use of pins than a backside cache interface.

Processors with on-chip DRAM controllers will become especially attractive after the debut of Direct RDRAMs. Accessing the bandwidth of a single RDRAM bank would require a system bus twice as fast as the just-emerging 100-MHz Socket 7 and P6 buses. An integrated Direct RDRAM controller would make the full bandwidth available without requiring such a fast system bus.

Many other partitionings are possible. The DRAM controller, PCI interface, and AGP interface could be integrated on the CPU, while the graphics chip and other peripherals remain off-chip. This approach would allow system makers to choose different graphics controllers while still providing performance efficiencies and reducing total pin count.

AMD has its hands full with the K6 3D and K6+, as well as creating system logic for the K7, so it may be late to the integration party. AMD's 486-based Elan part offers high integration but is too slow for mainstream PCs and has an outdated set of peripherals. IDT, however, with its focus on low-cost systems, is more drawn to this approach; sources indicate the company plans to have a CPU with an integrated north bridge by the end of this year. The company is also rumored to have a 3D graphics engine under development.

High-end and even midrange PCs will continue to use variations on today's multichip strategy for years to come, since this approach most easily supports a wide range of system designs. The most compelling integration ideas for such designs are to put the DRAM controller on the CPU and to combine the north bridge, south bridge, and super-I/O chips. Highly integrated processors are also likely to play a role in notebook systems, where power savings are as important as chip-count reduction. Most integration efforts are likely to focus on low-cost systems, giving system designers a range of options including single-chip PCs, standard processors with highly integrated system logic, and various intermediate partitionings. M

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