Benchmarking The 68000 and 80X86

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What's the fastest 16-bit chip around? It depends on whom you're listening to.

Intel has published reports comparing the speeds of its 80*86 family and Motorola's 68000. Their reports claim the iAPX286 is three to six times faster than the 8086 and three times faster than the 68000. Motorola decided to study Intel's benchmark results, and they found some inconsistencies in Intel's comparisons. Here's food for thought:

1. Intel used the fastest iAPX286 they make (8MHz), but not the 12.5MHz Motorola 68000.

2. Intel used a record area of 64K for the linked list benchmark (which is the maximum memory all 80*86 chips can address without segment switching) and used a 16 Megabyte area for the 68000.

3. None of Intel's benchmarks handled the case of crossing a segment boundary. Obviously, many applications require more than 64K RAM. Crossing a segment boundary means more overhead (slower operation) for Intel's parts.

Intel Vrs. EDN Benchmarks

EDN published a list of benchmarks which the major chip manufacturers can use to compare parts. Figure 1 gives the results used in the Motorola report, using the fast chips.

From these results one concludes that the 286 can't be three to six times faster than the 8086. In fact, the 8086 beats the iAPX286 in the I/O Interrupts benchmark and finishes close behind in three others. In all cases, the 12.5MHz 68000 was faster than the iAPX286.

It's worth noting that the iAPX186 is slower than the 8086 in five of the seven benchmarks. Even if you extrapolate the iAPX186 to 10MHz, it's not much better than the older 8086. (What about the 8088? It's in their benchmark report for the Z80.)

EDN asked Intel to send in the code for their benchmarks, but Intel refused. Motorola interpreted Intel's refusal to mean that the code for the iAPX286 was so long and clumsy Intel would be embarrassed to see it in print.

Why The Discrepancy?

One explanation might be the seg-

mented architecture of the 80*86 family. The maximum memory address in that case is 64K. Since the iAPX286 has an on-board MMU (memory management unit), the MMU takes over and updates the segment registers when the software addresses an out-of-boundary location. This creates a significant overhead when compilers operate on large data areas.

The 68000 can address anywhere in its 16 Megabyte address space without any overhead. Even when an external MMU was added to the system, the 68000 ran faster than the 80286 in five ot the seven benchmarks.

Benchmarks are, well, they're benchmarks, and obviously they're only one consideration for designers. But they're food for thought.

Editor's note: Of course, there's more to a microprocessor's success than benchmarks. The Intel-Motorola battle illustrates how marketing moxy can outweigh performance in the battle for industry's pocketbooks.

In 1981, when the Motorola 68000 was gaining momentum, Intel president Andy Grove called in Regis McKenna, a public relations hotshot from Palo Alto, California.

Grove, McKenna, and six Intel managers met to develop a new marketing strategy for Intel. Their project was codenamed CRUSH. Very simply, its intention was to stop the movement of designers from the Intel chips to the newer 68000 series.

After surveying the market, they concluded that if customers compared the 8086 to the 68000, chip to chip, "Intel would have trouble." The 68000 was becoming more and more popular among software-oriented companies, while the 8086 was holding its own among hardware-oriented companies. (See "The Last Page" this issue for details.)

The CRUSH strategy was to play on customers' fears. They wanted people to worry about the consequences of committing them-

selves to Motorola. After all, the 68000 had very little software, no peripheral chips, and no development system. And Motorola hadn't clearly defined its future. Would customers get stuck with an orphan if they went 68000?

During the next quarter, Intel gave 50 half-day seminars to potential customers, and thereby won the positioning battle. Motorola is only now beginning to catch up in the home computer market, with new machines coming from Amiga, Atari, and Apple.

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Figure 1 - Intel Vrs. Motorola Benchmarks

		MC68000 12.5	MC68008 10	8086 10	iAPX186 8	iAPX286 8	MHz
A	I/O Interrupts	25.6	57.6	43.2	50.0	96.8	us
B	I/O Processing	259.2	573.6	396.0	446.2	357.3	us
E	String search	127.0	372.6	201.0	249.8	128.4	us
F	Bit Manipulation	55.4	116.1	127.1	158.2	97.9	us
H	Linked List	116.8	281.6	269.0	259.2	199.8	us
I	Quicksort	13.9	31.0	38.3	45.2	36.1	ms
K	Bit Matrix	289.1	555.6	938.5	724.7	508.8	us