

THE PUBLISHER'S VIEW

Open Variant of x86 Architecture Emerging

Multiprocessor Specification Is Latest Battleground

Despite Intel's announcement of its plan to develop a next-generation architecture in collaboration with HP, the x86 architecture will continue to dominate at least until the end of the decade. Eventually, Intel's x86 competitors may have to find a path to a new architecture, but in the meantime, keeping up with the gradual evolution of the x86 is of far more commercial relevance.

Many years ago, Intel decided to abandon its strategy of licensing alternate sources for its microprocessors. Intel's desire to keep the 386-and-up market to itself has led to protracted legal battles. So far, the legal attacks have not succeeded in keeping others out of the market, and Intel has quietly been pursuing new ways of limiting the opportunities for other chip makers.

Intel's new strategy involves a combination of extensions to the architecture and system-level patents. The patent strategy first came into public view with Intel's demand for royalties from system makers using non-Intel x86 processors, based on system-level claims in the '338 patent (which describes the 386 memory management scheme). Intel hoped to make it hard for its competitors to be price-competitive by adding a system royalty fee to the effective price of the chip. Asserting a system-level patent enabled Intel to seek royalties even though many chip makers have an Intel patent license.

The '338 patent effort failed because the court ruled that the system-level claims of the patent couldn't be separated from the chip-level claims; a license to '338's chip-level claim, which describes how the MMU works, implies a license to the system claims, which describe the page tables stored in memory, because the chip can't be used without connecting it to memory. It is a fair guess that Intel has been more careful in crafting its recent patent applications, and that patents have been written with system-maker licensing in mind.

Intel's effort to establish a multiprocessor standard around its APIC interrupt controller (*see 080603.PDF*) is viewed by Intel's competitors as part of its patent strategy. Intel hopes to establish a second processor socket as a standard feature in next-generation Pentium systems. In support of this goal, it has licensed the part of the APIC that accepts the interrupt inputs—called the I/O APIC—to several chip-set makers. The MP specification itself is open and royalty free.

The rub for x86-compatible CPU makers is that the other half of the APIC, called the local APIC, is integrated on Intel's P54C Pentium processor, and this logic isn't being licensed to other companies. Other processor

makers could reverse-engineer the local APIC and include an equivalent in their chips, but they are wary of system-level patents. Intel's chip patents aren't an issue, since the processor makers use Intel-licensed foundries. But if Intel has system-level patents that describe the way the local and I/O APICs communicate, then the company could use such patents to demand royalties from any PC maker using a non-Intel processor in a system with APIC logic. According to Cyrix, there are at least two such patents: numbers 5,282,272, issued 1/25/94, and 5,283,904, issued 2/1/94.

As a result of these concerns, Cyrix has developed an alternative method for building two-processor systems. Cyrix's design uses an extended 8259A interrupt controller, and it does not require any support logic in the microprocessor. Cyrix claims that the APIC is awkward to use in a Windows system, because many drivers—even for Windows NT—still depend on the details of the 8259A. As a result, even systems designed solely for NT must continue to support the 8259A in addition to the APIC. Cyrix's alternative is to add to the 8259A about 1500 gates of logic, for which Cyrix is providing a Verilog design (at no charge) to chip-set and system makers. Cyrix says that it has support for this alternative standard from other x86 processor makers.

It remains to be seen whether Cyrix will be able to garner enough chip-set and operating-system support to establish its alternative MP standard, which it calls SLIC, but the effort is indicative of things to come. Intel's secret "Appendix H" extensions to the x86 architecture, as implemented in Pentium, are another possible area for collaboration. If all the non-Intel vendors agree on a way to implement the Appendix H capabilities, Microsoft would probably be willing to support it.

Intel's attempts to set up roadblocks for its competitors are causing a split in the architecture with regard to extensions beyond the 386. With half a dozen companies other than Intel now making 486-compatible processors, they have enough clout—if they stick together—to establish an open version of the x86 architecture. Intel will remain the dominant supplier for at least the next few years, but an open variant of the architecture could become just as significant as Intel's version—and could become dominant at the end of the decade when Intel makes its transition to the new Intel/HP architecture. ♦

