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THE LATEST PENTIUM 4 CHIP REACHES **3 GHZ AND PROMISES YOU A VIRTUAL SECOND** PROCESSOR VIA INTEL'S HYPERTHREADING TECHNOLOGY. BY TOM MAINELLI

THE LATEST Pen-Genter tium 4 processor not only passes another megahertz milestone by running at 3.06 GHz, it also introduces Intel's new hyperthreading technology to the desktop.

Hyperthreading enables one processor to act like two. As a result, it can simultaneously tackle multiple applications (or a single application that has multiple threads), put idle CPU cycles to use, and boost system performance by up to 25 percent—all without requiring specially written applications, according to Intel.

Sounds good, doesn't it? Exclusive PC World tests on three of the first systems to use the new processor, however, show that hyperthreading's benefits largely are application- or even taskspecific. For example, on the office applications that most people use-such as Microsoft's Word and Excel-hyperthreading had a neutral or slightly negative impact. And on tests specifically designed to expose the benefits of hyperthreading, many improvements were too slight to be detectable by the average user,

except with select filters in Adobe Photoshop, with various video and photo programs such as Adobe Premiere and Roxio VideoWave, and on certain multitasking tests.

Furthermore, a comparison system equipped with AMD's Athlon XP 2800+, which runs at 2.25 GHz, more than held

its own against these 3-GHz powerhouses that were running 800 MHz faster. Nevertheless, hyperthreading remains a very new technology, and Intel anticipates further performance improvements as applications are modified to take better advantage of it.

We tested three shipping



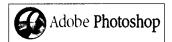
NOTES FROM THE LAB

■ For optimum singleapplication performance, you must do more than



disable hyperthreading in your new system's BIOS: You have to turn the PC off and then reinstall Windows XP from scratch. That's because the multithreaded version of Windows XP loads more files and uses more resources than the standard version, and so imposes a performance penalty from the get-go-when you switch off hyperthreading, those files are still loaded.

* Adobe Photoshop can show dramatic speed improvements with hyper-



threading, but you have to use the right filters, such as Crystallize or Radial Blur—those that tend to do calculations throughout the process instead of just simple conversions. Multiple calculations keep the CPU busy and take advantage of hyperthreading efficiencies. You can get bottlenecks if you have an application—or multiple single-threaded applications—that try to use the same resources on the chip.

3.06-GHz P4 systems, each packing 1GB of 1.066-GHz RDRAM and running Windows XP Professional. (Currently, hyperthreading works only with either Windows XP Professional or Home, or with such major distributions of Linux as SuSE or Red Hat; these OSs can recognize the technology and use it as they would two physical processors.) Our P4 PCs included the Dell Dimension 8250 (\$3419), the Falcon Northwest Mach V (\$3288), and the Gateway 700XL (\$3899), each loaded with high-end components and ready for the most demanding computing tasks.

Our two shipping comparison machines were Falcon's Athlon XP 2800+ Mach V, carrying 1GB of 333-MHz DDR SDRAM (\$2786), and Xi Computer's MTower DPR, with two 2.8-GHz Xeon CPUs and 512MB of 800-MHz RDRAM (\$3924). Like the P4 systems,

the two comparison PCs ran Windows XP Pro; we tested all Intel-based PCs with hyperthreading both on and off.

IFFY ON OFFICE APPS

ON OUR PC WorldBench 4 test suite, hyperthreading produced little positive effect—as we expected given that the multiprocessor-aware OS imposes a performance penalty because it requires additional resources to run (see "Notes From the Lab," above), and PC WorldBench 4 uses many standard office apps that can't take real advantage of hyperthreading when run singly. The Athlon XP system scored 130, besting all three P4 PCs as well as the dual-Xeon unit. In fact, the score for each P4 system was the same or slightly worse with hyperthreading turned on. The Falcon suffered the biggest drop, from 127 with the feature disabled to 121 with it enabled.

Also, with hyperthreading two of the three 3.06-GHz systems scored 7 to 8 percent lower than the average of five previously tested P4 systems running at 2.53 GHz (121) and of six at 2.8 GHz (123).

HITS AND MISSES

TO BETTER EXAMINE hyperthreading technology, the PC World Test Center devised several tests. Our analysts created two using Photoshop, engineered two multitasking tests, and added snippets from the still-in-progress PC World-Bench 5 (due later in 2003).

Our first Photoshop test employed 20 commonly used filters—most of them specified by Adobe and by PC World's art department, with a few chosen from Intel's recommendations. Since Photoshop is a multithreaded application, we expected some improvement with Intel's new technology, but the Athlon XP PC beat the P4 and Xeon systems regardless of hyperthreading status. The Dell PC received a 2-point boost from hyperthreading-the largest among the P4s here, but scarcely noticeable by most users.

In a second round of Photoshop tests, we used 20 filters selected by Intel to showcase its technology. Using these filters, which often incorporate intermediate calculations that hyperthreading can run in parallel, the P4 machines did show marked improvement. For example, the Dimension 8250 completed the test in 118 seconds with hyperthreading turned off (slower than the Athlon XP system's 104 seconds), but reduced its time to 96 seconds with the feature turned on-certainly a significant improvement.

IN BRIEF **Product Pipeline** MORE MEDIA PCs: Following in HP's footsteps, ABS, Alienware, Cyberpower, and Gateway now offer PCs with Microsoft's remote-controlready Windows XP Media Center Edition, ABS's PC starts at \$1699 sans monitor (find.pcworld.com/32183); Alienware's box-shaped Navigator Pro starts at \$1999 (find.pcworld.com/32132): Cyberpower's entry-level model starts at \$1499 (find. pcworld.com/32180); and Gateway's high-end \$4000 model includes a 42-inch plasma-screen television (find.pcworld.com/32135). PERSONAL TOUCH: HP's IPag Pocket PC H5450 is the first PDA to offer blometric security with a built-in lingerprint scanner, The \$899 device also features Wi-Fi and Bluetooth adapters along with a sleek new design, find. pcworld.com/32144 Did You Know? THE NUM-BER of U.S. households with three cell phones

homes have two cell phones,

and 32 percent have one.

TEST REPORT

HYPERTHREADED P4 PCs' PERFORMANCE A MIXED BAG...

SYSTEM	СРИ	Метогу	Hyperthreading	PC WorldBench 4 score	PCW	(027.61 Intel (seconds)	DivX	(AV) (5) MPEG-1 (seconds)	e (cannis)	Castle Wolfenstein 1024 by 768 (fps) 1	Unreal Tournament 1024 by 768 (fps) (
Dell Dimension ,8250	3.06-GHz Pentium 4, 512KB L2 cache	1GB PC1066 RDRAM	Disabled	117	108	118	73	250	251	110	206
			Enabled	113	106	96	74	223	239	113	200
Falcon Northwest Mach V	3.06-GHz Pentium 4, 512KB L2 cache	1GB PC1066 RDRAM	Disabled	127	102	113	72	252	278	117	227
			Enabled	121	102	92	72	225	274	118	227
Gateway 700XL	3.06-GHz Pentium 4, 512KB L2 cache	1GB PC1066 RDRAM	Disabled	118	110	120	82	251	249	123	208
			Enabled	117	109	100	83	226	231	123	210
Falcon Northwest Mach V	2.25-GHz Athlon XP 2800+, 256KB L2 cache	1GB DDR333 SDRAM	n/a	130	95	104	81	269	231	102	229
Xi MTower DPR	Dual 2,8-GHz Xeon, 512KB L2 cache each	512MB PC800 RDRAM	Disabled	111	104	84	77	207	303	96	200
			Enabled	111	102	72	75	215	299	96	200
Average of six systems ²	2.8-GHz Pentium 4, 512KB L2 cache	512MB RDRAM	n/a	123	n/a	n/a	ʻn/a	л/а	n/a	n/a	n/a
Average of five systems ²	2.53-GHz Pentium 4, 512KB L2 cache	1GB RDRAM or SDRAM	n/a	121	n/a	n/a	n/a	n/a	n/a	n/a	п/а

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HOW WE TEST: All PCs tested with PC WorldBench 4, PC World's application-based benchmark; see www.pcworld.com/benchmark. In the Photoshop 7.0.1 tests, we timed first the running of 20 commonly used filters on an image (PCW) and then 20 intel-designated filters on the same image (Intel). In Roxio VideoWave 1.5 tests, we timed first the conversion of a raw video file into a DivX file with sound, then the conversion of a raw video file into another video file, and then to an MPEG-1 (both with sound). In the Adobe Premiere 6 test, we timed the conversion of a raw video file into two finished files. In the Return to Castle Wolfenstein and Unreal Tournament 2003 tests, we measured the frame rates during a recorded demo and a flythrough of one game level, respectively. A lower score is better in the Photoshop, Premiere, and VideoWave tests; in others, higher is better. Tests developed and conducted by the PC World Test Center. All rights reserved. n/a=Not applicable. \ Frames per second. \ ^2 These systems ran Windows XP Home instead of Windows XP Pro.

Hand-timed multitasking tests proved a mixed bag for the P4 systems. In one test the photo-management application ACDSee converted 315 TIFF files into JPEGs in the foreground, as McAfee Virus-Scan checked a directory of folders in the background. Though the P4-based systems all outperformed the Athlon XP PC here, hyperthreading's

benefits were far from uniform. For example, the Dell experienced a 4 percent slowdown on ACDSee, but a 4 percent boost on McAfee, whereas the Gateway netted an 8 percent boost on McAfee and no slowdown on ACDSee. In every case, however, running the applications consecutively took less time than running them concurrently.

The opposite was true on a different multitasking test. Here, we used Ahead's Nero Burning ROM to re-create a 490MB hard drive image in the background and used Musicmatch to convert ten WAV files into MP3s in the foreground. Unlike in the previous tests, running the two applications simultaneously was faster than running them

separately-by about 30 seconds for the P4s and by 53 seconds for the dual-Xeon PC. Again, the P4-based systems performed best overall, and many performed slightly better with hyperthreading in the concurrent runs.

In testing VideoWave, we used both DivX-based files and MPEG-1 files. Scores fell slightly or remained the

TEST REPORT

...BUT P4 PCs HAVE A MULTITASKING ADVANTAGE

	сы́л	MINISTRACIONES MULTINASTRICO (ESCRIPO)								
SYSTEM		Hyperthreading	Musicmatch 7.2 solo	#Nero Burning ROM 5.5 solo	Musicmatch in the foreground	Nero in the background	ACDSee solo	McAfee VirusScan 7 solo	#ACDSee In the foreground	McAfee in the background
Dell Dimension 8250	3.06-GHz Pentium 4	Disabled	139	48	158	63	94	130	210	268
		Enabled	139	47	155	65	95	130	219	256
Falcon Northwest Mach V	3.06-GHz Pentium 4	Disabled	137	60	158	77	86	135	222	272
		Enabled	138	53	160	66	87	137	226	268
Gateway 700XL	3.06-GHz Pentium 4	Disabled	140	47	159	57	82	147	199	276
		Enabled	140	45	156	52	86	150	199	255
Falcon Northwest Mach V	2.25-GHz Athlon XP 2800+	n/a	158	51	176	76	82	125	234	286
Xi MTower DPR	Dual 2.8-GHz Xeon	Disabled	149	70	166	79	88	137	216	255
		Enabled	149	70	166	75	86	140	227	269



HOW WE TEST: In the Musicmatch Jukebox 7.2 solo test, we timed the conversion of ten WAV files into MP3s; in the Nero Burning Rom 5.5 solo test, we timed the creation of a 490MB hard drive image. On Multitasking Test 1, we timed the Musicmatch test running in the foreground and the Nero test running simultaneously in the background. In the ACDSee 5 solo test, we timed the conversion of 315 TIFF files into JPEG files; in the McAfee VirusScan 7.0 Home Edition test, we timed the scan of a directory for viruses. On Multitasking Test 2, we timed the ACDSee test running in the foreground and McAfee running simultaneously in the background. In all cases, lower is better. Tests developed and conducted by the PC World Test Center. All rights reserved. same with hyperthreading enabled on the DivX files, but they improved by over 10 percent on the MPEG-1 files.

Bottom line: Hyperthreading's effects vary widely, and depend on what applicationor set of applications-you run. In most cases, however, it seemed to have only a slight effect. And the only way to gauge how your favorite applications will react is to try them out. (For all test results, see the charts on page 28.)

TECHNOLOGY A BUST?

WHY WOULD a speedier chip that is capable of acting like two processors have so little positive impact on test scores?

"One ill-behaved application could cause problems in a hyperthreading PC," suggests Kevin Krewell, general manager at research firm Micro-Design Resources. That's because while the new P4 tricks the operating system into believing it is two chips, it still has the resources of just one.

For example, the new P4 shares its on-board cache as needed, but it splits its write buffer resources in half—so a single-threaded application that once had access to all eight write buffers can now only use four, he explains.

Brian Fravel, Intel's marketing manager for desktops, claims that with hyperthreading enabled, "The vast majority of applications will be neutral to positive in a stand-alone environment, and almost all applications will see a benefit when multitasking."

The key to taking advantage of hyperthreading is not merely to run multiple programs or a multithreaded application; it is to make sure that those programs hammer the processor

with tasks, says Dean McCarron, a principal analyst at Mercury Research. "Both threads need to be throwing instructions at the processor simultaneously," he says.

Though software doesn't need to be optimized in order to use hyperthreading, vendors can tweak their programs to utilize the technology better, says Intel's Fravel. The company won't disclose specifics, but according to Fravel the developers of image- and video-editing applications will probably be among the first to optimize their current offerings. "When you look at video encoding and transcoding today, it's so processor intensive. There are so many places where, if you write it to use hyperthreading, you can take advantage of those unused

processor cycles," Fravel says.

Video game programmers could also make multithreaded hay, simultaneously increasing the sophistication of artificial intelligence engines and developing a more realistic 3D environment, he adds.

Intel clearly hopes hyperthreading will make PC sales jump ahead of where they are today, says MDR's Krewell.

"If you look at the timing, Intel is clearly trying to goose the market," he says. "Intel will have the latest and greatest chip with the newest buzzword, and that could be a substantial marketing tool."

COMPETITION AHEAD

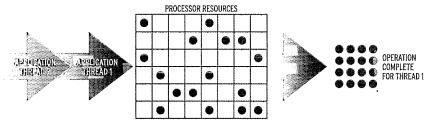
DON'T EXPECT the competition to sit still as Intel trumpets its new technology. AMD will launch an improved version of its current Athlon XP chip, code-named Barton, and its 64-bit Hammer-based processors, sometime in the first half of 2003. According to Krewell, the highly efficient Hammer, which comes with on-board memory controllers, should help AMD compete vigorously against Intel's hyperthreaded Pentium 4.

In the meantime, though, for straight-ahead performance and price, you're likely better off choosing one of Intel's older P4 machines or a highend Athlon XP-based system. If you are serious about multithreaded applications or you use video or photo editing programs heavily or you multitask as a matter of course, the new P4 systems may suit you. Just remember to choose your applications carefully.

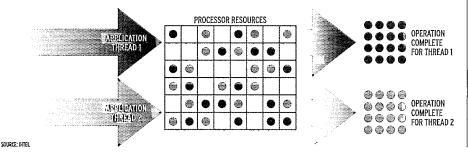
HOW HYPERTHREADING WORKS

THE AIM OF INTEL'S new hyperthreading technology is to use a CPU's resources more efficiently to get the job done. As Brian Fravel, Intel's desktop marketing manager, puts it, "Today's processors are one cook with one pan; the new chip is still one cook, but with two pans." A cook who works on two dishes at the same time should be able to complete work on both in less time overall.

WITHOUT HYPERTHREADING: When a multithreaded application or multiple applications send requests to the CPU, they line up and get taken care of sequentially, so one app stays idle until the other's task is complete, leaving some of the CPU's resources unused.



WITH HYPERTHREADING: The processor and operating system can see multiple requests from apps and feed them to the CPU so that it handles both simultaneously. This should yield a more-efficient use of resources and permit quicker completion of both applications' tasks.





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