STAR Watch

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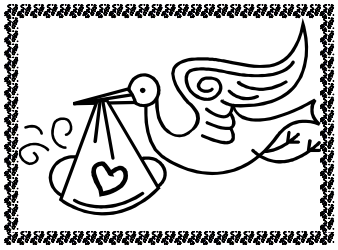
Double the Performance: Dual-Core CPU's Make Their Debut



Starting this month, both Intel and AMD are producing computer CPU chips that contain two complete processors in a single package. Each of these processors can execute instructions independently of the other. While it has tremendous promise for the future, how useful is it today or in the foreseeable future?

In the beginning…

Back when the only operating system for personal computers was DOS, it was very straightforward. The computer ran one user application at a time. It was either idly waiting for some user input or completely consumed by its attempt to process a user's request. Since there was one processor and one application, life was simple: If the application needs processing resources, just do it.

When Windows operating system came along, users could have multiple applications running concurrently. That fundamentally changed the way that processing time was allocated. The operating system was required to keep track of all applications, and provide each of them with the processing resources that they needed. Everything was fine until the demand for processing resources exceeded the ability of the processor. When that happened, something had to wait. If the wait times were not excessive, computer users accepted the delays with resignation .

As faster processors were introduced, processing delays were reduced. But along with faster processors came computers with more RAM so that users could run more applications that had more functionality (and created even more demand for processing power). Computer hardware technology has raced to stay ahead of computer software requirements for its entire life by providing processors that got faster and did more.

In this issue…

Today, there are many in the computer hardware field who warn that the Laws of Physics will prevent processors from continuing to increase their clock speeds. If we believe these people, then it becomes clear that increased processor speed will not continue to be an option for the long run. Moving to a dual-core processor packages double the horsepower in a single processor package—or does it? Does having two processors instead of one truly deliver twice the performance? The most accurate answer is "maybe".

Threads, Threading, Multi-Threading, Hyper-Threading…

In order to understand how multiple processors affect performance, it is important to understand how computers process instructions within an application. When an application first starts up, Windows considers it to be a single sequence of instructions that can run in parallel with other applications that are present on the computer. This single sequence of instructions is called a thread (or "thread of execution"). Since by definition, a thread is a single sequence of instructions, it can only be executed by a single processor. If multiple processors are present, only one could be used to execute this thread. The other processors could be used to execute the threads of other applications, but not this thread. Two processors cannot operate on the same thread at the same time.

Many programming languages and other software development environments allow application developers to declare that parts of a single application can logically separate themselves from the main process and become separate threads of execution. When this happens, the application is described as being Multi-threaded. In a multi-threaded application, if a processor is available, any thread in need of execution can be handled by any available processor.

Hyper-Threading, on the other hand, is Intel's registered trademark for their implementation of the simultaneous multithreading technology on the Pentium 4 processor chip. The technology improves processor performance under certain workloads by providing useful work for execution units that would otherwise be idle. It is Intel's attempt to keep the processor busy. Hyper-Threading is a hardware feature that is specific to Intel processors. Multi-Threading is a software feature common to all operating systems. Hyper-Threading was an important step in the evolution of the personal computer from single-core to multi-core processors, but it's presence or absence has no effect on multi-threading. Currently, the only operating system that has implemented Hyper-Threading support is Windows XP.

So, you bought a dual-core processor machine…

If you purchased a computer with a dual-core processor today, would it be better than a single-processor machine of equal clock speed? If the machine is to be used as a web server or file server, the answer is an unequivocal "Yes". Microsoft's file/web server operating systems and the functions that they support are already multi-threaded. There would be an immediate performance increase.

But when it comes to user workstations, it's not as easy to answer the question.

For a specific application program, the likelihood of improved performance is slim, but possible. Except for some high-end applications, few applications bother to multi-thread right now. Effective multi-threading requires additional design and programming time. That translates into additional cost for the software vendor which must be passed along to the consumer.

But what about games? If the computer is a dedicated gaming machine, a dual-core machine probably won't perform any better than it would on a single processor machine. Currently, few heavy-duty games are multi-threaded. But, if you wanted to play a game on your computer while you were rendering an hour-long video, a dual-core processor would definitely work better than a single-core processor.

Even though individual applications may not run faster on dual-core processor machines, the overall performance of the machine will be smoother. If 100% of one processor's capacity is used to service an application that is running, the second processor is still available to perform other user tasks.

There's Hope…

Recently, in an effort to jump-start development for dual-core processors, Intel has upgraded several of it's application development tools. Intel claims that version 7.0 of their C++ and Fortran compilers for Windows and Linux can improve the performance of applications for certain Intel processor-based systems up to 40% compared to compilers currently available from other vendors. The Version 7.0 Intel compilers include an auto-parallelization option that automatically looks in applications for opportunities to create multiple threads of execution. This may be of great help for developing applications for Intel processors, but most vendors develop products that must work on processors from other vendors. It is unclear from any descriptions of this product that we have found whether or not it will work with other vendor's processors. If it only works with Intel products, its impact on application development will be negligible. But if Intel can do it, compliers from other vendors should also be able to do it. It's only a question of "when".

Software Licensing Issues

Microsoft has committed to licensing its operating systems and other software based on the number of CPU packages, not actual number of CPU's. In this case one dual-core CPU is the same as a single-core CPU. Several versions of Linux have software modules that can be added to support multiple processors.

But some well-known software vendors are not as user-friendly. To Oracle Corporation, every processor in the system increases the license fee, regardless of how it is packaged. So, one dual-core CPU equals two processors.

IBM Corporation is currently considering a dual-core processor as one processor for licensing purposes, but has publicly stated that it reserves its right to change its policy at any time in the future.

If you plan on buying a file server that has one or more dual-core CPU's and your plans for that server include third-party software, it is very important that you research this licensing issue to avoid any nasty financial surprises.

Processor Performance

In general, if you are hoping to pick up a machine with a dual-core processor that runs at the clock speed of the fastest single-core processors, you are going to be seriously disappointed. Both Intel and AMD are faced with the same issue: Heat build up. Neither company is producing dual-core processors whose speeds come close to the speeds of the fastest single-core processors because faster processors generate too much heat. While some progress has been made by both vendors, it's going to be a while before reasonable solutions to the heat issue are implemented, allowing speeds of dual-core processors to approach the speeds of their single-core counterparts.

Comparing the relative performance of Intel and AMD products is not as simple as comparing clock speeds, since AMD processors are architecturally quite different from Intel's. AMD processors are able to provide real-world performance that is equivalent to Intel processors, but at significantly lower clock speeds. So, instead of hyping clock speeds, AMD designates the performance level of their processors by numbers that match the clock speed of Intel processors with equivalent performance. (Example: An AMD 3800 processor gives approximately the same performance as an Intel 3.8GHz processor).

Intel's dual-core processors range in clock speeds from 2.8GHz to 3.2GHz, but their single-core processors have clock speeds up to 3.8Ghz. AMD has also backed off the performance of the cores within its dual-core processors. They have also created some amount of confusion by labeling their dual-core processors with performance values that are double the performance value of the individual cores. The end result rates a dual-core processor as 4200, 4400, 4600, or 4800 when they actual performance level of the individual processors is only between 2100 and 2400. Using AMD's own marketing hype against them, the performance level of the fastest AMD dual-core appears to be significantly less than the slowest Intel dual-core. While its fastest single-core AMD processor is rated at 4000+, the fastest dual-core is only rated at 4800 (or 2400 x 2).

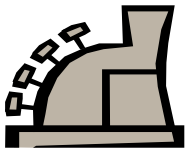
Even though first impressions are that Intel dual-core processors should trounce their AMD competitors, results posted on two well-known benchmarking sites, Anandtech and Tom's Hardware, rate AMD's performance slightly ahead of Intel's for most activities.

There is, however, a significant difference between the two vendors products. Intel has chosen to double up processors from its 32-bit processor line. AMD on the other hand, is producing dual-core 64-bit processors. With Microsoft's recent release of a version of Windows XP for 64-bit processors, AMD is poised to surge ahead as application developers begin to produce applications that can utilize the 64-bit processor's additional capabilities.

Pricing

The chart below shows the lowest street prices that we could find for the Intel and AMD products:

Pentium D 820	2.8GHz	$ 265
Pentium D 830	3.0GHz	$ 365
Pentium D 840	3.2GHz	$ 610
Pentium 840 EE	3.2GHz	$1069
Athlon 64 X2	4200	$ 599
Athlon 64 X2	4400	$ 669
Athlon 64 X2	4600	$ 899
Athlon 64 X2	4800	$1099



In conclusion…

If you are in the process of buying a new computer (user workstation or office file server) and you are wondering whether or not you should even consider it: By all means, take a look at machines with dual-core CPUs. As previously discussed, they will present certain processing advantages. If you can find a system with all of the features you want at a price you are willing to pay and it happens to have a dual-core CPU, go for it. The performance will not disappoint you now, or as new versions of software are released that fully utilize the processor's capabilities.

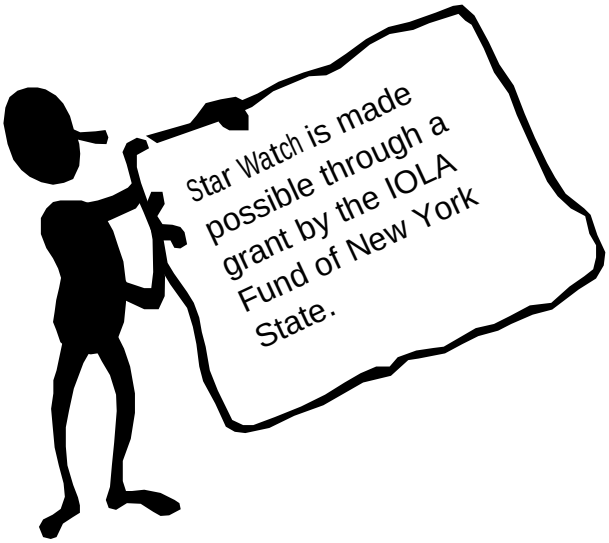
In the greater sense, the move to dual-core processors is not a big deal because users get double the aggregate horsepower for almost the same cost. This change is most important because it signals the beginning of a major industry change in philosophy: Getting it done with one very fast single CPU is clearly not a viable option for the future.

Intel has already predicted that processors for consumer-level computers will contain up to eight cores per package by 2008. Over the next couple of years, look for more multi-core processors and other major hardware changes as processor manufacturers attempt to keep performance ahead of demand.

WNYLC Web Statistics For May 2005

Total Hits.....338,401
Total User Sessions.....47,806
Average Hits/Day
(Monday - Friday).....14,069
Average user Sessions/Weekday.....1,810
Number of Pages Viewed.....111,899
Average Number of Pages Viewed Per
Day.....3,609
Number of Documents Viewed.....72,661

Accessed Using Internet Explorer.....88%
Accessed Using Netscape.....5%
Operating Systems Used:
Windows 98.....14%
Windows 2000.....19%
Windows XP.....53%
Windows 95.....1%
Windows ME.....1%
Windows NT.....1%
Macintosh.....1%
Linux/Unix.....1%



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