Barton: 512 KB Athlon XP Reviewed

By Johan De Gelas – February 2003

The upcoming Opteron and Athlon 64 are constantly in the limelight of the hardware community. No other AMD processor has created so much hype, high hopes, and discussion. In the shadow of its big brother is "Barton," the first AMD processor with 512 KB of L2-cache integrated in the die.

This exclusive 512 KB L2-cache works together with the 128 KB L1-cache (64 KB data, 64 KB instruction) to form one impressive 640 KB on-die cache. According to AMD, the extra 256 KB cache boosts, an 2170 MHz Athlon XP from a 2700+ level to a 3000+ one. The 54.3 million transistor 2.17 GHz Barton Athlon XP will thus take on the mighty 55 million transistor 3.06 GHz Pentium 4 with Hyperthreading. Will 256 KB extra cache and a clockrate of 2.17 GHz be enough to compete with the fastest Intel CPU available today? Well, we'll find out in a moment. But before we look at the benchmarks, I'd like to discuss the different L2-caches, as caches are extremely important for modern CPUs.

A 512 KB L2 for the Athlon

L2-cache has often been a drag on the performance of AMD's processors. The K6 was a sixth generation architecture but it came with a fifth generation off-die L2-cache running at only 66 or 100 MHz. The L2 cache of the K6-III was pretty impressive, but the clock frequency of the K6-III did not scale past 450 MHz. The Athlon was a very impressive seventh generation architecture, but it was launched with a six generation L2-cache system.

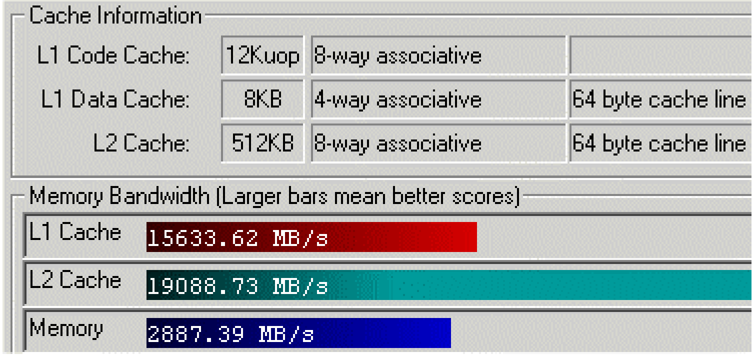
In contrast, the L2-cache made the Intel processors really shine. The PII had a 512 KB half speed, back side bus cache, which gave Intel's CPU a considerable advantage over competitors like the Cyrix MII and AMD K6. The most important reason why the Coppermine Pentium III could somewhat keep up with the more advanced Athlon was its low latency, high bandwidth cache. Extremely impressive for its time, as the 256 KB cache was not only accessed via a 256-bit data path, but it could also respond in an amazing 4 clockcycles (total L2-cache latency was 7 cycles).

Back to today: as the Pentium 4 was built to reach very high clockspeeds, a **4 cycle L2-cache latency was not possible**. The L2-cache of the Pentium 4 is still pretty impressive, though, as you can see below. **ScienceMark 2.0** tells us what Intel's engineers have been capable of. We tested with the 3.06 GHz Pentium 4. The most accurate numbers are the 32 byte to 256 byte step numbers (columns) in rows between the 32768 byte and 131072 dataflows, as we are sure that these measurements happen in the L2-cache.

Testing cache latency...

	4	8	16	32	64	128	256	512
4096	2	2	2	2	2	2	2	2
8192	2	2	2	2	2	2	2	2
16384	2	2	4	9	16	13	13	13
32768	2	2	4	10	16	16	16	17
65536	2	2	4	10	17	16	17	18
131072	2	2	4	10	18	18	19	19
262144	2	2	4	11	18	18	19	21
524288	3	3	10	12	20	24	27	28
1048576	5	9	18	36	64	250	253	247
2097152	5	9	18	36	64	250	257	258
4194304	5	9	18	36	64	251	254	260

A latency of 8 cycles (10 including the latency of the L1-cache) to 17 (total latency of 19) cycles is still very impressive for a CPU that runs at 3 GHz. Eight 3 GHz cycles equals 2.4 ns, faster than the Pentium III's L1-cache has ever been! Let us take a look at the bandwidth of the L2-cache.



Although 19 GB/s is nowhere near the theoretical 96 GB/s (3 GHz x 32 bytes/s), the Pentium 4 has a very fast L2-cache. One of the reasons for this big gap between theory and practice is the fact that only SSE(-2) instructions can move more than 8 bytes per cycle. And it is very unlikely that the Pentium 4 can sustain those 128-bit instructions at a rate higher than 1 per cycle.

Let us see how important cache is for performance. When the Pentium 4 was upgraded to a 512 KB L2 cache instead of a 256 KB one, performance was between **6%** and **61%** higher. The 61% higher performance in 3DSMax may surprise you, but it can be explained. The tiny 8 KB data cache can be accessed in 2 cycles by the integer units, but only in 6 cycles by the FPU/SSE-2 units of the Pentium 4. As the datacache is so small and relatively slow to access, the L2-cache is of the utmost importance to the Pentium 4 when crunching through FPU intensive apps. That is also the reason why integer intensive applications see a smaller boost.

Modern games which also tend to be FPU intensive, reported an impressive **15 to 17% boost** thanks to the larger L2-cache. Only the older games (like Unreal Tournament) did not perform much better as their critical loops were satisfied with 256 KB.

Now let us see what the new AMD has in store. AMD has finally caught up to the Pentium 4, and has even more cache on board than the fastest CPU of Santa Clara. I'd like to point out again what marvelously efficient architecture the Athlon is: even Barton with 640 KB cache onboard is only 101 mm², which still a lot smaller than Intel's Northwood 130 mm². Of course, the slightly larger die size is no problem for Intel, given its huge fab capacity, and 300 mm² wafers.

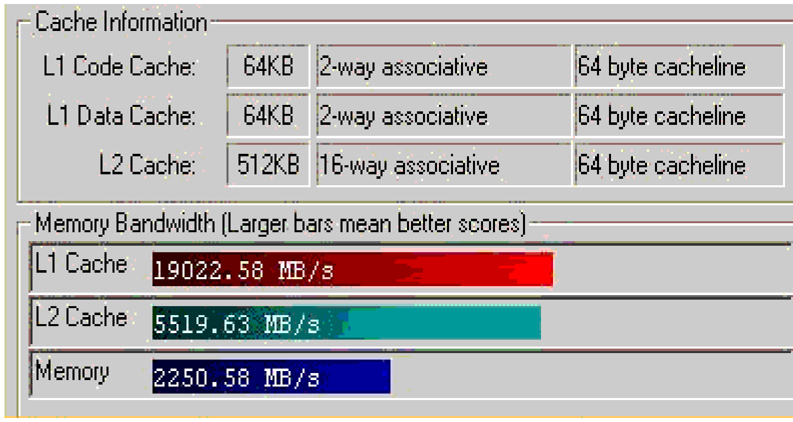
Back to Barton, though. How good is Barton's cache? Well, latency is identical to the cache of Thoroughbred, the other 130 nanometer Athlon XP. Take a look below...

Testing cache latency...

	4	8	16	32	64	128	256	512
4096	3	3	3	3	3	3	3	2
8192	3	3	3	3	3	3	3	3
16384	3	3	3	3	3	3	3	3
32768	3	3	3	3	3	3	3	3
65536	3	3	3	3	3	3	3	3
131072	3	4	5	18	24	20	20	20
262144	3	4	5	18	24	20	20	20
524288	3	4	5	18	24	20	20	20
1048576	10	19	36	76	141	238	238	238
2097152	10	19	36	76	141	239	239	240
4194304	10	19	36	76	141	239	239	241

Finished testing latency._

The L2-cache seems to have a latency between 15 (+L1-cache latency = 18) and 21 (24) cycles. The 24 cycles are a bit odd, as AMD's technical documentation talks about a (total) latency between 11 and 20 cycles and other cache programs (cachemem) confirmed the maximum of 20 cycles. Nevertheless, the important point is that the total L2-cache latency of the Athlon is higher than the Pentium 4's. What about bandwidth?



The 64-bit 2.17 GHz L2-cache offers up to 5.5 GB/s to the CPU core, between 3 to 4 times less than the 3 GHz Pentium 4. However, you may not conclude immediately that Athlon's L2-cache is very slow and hampering the performance of the Athlon. Contrary to the Pentium 4, the L1-cache will deliver a lot of the bandwidth needed. Just imagine an FPU intensive application that runs 85% in the L1-cache and 15% in the L2-cache (ignoring the memory subsystem for the moment). As the Pentium 4 only searches and uses its L2-cache, itwill have a 19 GB/s pipe to its FPU pipeline. The Athlon will have a (0.85 x 19 GB/s + 0.15 * 5.5 GB/s) 17 GB/s pipe to the FPU unit. In most applications, especially the FPU intensive ones, the Athlon needs its L2-cache much less than the Pentium 4.

Therefore, we can already say that the performance increase from Thoroughbred (384 KB cache) to Barton (640 KB) will be much less than what we have witnessed with the transition from Willamette (256 KB) to Northwood (512 KB) for the following reasons:

- The latency of the Athlon's L2-cache is higher
- The Pentium 4 L1 data cache is very small in integer applications, and non-existent in FP applications
- The Athlon, in contrast, relies heavily on its huge 64 KB L1 data cache in all applications
- Barton has 67% more cache than Thoroughbred, Northwood had 100% more cache than Willamette

So we can not expect too much of Barton's L2-cache increase...

The AMD Family

The Athlon now exists in many different versions. Although we are pretty sure the Ace's Hardware veterans already know them; all, we decided to provide a quick overview of all the AMD Athlons you can find in the shop.

From left to right, top to bottom: Thoroughbred, Barton, Palomino, and Thunderbird

In the first row on the right, we see the long and rectangular die of Barton, which is essentially a longer version of the Thoroughbred. The Palomino core however has a different layout and looks more like a square. The Thunderbird which does not include the hardware prefetch, larger TLBs and SSE that the other members of the family have, is wider than it's longer. Below you find a table with all the different versions and steppings of the Athlon and the Pentium 4.

Processor Model	Process (nm)	FSB (MHz)	L2-cache size	Comments	Supporting Chipsets
Athlon XP 1500+ -2100 (Palomino)	**180**	266 (133 MHz DDR)	256 KB	First Athlon with SSE and prefetch, decent overclocker (10-15%)	VIA KT133A, VIA KT266/266A-400, SIS735-746, nForce, nForce 2
Athlon XP 1700+ - 2200+ (T-bred A)	**130**	266 (133 MHz DDR)	256 KB	Athlon 1700-1900 run very cool, Athlon 2200 is a bad overclocker. All KT133A boards we tested did not work.	Some KT266A boards, VIA KT333-400, SIS735-746, nForce, nForce 2
Athlon XP 2400+ - 2600+ (T-bred-B)	**130**	266 (133 MHz DDR)	256 KB	Extra metal layer results in more frequency headroom, good overclocker. 2 GHz 2400+ reaches up to 2.4 GHz	VIA KT333-400, SIS735- 746 nForce 2
Athlon XP 2600+ - 2800+ (T-bred-B)	**130**	333 (166 MHz DDR)	256 KB	First Athlon with 333 MHz FSB, works only on KT400, some KT333 and all nForce 2 boards.	Some VIA KT333 boards, KT400, SIS 746, nForce 2
Athlon XP 2500+, 2800+ and 3000+ (Barton)	**130**	333 (166 MHz DDR)	512 KB	512 KB cache, lower clockspeeds than T-bred B. 3000+ is a bad overclocker	Some VIA KT333 boards, KT400, SIS 746, nForce 2
Pentium 4 1.3 - 2.0 GHz (Wilamette)	**180**	400 (100 MHz quad)	256 KB	Hot, and relatively bad performance. 2 GHz exists in 423 pin and 478 pin version.	i850
Pentium 4 1.6 - 2.6 GHz (Northwood)	**130**	400 (100 MHz quad)	512 KB	Excellent overclockers, especially 2 GHz and below.	All boards with 478 pin socket
Pentium 4 2.26 -2.53 GHz	**130**	533 (133 MHz quad)	512 KB	533 MHz bus gives nice boost to performance	i845E, i845GE, SIS645DX-648, i850E, VIA P4X333-400, E7205
Pentium 4 2.66 -2.8 GHz	**130**	533 (133 MHz quad)	512 KB	C1 stepping... 2 to 7% better perfromance thanks to slightly improved architecture (microcode)	i845(P)E, i845GE, SIS645DX-648, i850E, VIA P4X333-400, E7205
Pentium 4 3.06 GHz	**130**	533 (133 MHz quad)	512 KB	Needs a Hyperthreading aware chipset. Works best with an Intel 533 MHz FSB chipset.	i845(P)E, i845GE, i850E, E7205

We have tested VIA KT133A and KT266 boards from Gigabyte, MSI, ASUS and several others and found that the Thoroughbred is not supported by the VIA KT133A (SDRAM)/KT266 (DDR) chipset. If you have any luck with such a board, **let us know on the message board**! The SIS735 seems to support all the 266 MHz FSB T-breds.

As a lot of people prefer cool CPUs to hot ones let's take a look at the power dissipation figures for the Athlon family:

Processor Model	Frequency (MHz)	Nominal Voltage	Typical Thermal Power	Maximum Thermal Power
Athlon 1400 (T-bird)	**1400**	1.75V	65 W	72 W
Athlon XP 1700+ (Palomino)	**1467**	1.75V	57.4 W	64 W
Athlon XP 2100+ (Palomino)	**1733**	1.75V	64.3 W	72 W
Athlon XP 1700+(T-bred)	**1467**	1.50V	44.9W	49.4W
Athlon XP 1800+	**1533**		46.3W	59.2 W
Athlon XP 1900+	**1600**		47.7W	60.7 W
Athlon XP 2000+	**1667**	1.60V	54.7W	60.3W
Athlon XP 2100+	**1733**		56.4W	64.3 W
Athlon XP 2200+	**1800**	1.65V	61.7W	67.9W
Athlon XP 2600+	**2133**	1.65V	62 W	68.3W
Athlon XP 2800+ (T-bred)	**2250**	1.65V	64 W	74.3 W
Athlon XP 2500+(Barton)	**1833**	1.65V	53.7 W	68.3 W
Athlon XP 3000+ (Barton)	**2167**	1.65V	58.4 W	74.3 W
Pentium 4 2.0 GHz (0.18 micron)	**2000**	1.7V	72 W	92 W
Pentium 4 2.0 GHz (0.13 micron)	**2000**	1.5V	52.4 W	66 W
Pentium 4 2.2 GHz	**2200**	1.5v	55.1 W	70 W
Pentium 4 2.8 GHz	**2800**	1.525V	68.4 W	85 W
Pentium 4 3.06 GHz	**3060**	1.55 V	81 W	+/- 105 W

Notice how the Palomino was able to reach 1733 MHz with the same power dissipation as the 1.4 GHz Thunderbird. Conversely, the 2.16 GHz Barton has the same maximum power dissipation as the 2.25 GHz Thoroughbred. Interestingly, however, typical power dissipation seems to have decreased relative to Thoroughbred. It's unclear why this is the case, but perhaps there are some power-saving features built into the core. This is all speculation, though. The larger cache does mean lower average bus utilization, making it a possible contributor to the reduction in typical power consumption, but this also means the cache hitrate is higher and therefore, the core is more active (thus using more power).

To conclude this section, let's take a quick look at AMD's pricing.

Motherboard	Price (Pricewatch 12/12/2002)
Athlon 3000+	$588
Athlon 2800+	$375
Athlon 2700+	$349
Athlon 2600+	$297
Athlon 2500+	$239
Athlon 2400+	$193
Athlon 2200+	$157
Athlon 2000+	$83
Athlon 1800+	$69

Although you can get a 1.3 GHz Duron for about $47 (and probably lower), we think that the Duron and Thunderbird Athlons should be avoided as the Athlon XP 1800+ is very cheap now and offers much better performance.

Benchmarked Configurations

All Pentium 4 systems used the **Gigabyte GA-8INXP ("Granite Bay chipset")** unless we add "DDR333" to the label. All systems were tested with NVIDIA's Detonator 41.09 drivers. The desktop was set at a resolution of 1024x768x32bpp with an 85 Hz refresh rate. V-sync was off at all times.

We used **Corsair's XMS 3200 CAS 2 DDR** (DDR400) for maximum overclocking possibilities and stability.

Pentium 4 2.8 GHz, 3.06 GHz (Hyperthreading enabled)

- **Gigabyte GA-8INXP (E7205/ "Granite bay Chipset) - Dual DDR266**
- **MSI 845PE MAX2 (i845PE chipset) BIOS version 1.4 - DDR333**
- **2x256 MB Corsair PC3200 XMS (DDR-SDRAM) running at 266 MHz CAS 2 (2-2-2-6)**
- **Sound Blaster Live!**

Athlon 1400, Athlon XP 2700+, XP 2800+ (T-bred) and Athlon 3000+ (Barton)

- **ASUS A7N8x Deluxe nForce 2 rev. 1.04 BIOS version "G"**
- **2x256 MB Corsair PC3200 XMS (DDR-SDRAM) running at 333 MHz CAS 2 (2-3-3-6)**
- **Build-in APU**

Shared Components

- **Maxtor 80 GB DiamondMax 740X (7200 rpm, ATA-100/133)**
- **MSI Geforce Ti4600 (AGP 4x) 128 MB**

Software

- **Intel chipset inf update 4.09.1012**
- **NVIDIA nForce 2 2.03 drivers**
- **Windows XP Service Pack 1**
- **DirectX 8.1**

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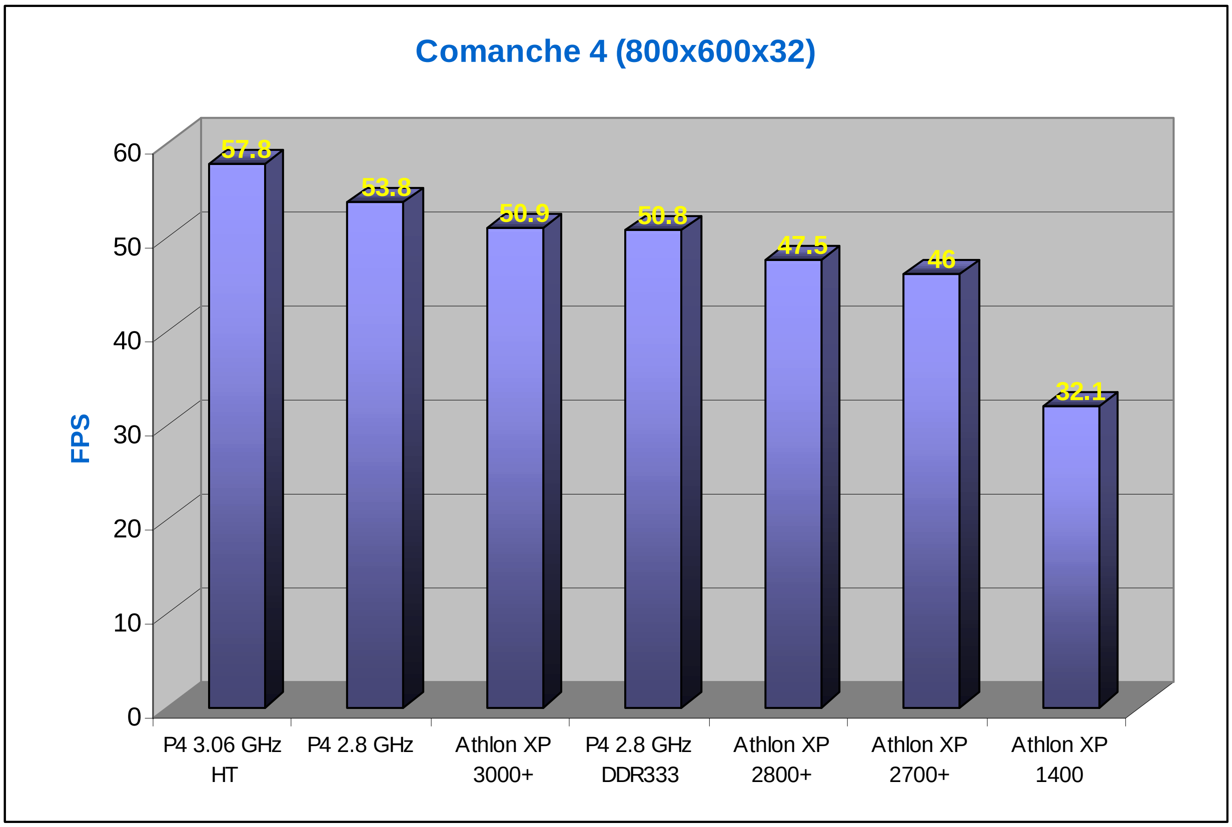
- Angelique Berden (**MSI**)
- Robert Pearce (**Corsair**)
- Kristof Semhke and George Alfs (**Intel**)
- Will Teng and Carol Chang (**ASUS**)
- Sharon Tan (**BAS computers Netherlands**)

Let us see some benchmarks!

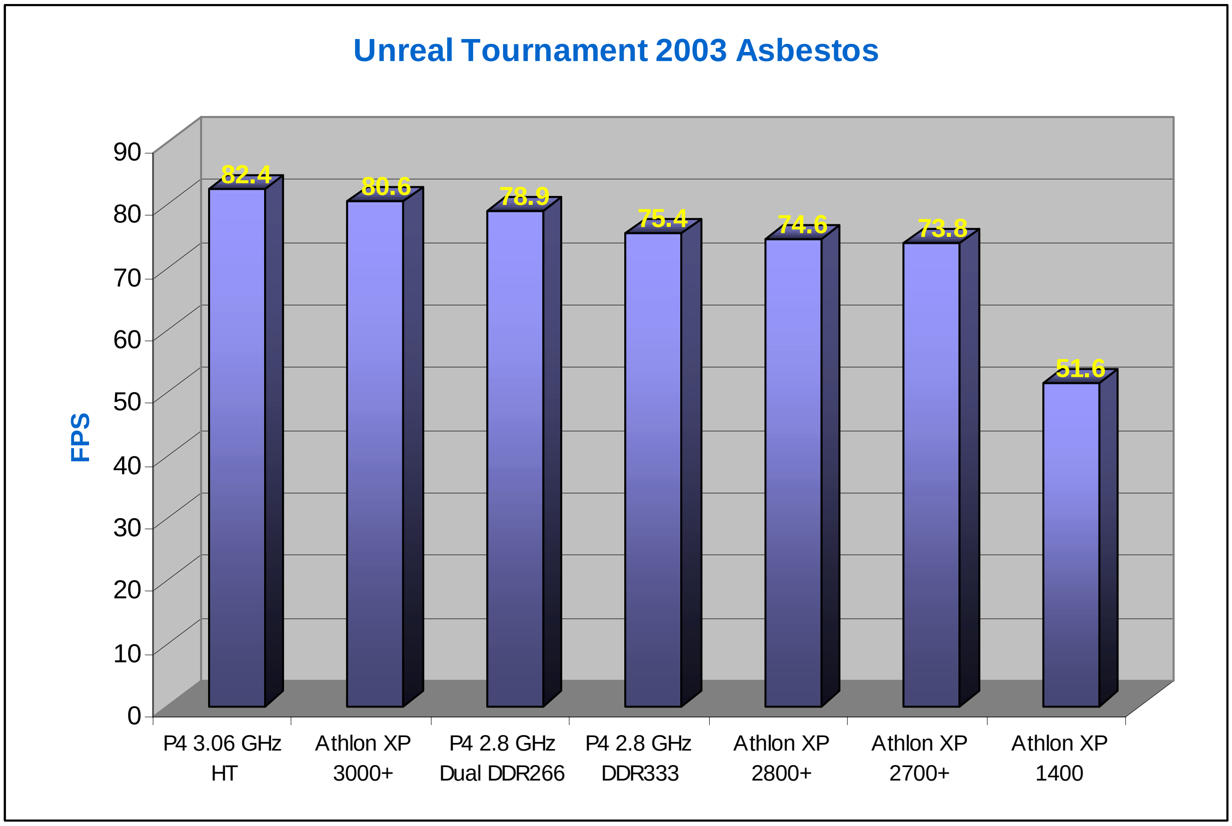
Gaming Benchmarks

Here are the Comanche results, the military helicopter simulator, which is one of the few games that uses DirectX 8's pixel shader effects.



If you are a bit amazed by the low Comanche numbers, please note that the NVIDIA's 41.09 drivers seem to produce much lower results than the 30.82 drivers we have used in some of our previous reviews. The extra 256 KB L2-cache of the Athlon 3000+ (512 KB, 2.17 GHz) boosts performance by 10% compared to the Athlon 2700+ (256 KB, 2.17 GHz) and also manages to top the Athlon XP 2800+ and the DDR333-configured 2.8 GHz Pentium 4. Pretty good, but not good enough to beat the 3 GHz Pentium 4.

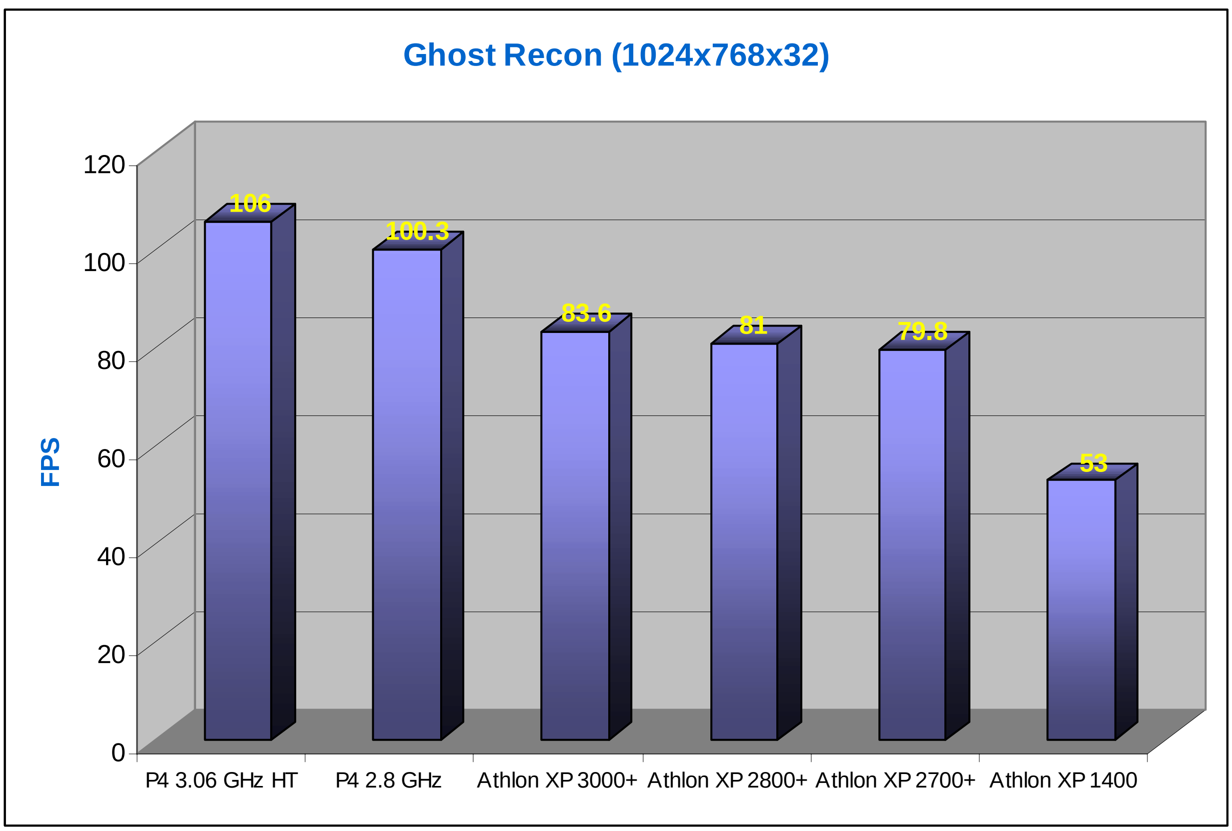
Let's see some Unreal Tournament 2003 benchmarks, as the latest Unreal game is by far the most popular first person shooter. We chose the Asbestos benchmark as it is one of the most intensive UT2003 benchmarks.



Barton is 9% faster than a similar Thoroughbred, justifying the 300 point higher QS rating. It also manages to outperform the 2.8 GHz Pentium 4 on Granitebay this time around. However, the Athlon XP is beaten again by the 3.06 GHz Pentium 4, which has a very small edge thanks to Hyperthreading.

Ghost Recon: Desert Siege

In our **last Upgrade guide**, many people where happy to see **Ghost Recon** among the gaming benchmarks. The "Realistic Combat" first person shooters are a favorite of no less than 17 to 18% of our readers! Just like last time, we set all graphics settings to the highest quality. Ghost Recon excels in detailed shadows and enemy AI, which are both very processor intensive. Many people would like a better ally AI though.



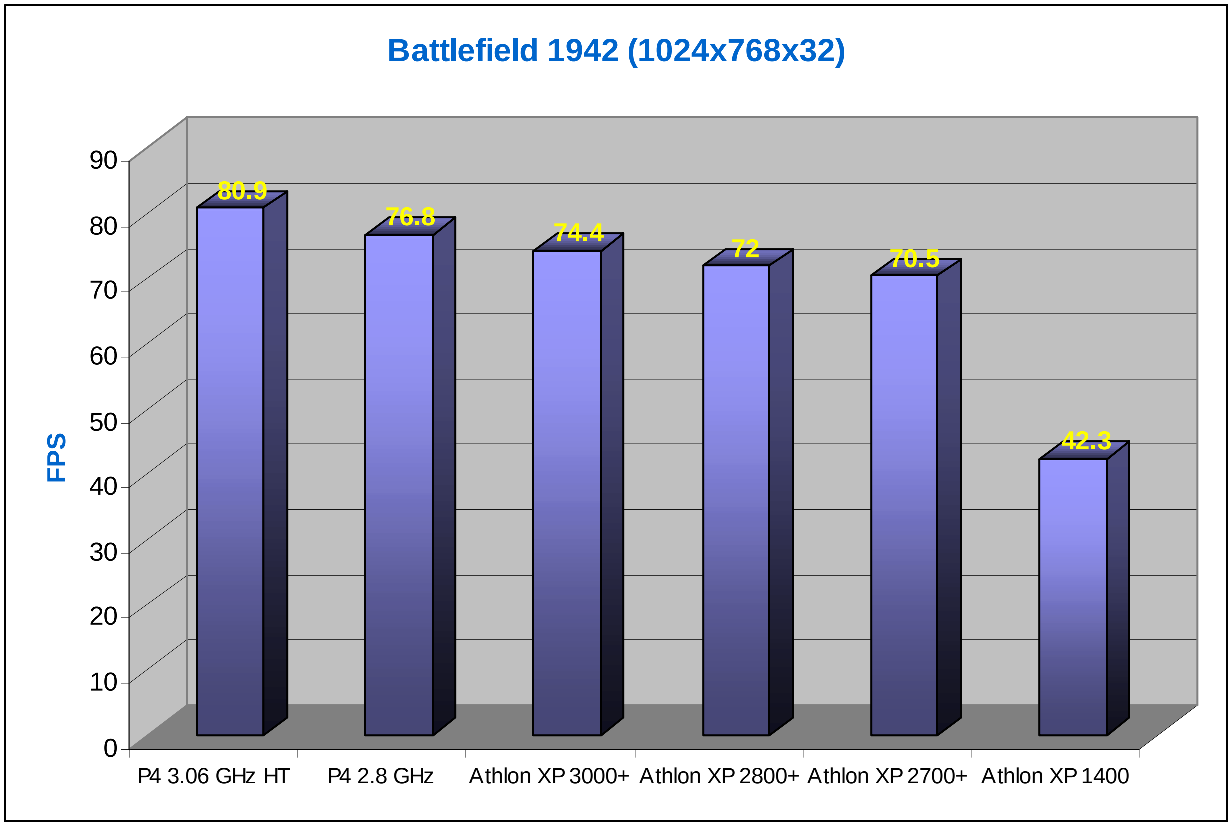
Barton cannot save the AMD family from being outperformed considerably by the flagship from Santa Clara in this benchmark. The extra L2-cache delivers a rather mediocre 4.7% performance boost. The error margin of our Ghost Recon benchmark is pretty low (1%), with very repeatable results. So we can definitely say that the Pentium 4 has a considerable advantage here.

Battlefield 1942

This first person, team-based action game places you in the midst of one of the WWII battles and you can drive tanks and jeeps and fly Spitfires and Stuka's. Again, you cannot run around as Rambo and get your BFG-9000 to kill a tank, but instead need to depend on your teammates. While it is not as realistic as Ghost Recon, enemy and ally AI is very important. In fact, AI takes up at default 20% of CPU performance, and we raised it manually to it's maximum of 25%. You can find **the other settings and more benchmarks here**.

The "Refractor 2" 3D rendering is able to render open landscapes in which the intense action takes place.

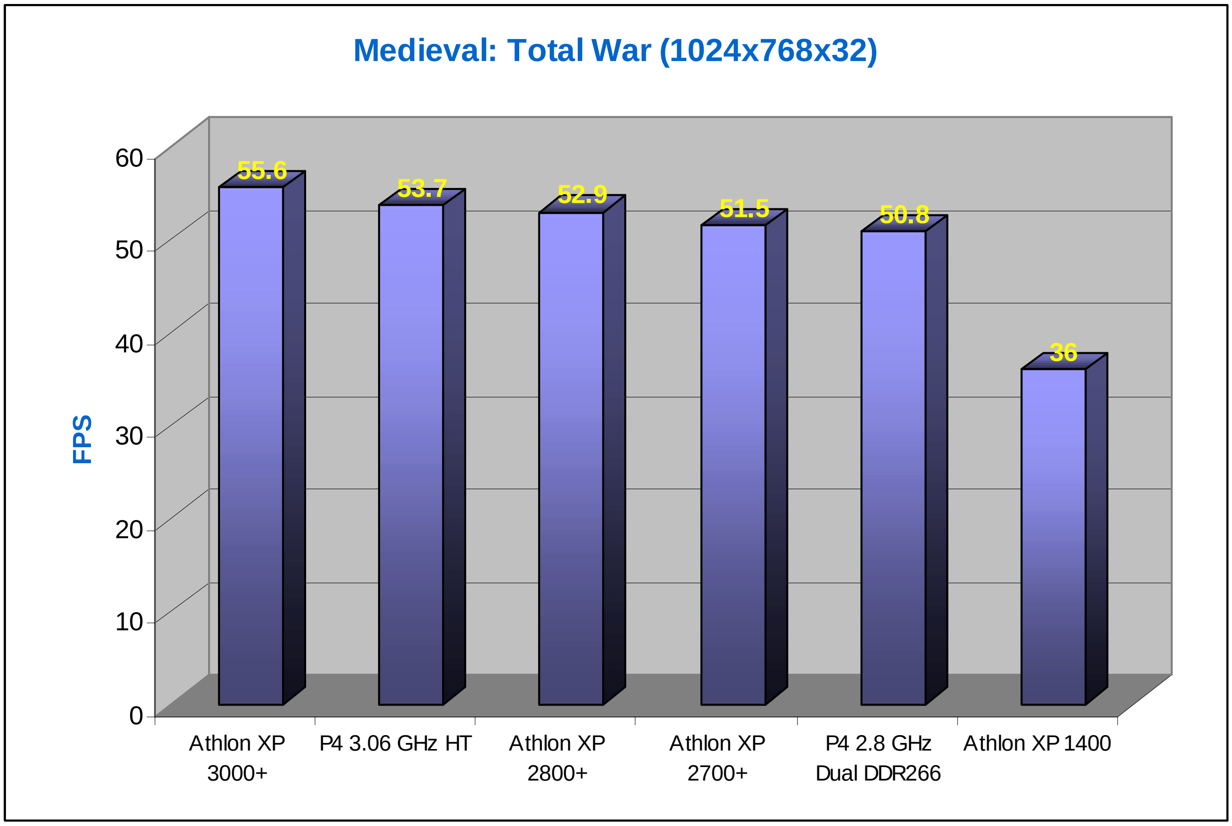
Artificial intelligence is very advanced and not scripted just like Ghost Recon. Shadows are calculated by the video card, and if a DirectX 8 compliant video card is available, it takes over the calculations of skinning on animated meshes (what makes the soldiers look more life like).



The Barton core is roughly 5.5% faster than the T-bred. However, we cannot make too many conclusions on this benchmark, as the error margin of our B1942 benchmark is still rather high (3-5%). However, repeated benchmarking revealed that the 3.06 GHz Pentium 4 is, without a doubt, faster than the Athlon XP 3000+.

Medieval: Total War

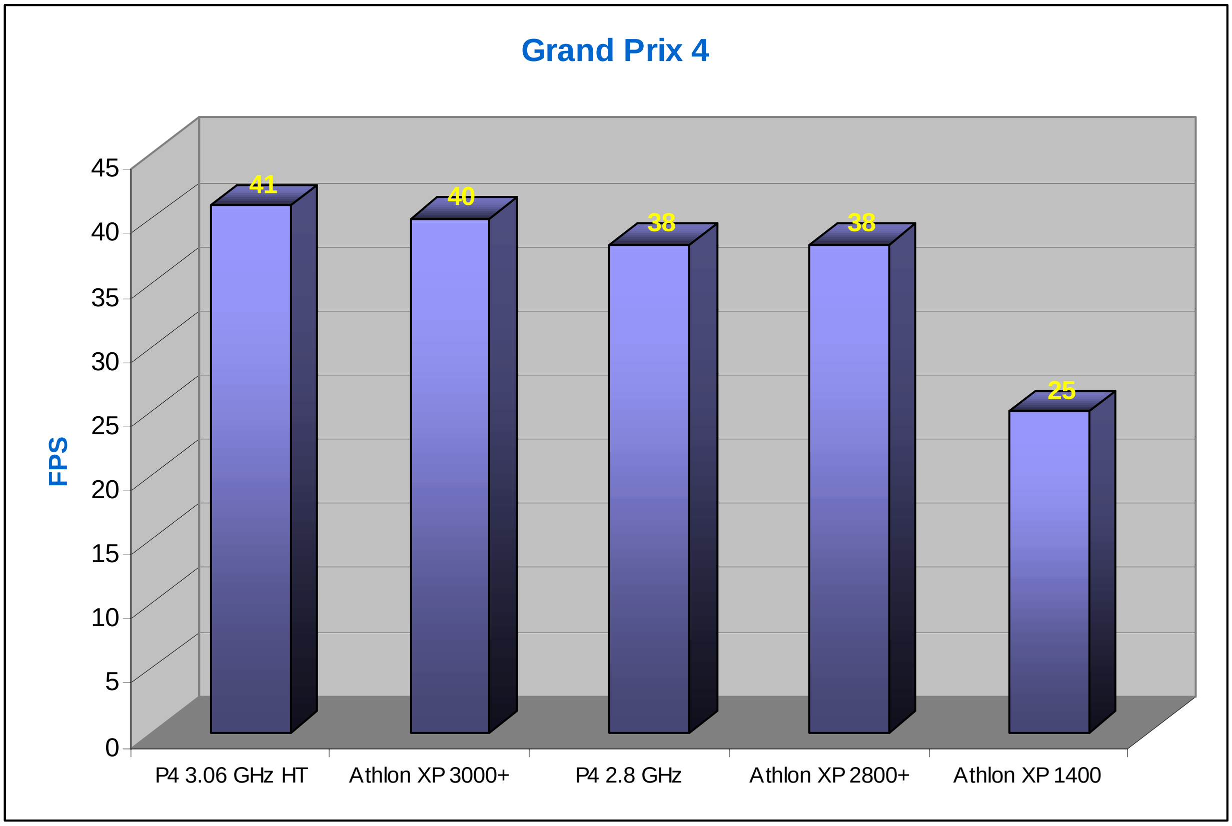
Medieval: Total War is based on the an improved version of the game engine that powered "Shogun: Total War." It contains a strategy "board game" element as well as tactical, stunning "Real Time Strategy" battlefield element. Our Fraps benchmarking is, thanks to the replay feature, very repeatable and error margins are low.



With already four games leading on the Pentium 4, things were starting to look pretty bad for the Barton. Luckily, the Athlon XP takes it revenge in Medieval: Total War and outperforms the similar Pentium 4s by a measurable amount of frames per second. The extra cache boosts the Athlon by 8%.

Simulator: Grand Prix 4

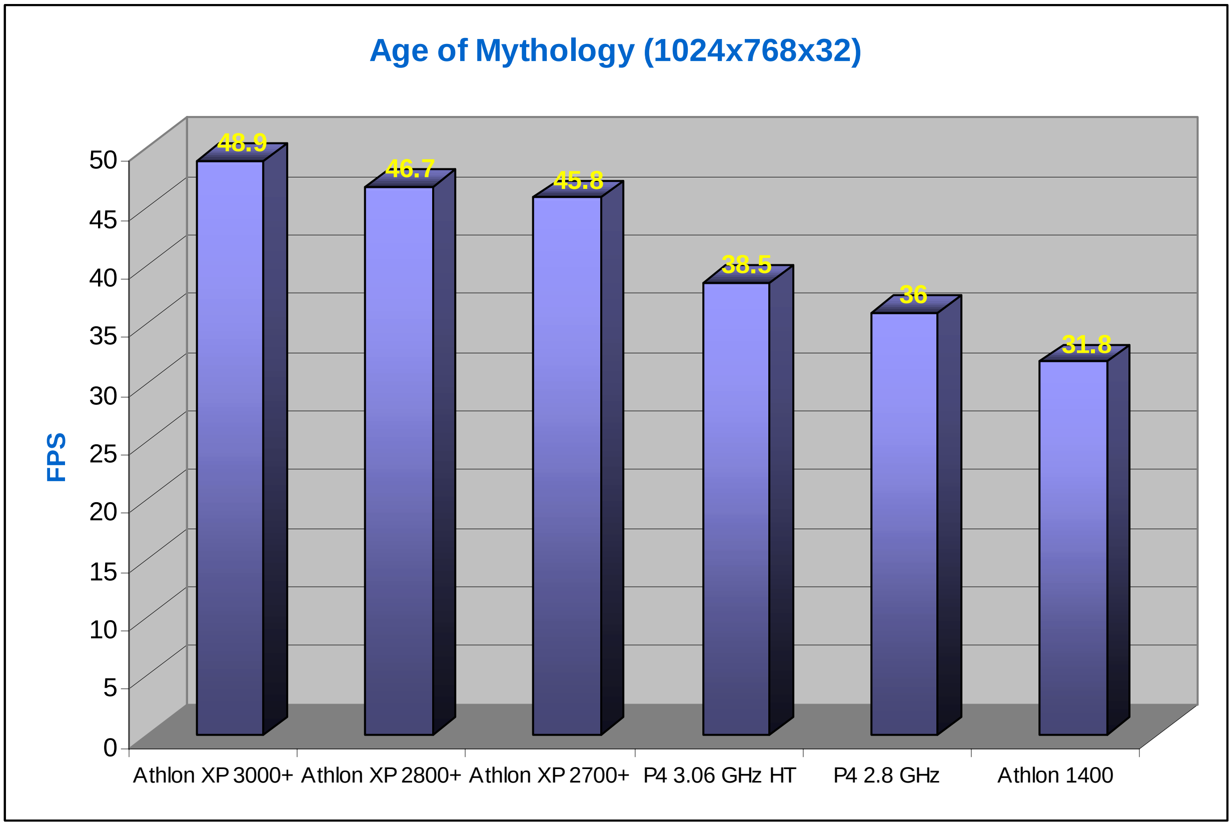
Grand Prix 4 is one of the more popular Formula One simulators. This engine is a typical DirectX 7 engine, which takes advantage of hardware transform and lighting, environment mapping (reflections on cars and in wet surfaces) and bump mapping (heat haze from engine heat).



The Barton Athlon XP and Pentium 4 perform very similar to each other. Note that the built-in benchmark of Grand Prix 4 is rather "coarse-grained".

Age of Mythology

Age of Mythology is the third incarnation of Microsoft's and Ensemble Studio's very popular Age of Empires series. The 2D Genie Engine of Age of Empires has been replaced with a new 3D engine. Age of Mythology **is a mostly CPU limited game**, which makes it very interesting for this review. We tested the framerate of a battle with a few tens of units.

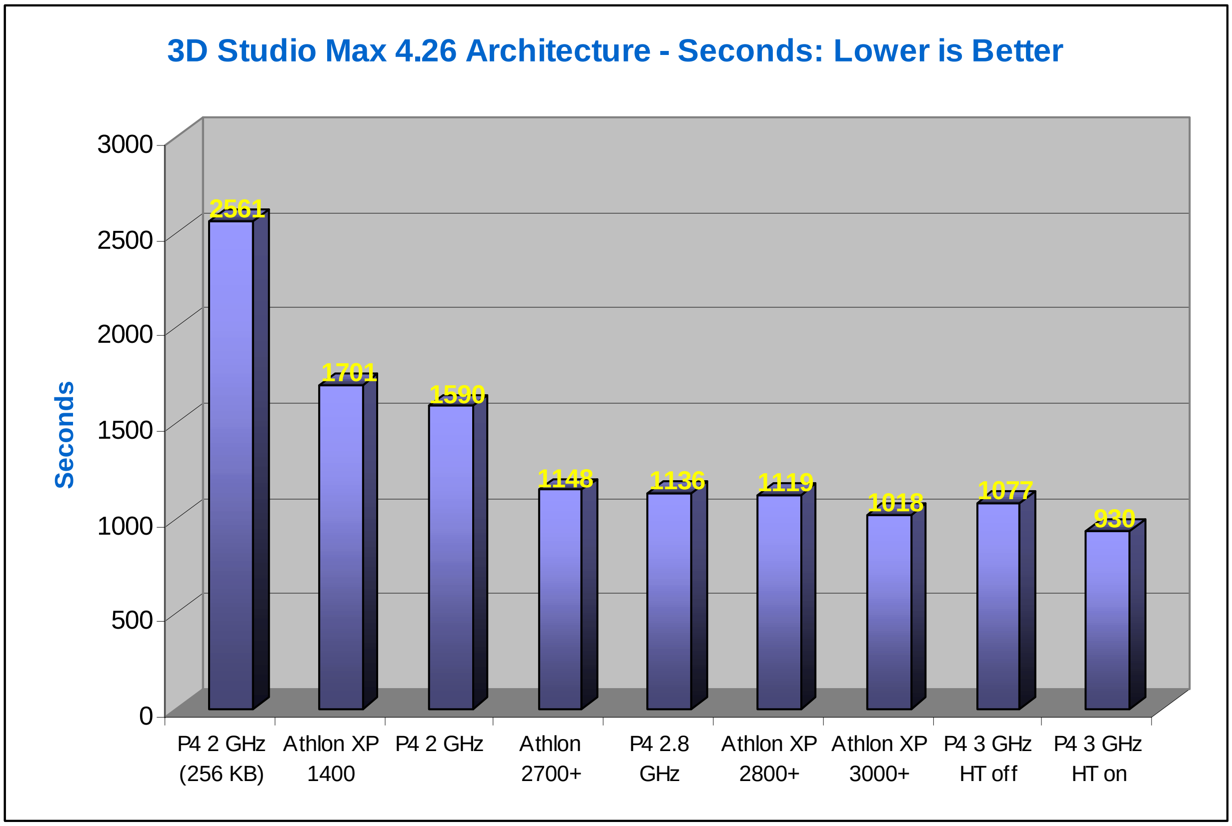


Ensemble Studio's Age of Mythology runs much more smoothly on the Athlon when big battles are going on. Barton is 7% faster than T-bred at the same clockspeed. Barton has a considerable lead of 10 FPS over the 3.06 GHz Pentium 4 in this benchmark.

Workstation Tests

While most office applications do not require fast CPUs, upgrading to a faster CPU can still improve the performance of typical workstation applications dramatically . **Note that for all OpenGL tests (SPEC ViewPerf) we used a** Quadro 4 XGL 900, a real OpenGL workstation card, and not the GeForce 4 Ti 4600, which was used for the gaming benchmarks.

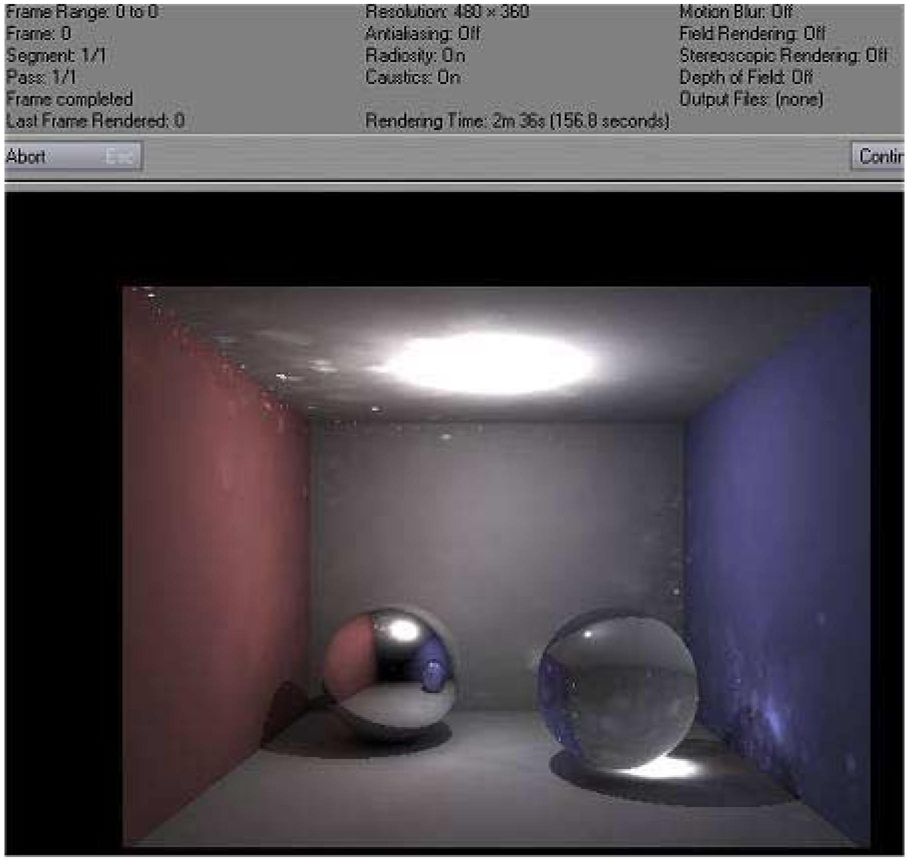
Our first test is a 3DSMax Rendering test. We tested the Architecture scene from the SPECapc 3DS MAX R4.2 benchmark. This test has a moving camera that shows a complicated building - a virtual tour of a scale model. This complex scene has no less than 600,000 polygons and 7 lights. It runs with raytracing and fog enabled. Frames 20 to 22 were rendered at 500x300 to the virtual frame buffer (memory).



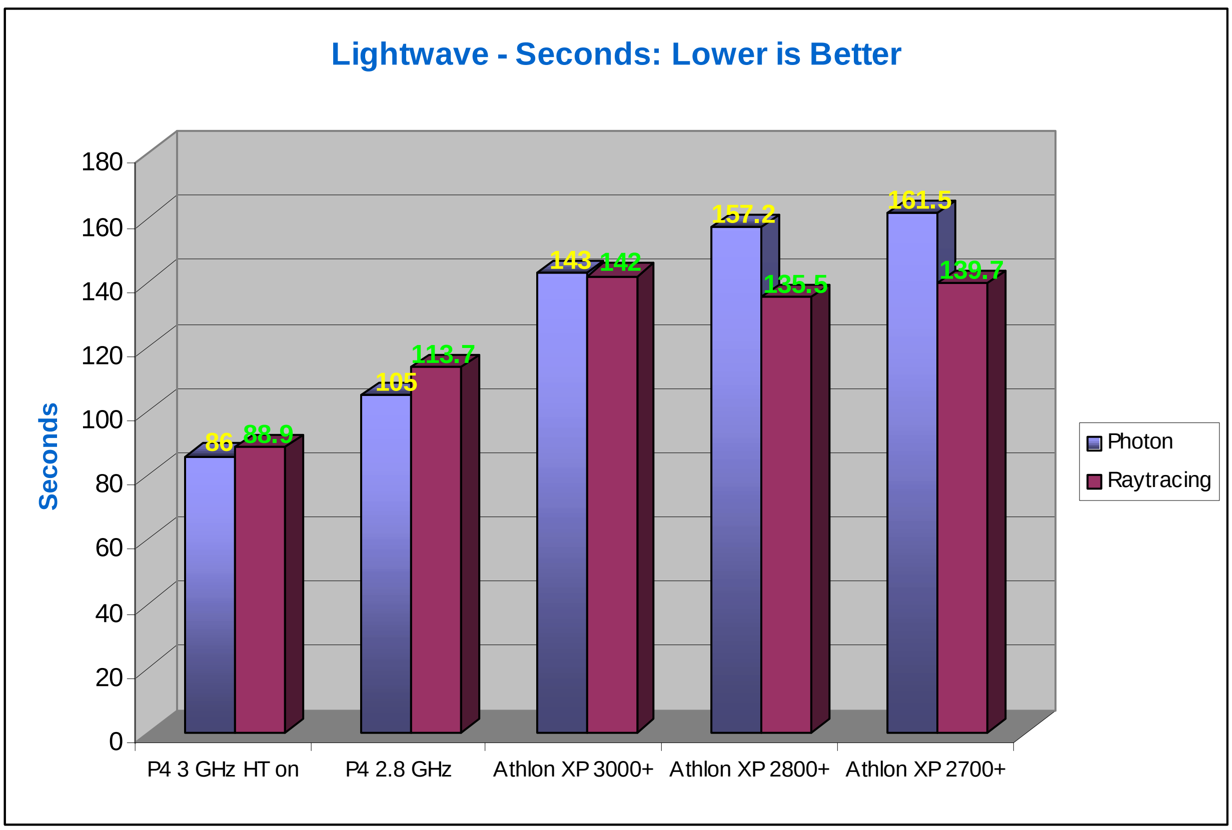
3DSMax illustrates very well our Pentium 4 versus Athlon L2-cache discussion. Willamette (256 KB) was a - let us be honest here - a lousy renderer. The extra 256 KB of Northwood changed the ugly duckling in a beautiful swan. The 2.17 GHz Barton improves performance by about 12% compared to the 2.17 GHz T-bred, which is good, but not quite so impressive. Notice that the Athlon XP 2700+ performs very similar to a 2.8 GHz Pentium 4. However, the Athlon XP 3000+ is beaten by the 3.06 GHz Pentium 4, as the latter gets an extra boost from Hyperthreading. So AMD's QuantiSpeed (QS) rating doesn't seem to be quite so accurate anymore in workstation applications that benefit a lot from Hyperthreading.

Lightwave

Newtek's Lightwave is one of the big names in the 3D animation realm and it is exceptionally well-optimized for the Pentium 4. We decided to benchmark the raytracing benchmark included in all Lightwave 6.0/7.0 and 7.5 packages. This way you can compare your configuration and results with ours. This **article** provides our rendering settings in the Render Options panel. We also tested with a special radiosity scene, called "Photon mapping" .



Radiosity is a lighting technique which makes the lighting of a scene much more realistic but which results in extremely slow rendering times, even on the fastest setups. So people tend to enable radiosity only in final stage of a project.

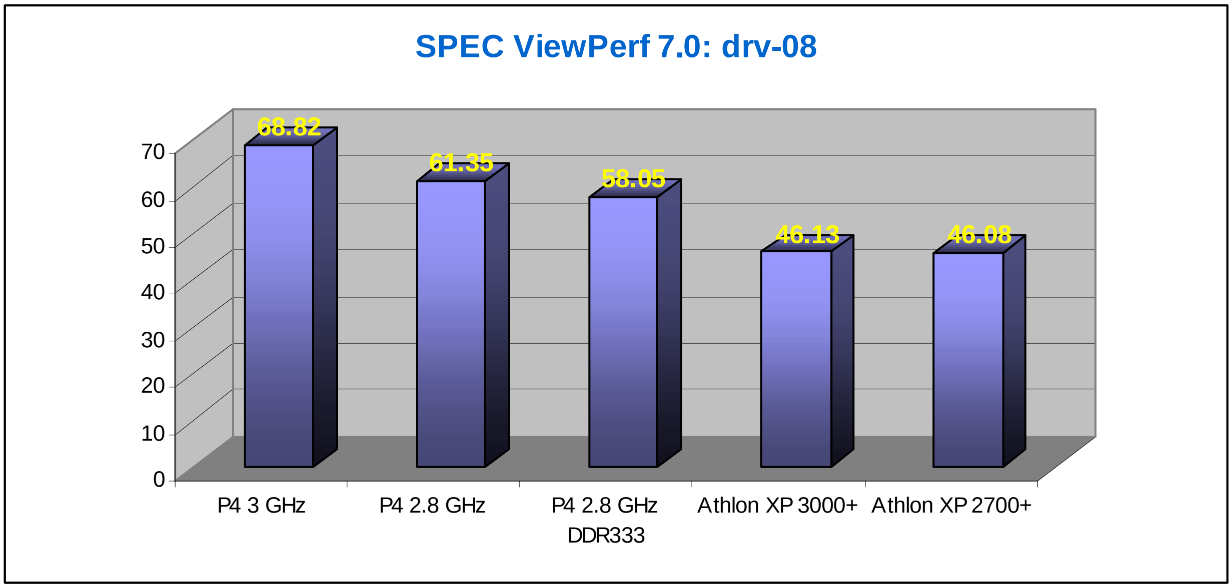


For the first time the higher clocked T-bred (2.25 GHz) is outperforming the "Barton" (2.17 GHz). However, we have reason to believe that both benchmarks are not very realistic. They contain extremely simple models, which probably do not take up a lot of space, and are therefore interesting to test the capabilities of a certain CPU core, but not for this kind of test. Barton's L2-cache can not pay off in the raytracing test because the models are so simple. This is not a very realistic situation as most scenes professional artists work on are very complex with 100k polygons or more. If you are able to send us a more complex benchmark, please do...

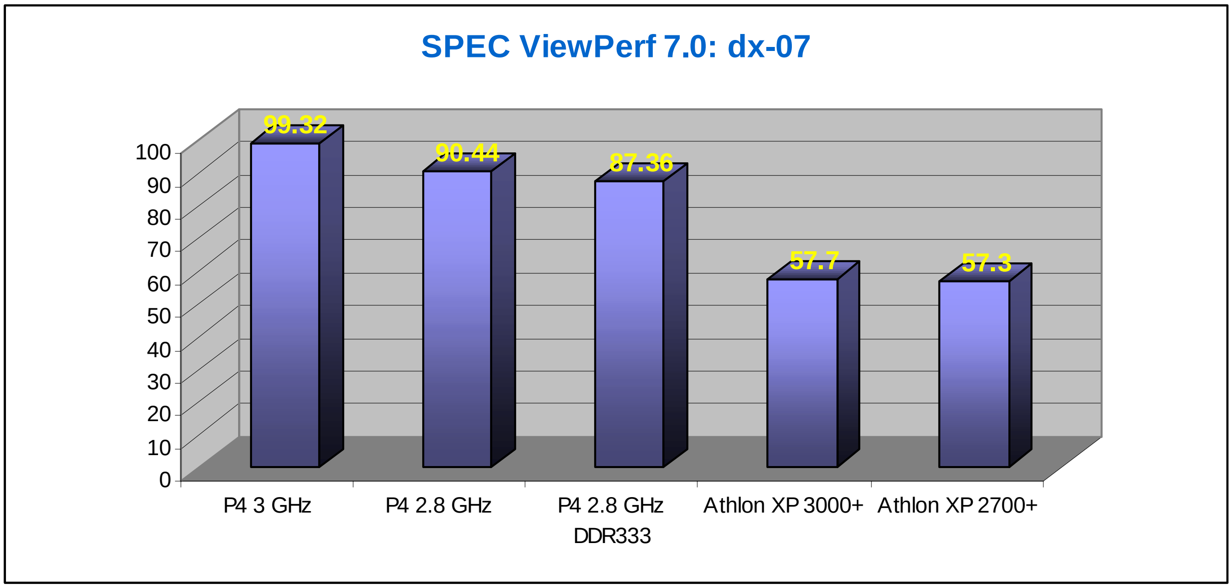
The radiosity algorithms are however so complex that the bigger L2-cache of Barton matters anyway. Lightwave remains of course the domain of the Pentium 4 which benefits a lot of from Hyperthreading and software optimizations.

Modeling: SPEC ViewPerf 7.0

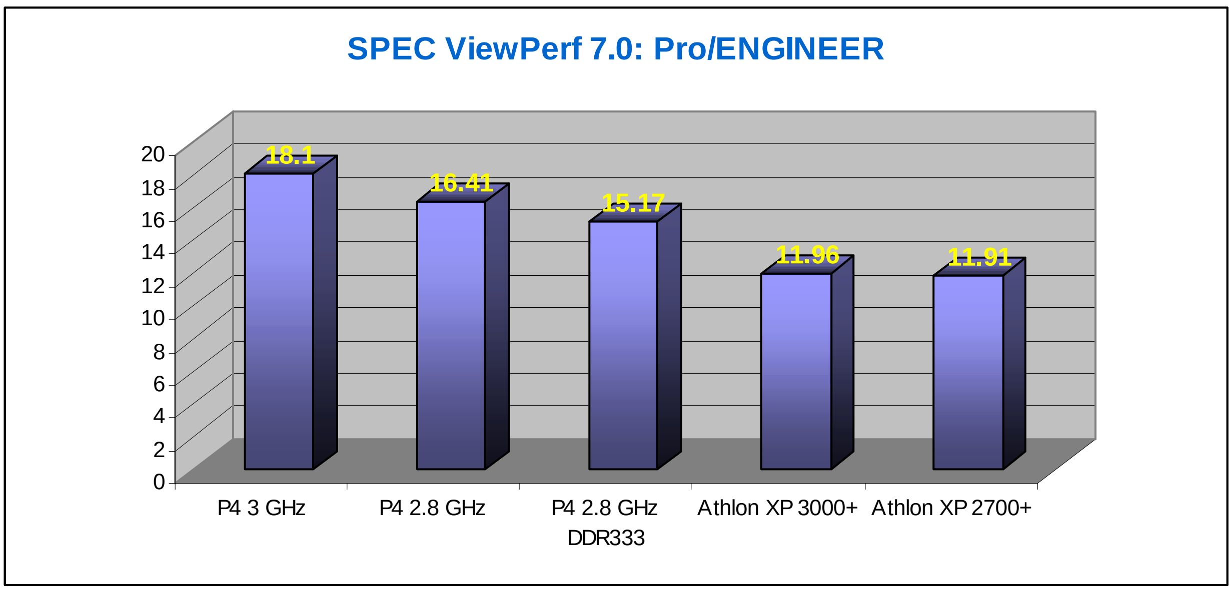
Modeling is a whole different story. Let us see what SPEC ViewPerf tells us. As we already pointed out, our videocard was the Quadro 4 XGL 900, as such an OpenGL video card is an indispensable tool for a 3D professional.



If your workstation is your main tool for designing plants and other complex structures, we told you in **our Granite Bay review** that the best options was a Pentium 4 with an i850E board or E7205 board. That does not change...

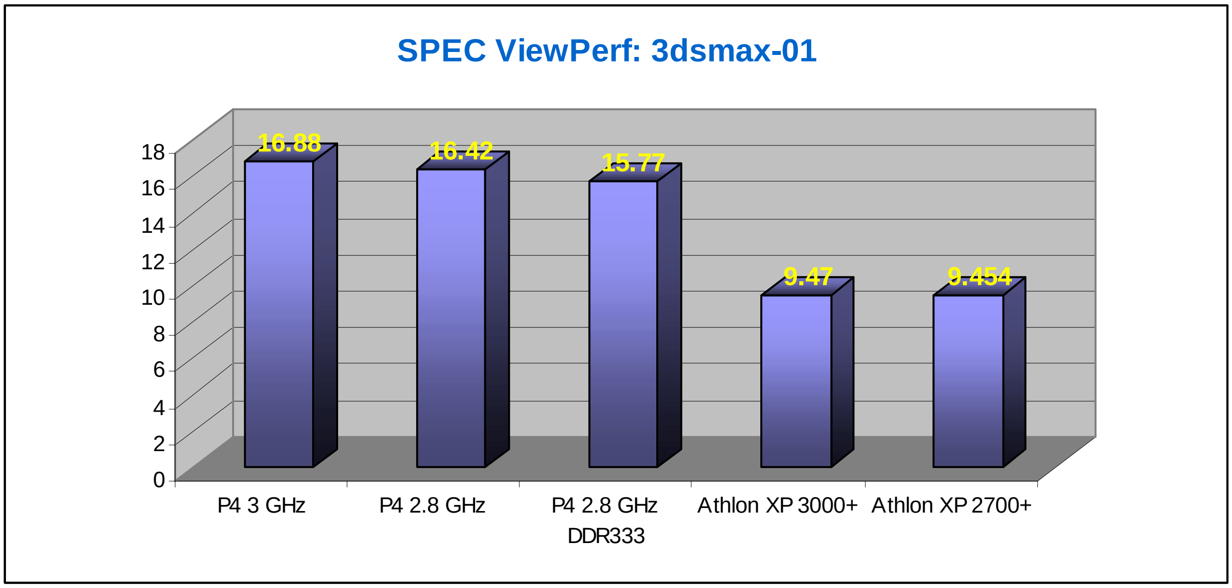


Scientific visualization goes so much faster on the Pentium 4. The Pentium 4 system simply walks over all Athlon systems.

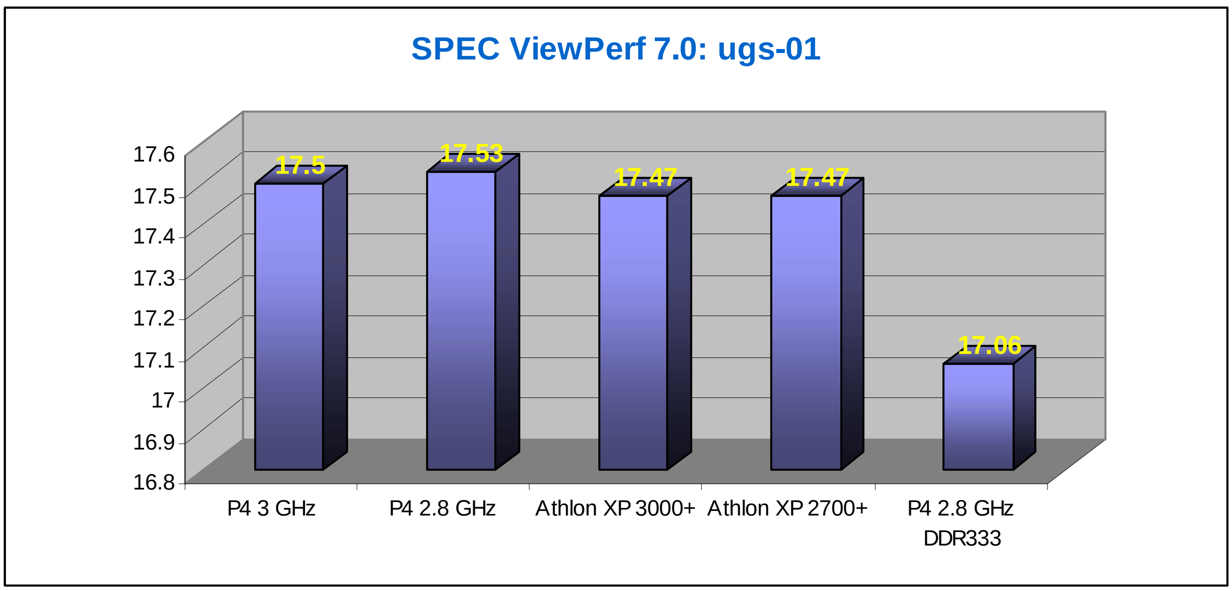


You may start thinking, how on earth can the Athlon perform so badly? Well, we are pretty sure the CPU itself is not to blame. Yes, the Pentium 4's fast FSB gives it a serious advantage: these kinds of applications work with 400k polygons per scene and more. All these polygons go from the memory to the CPU, from the CPU to the AGP card. If that was the only reason, the Athlon should perform as well as the Pentium 4s on the i845PE board (DDR333). And if you investigate the reviews which feature SPEC Viewperf and use a Geforce 4 Ti4600 as the OpenGL videocard, you will see that the Athlon will beat a similar Pentium 4 in many situations.

So we can safely assume that the Quadro drivers are not well optimized for the Athlon. Which is not really a surprise as most Quadro cards will find a place with a Xeon or Pentium 4 CPU. We tried to get some answers from NVIDIA, but no response yet.



Another landslide victory for the Pentium 4. However, 3DSMax is one of those applications where a gamers card like the Ti 4600 is not totally out of the question. If you change the Quadro 900 XGL for a Ti4600, the Pentium 4 and Athlon will perform equally.



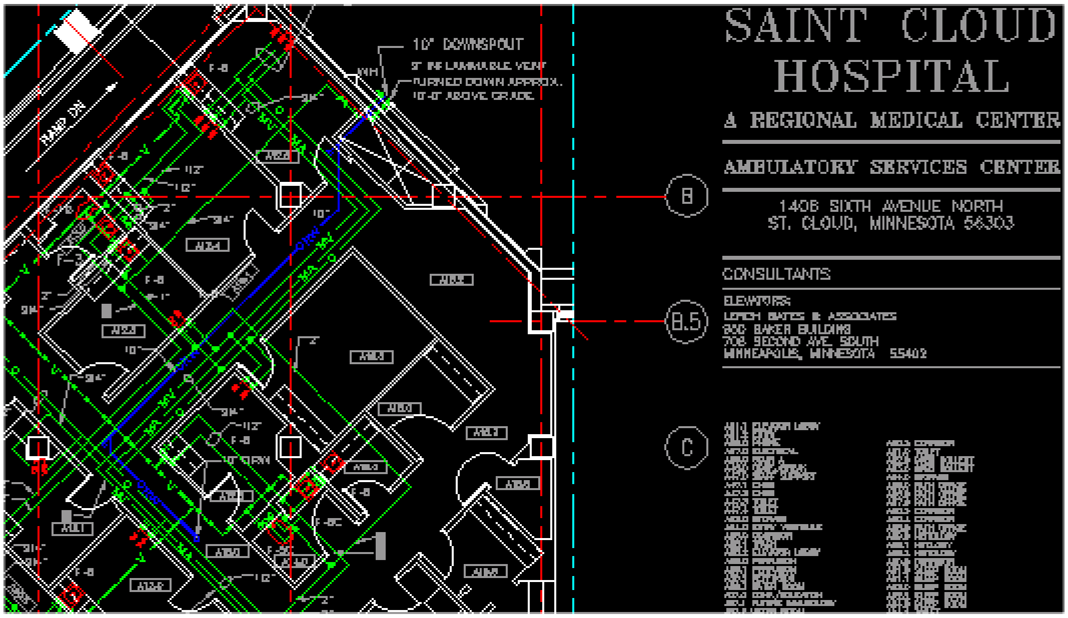
No real differences with this high end CAD application, all the CPUs perform almost identically here.

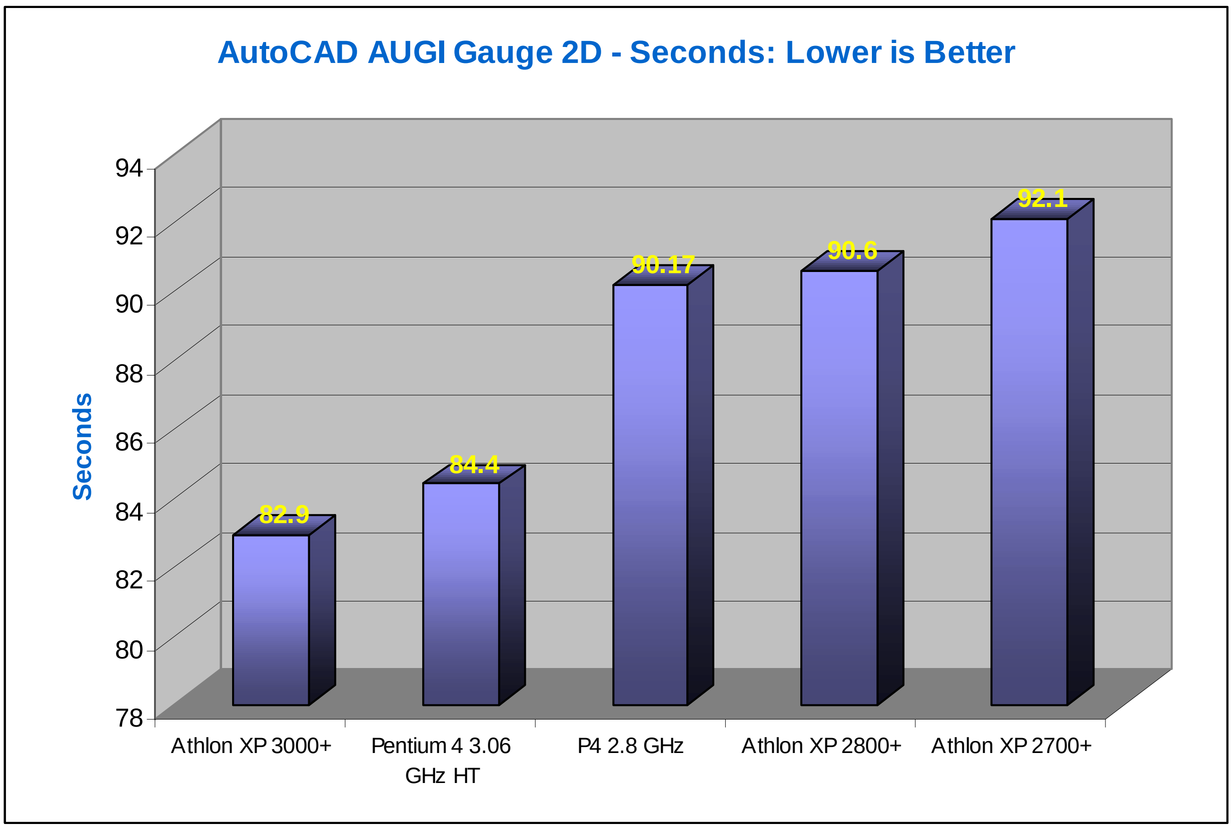
AutoCAD

We used the AUGI Gauge benchmark from Autodesk Users Group International. From the AUGI Gauge site:

> The AUGI Gauge is a performance-testing tool that can be used to develop benchmark scripts for testing different operations and different drawings. The testing tool comprises a Visual Basic front end and an AutoLISP testing engine. The AUGI Gauge prints completion times for each test operation to a text file, which can be imported into a spreadsheet for data manipulation. The original AUGI Gauge testing tool was designed to work with AutoCAD Release 12 (DOS), Release 13 (Windows) and Release 14. The current version works with AutoCAD Release 14 and AutoCAD 2000.

The benchmark itself consists of two sections, and we have used the real-world test that performs various file, edit, and display operations (totaling 30) on a series of 15 drawings that each average 2 MB in size.





The Athlon 3000+ lives up to it's rating this time, Hyperthreading can not save the Pentium 4.

Photoshop 7.0

Photoshop 7.0 has optimizations for all MMX capable CPUs as well as special optimizations for the Pentium 4. To test Photoshop, we used **PS7Bench 1.11**, a Photoshop action that runs 21 different operations on Photoshop 7.0 and measures the run time with Adobe's timing feature. We used the PS7Bench "Advanced" benchmark which manipulates a 50 MB image. With Photoshop 7 running, we set 300-340 MB physical RAM memory (out of 512 MB) was used, so disk swapping did occur on occasion, though not often.

Each filter was run 3 times, and the results you see here are the average of these 3 iterations. "History" was set to "1" instead of the default "20" to make the tests more repeatable. We found out that our benchmarking became much more repeatable and reliable when we increased memory usage to "81%", which was exactly 375 MB. This way no harddisk swapping could occur. To make it even more interesting, we included a dual Athlon 2200 MP. This configuration ran on a Tiger MPX with 512 MB of registered DDR266 CAS 2.5. The dual Athlon system has a much slower memory subsystem but a lot of brute SMP CPU power.

Test Nr.	Photoshop 7.0 Filter	Athlon 3000+	Athlon 2700+	P4 3.06 HT	P4 2.8	Athlon MP 2200	Athlon 2x MP 2200
1	Rotate 90	0.2	0.2	0.2	0.2	0.3	0.3
2	Rotate 9	2.8	2.9	2.7	3.3	3.5	**2.4**
3	Rotate .9	2.6	2.6	2.5	3.2	3.3	**2.2**
4	Gaussian Blur 1	0.8	0.8	**0.8**	0.9	1.1	1
5	Gaussian Blur 3.7	3	2.9	**2**	2.1	3.8	2.4
6	Gaussian Blur 85	3.4	3.5	**2.3**	2.6	4.6	2.9
7	Unsharp 50/1/0	1	1.1	**0.9**	1.2	1.3	1
8	Unsharp 50/3/7/0	3.1	3.1	**2.1**	2.4	4	2.5
9	Unsharp 50/10/5	3.1	3.1	**2.2**	2.4	4	2.5
10	Despeckle	2.6	2.7	2.2	4	3.3	**1.9**
11	RGB-CMYK	8.1	8.2	7.3	9.4	10	**5.4**
12	Reduce Size 60%	1.2	1.2	**0.9**	1	1.5	1.1
13	Lens Flare	3.9	4	**2.5**	3.8	4.3	3.1
14	Color Halftone	2.8	3.3	**2.2**	2.4	4.3	4.5
15	NTSC Colors	2.3	2.4	**2.4**	2.6	3.1	3.1
16	Accented Edges	10.4	10.9	**10.9**	12	13.7	13.9
17	Pointillize	17.5	17.7	12.1	18.8	21.3	**12**
18	Water Color	22.6	23.6	**26.4**	29.2	29.4	29.9
19	Polar Coordinates	8	8.3	7	8.5	10.2	**6.1**
20	Radial Blur	46.6	46.9	**33.1**	43.6	62.7	34.4
21	Lighting Effects	2	2	**1.9**	2.1	2.5	2

We ignore the first test as it runs too fast to notice any difference.

There are three very interesting trends to see:

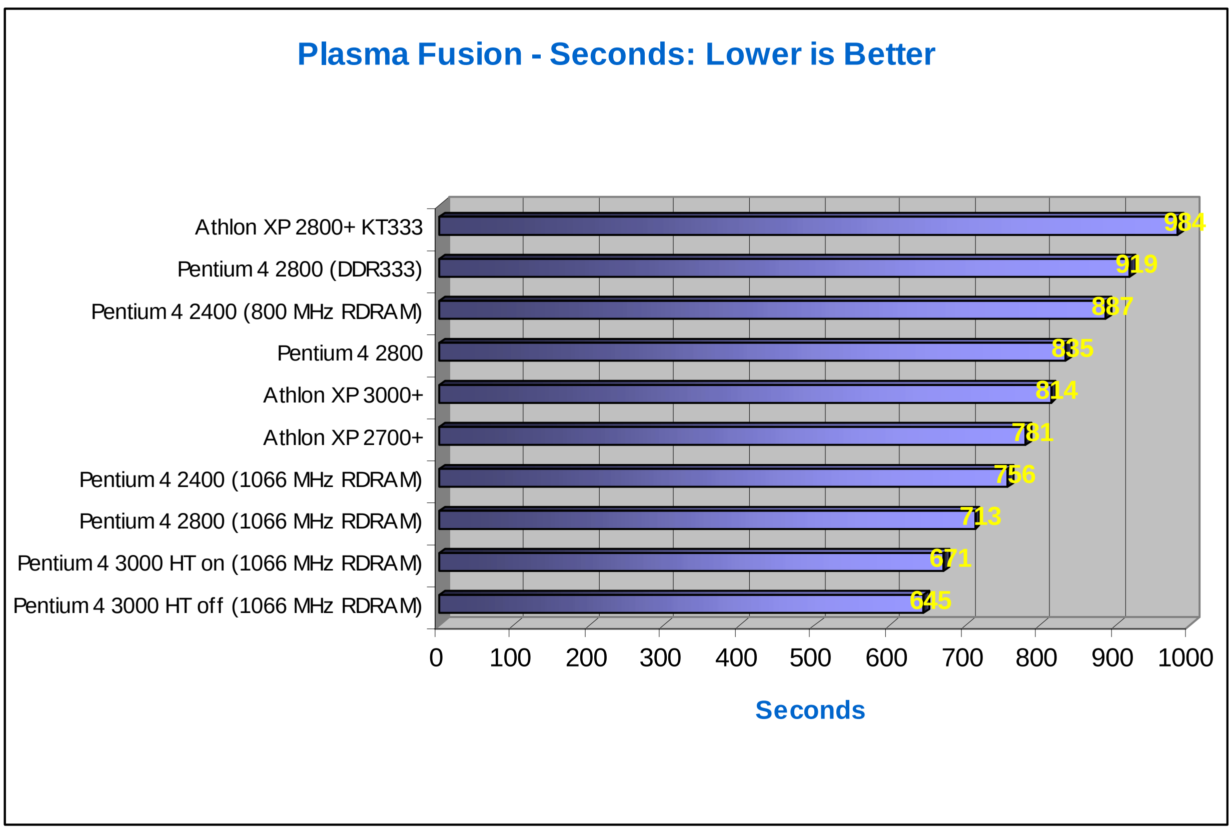
- Many Photoshop 7.0 filters are well optimized for SMP and Hyperthreading. Despite its pretty slow memory subsystem and relatively (single CPU) low clockspeed, the dual Athlon is fastest in 6 out of 20 tests. In 7 other tests, it also outperforms the Barton 3000+. That means that at least 13 out of 20 tests benefit well from SMP or Hyperthreading.
- Only 3 filters (Color Halftone, Accented Edges and Water Color) really benefit from the bigger cache of Barton
- The Pentium 4 wins in most filters. Better Photoshop optimization and Hyperthreading pay off for the Pentium 4

Of course, we used a 50 MB image. But if you work with smaller images, there is even less waiting time, and CPU power will be less important. Overall, the Pentium 4 is a clear winner in Photoshop. The Pentium 4 does all filters in 124.5 seconds, the Athlon XP 3000+ in 151 seconds. Contrary to the Athlon XP 3000+, the Athlon 2700+ lives up to its rating as it runs all tests in 151 seconds, while the 2.8 GHz Pentium 4 needs 156 seconds.

Plasma Fusion

The Plasma benchmark is our most recent new benchmark, you can read **all about it here**. Dr. Simon Bland gave us some new information:

> The MHD code is speed limited by the matrix inversion. The matrix consists of 2.1 million rows by 2.1 million columns, all values to double precision. It is, however, very sparsely populated… there are 29 non-zero diagonals. The current matrix solving method is an iterative solving method (bi-conjugate gradient solutions method). It uses 100 iterations to solve the matrix, each iteration consisting of ~5 matrix multipliers. As mentioned we are actively looking for better solving methods both for single and parallel.



The excellent memory subsystem of the nForce 2 boosts the Athlon performance considerably. With these kinds of huge matrices, CPU power does not matter that much. The Athlon XP 2700+ is able to beat the 2.8 GHz Pentium 4 GHz with DDR333, but a 2.4 GHz Pentium 4 equipped with fast PC1066 RDRAM memory system races past both systems. It is intriging to see that the bigger cache of Barton slows the plasma benchmark down. We'll have to investigate further why this is the case.

Conclusion

We have tested almost 20 different applications, but still I am not sure whether the 2.17 GHz Barton should carry the 3000+ rating. AMD marketing tells us "The AMD Athlon XP processor 3000+ is the world's highest performing desktop PC processor". They prove this by showing that the Athlon is between 8 and 17% faster than the 3.06 GHz Pentium 4 in benchmark suites such as SYSmark 2001 Office Productivity, Business Winstone 2001 and SYSmark 2001 Internet Content Creation. But Sysmark 2001 contains old software such as Adobe Photoshop 5.5, Macromedia Dreamweaver 3.0, Netscape Navigator 4.73, and Macromedia Flash 5. I highly doubt that many Photoshop users are still using Photoshop 5.5 or that people are browsing the web with Netscape Navigator 4.73.

What this shows is that the Athlon outperforms the Pentium 4 with ease in unoptimized, slight older applications. Even our own quick test run with a more recent benchmark suite such as Content Creation 2002 shows that the Athlon XP 3000+ outperforms the 3.06 Pentium 4 by 10% or more. So if you are using the applications in Content Creation 2002, and you won't upgrade your older software very soon, the Athlon XP 3000+ surely is the best CPU out there.

However, the number of applications that are optimized for the Pentium 4 is already numerous, and growing every day. You could focus on benchmarks with relatively small datasets (see our Lightwave tests) or benchmarks that rely on gigantic matrices (for example the Plasma benchmark) and say that the 3.06 GHz Pentium 4 is by far superior.

Neither two benchmark scenarios described are very realistic to most people out there. In other words, we need to test even more game engines and applications before we can pass our judgment on Barton. With the data we have today, I am inclined to tell you that the Athlon XP 3000+ should have been a 2.25 GHz Athlon XP with 512 KB cache. 3DSMax 4.26, Lightwave 7.5, Photoshop 7.0 all point out the Pentium 4 as winner, and only AutoCAD 2002 clearly favors the Athlon XP 3000+. These are all extremely popular applications, which matter to many people.

Let us look at the games. Comanche 4, Battlefield 1942, and Ghost Recon heavily favor the Pentium 4. Unreal Tournament 2003 and Grand Prix run a (very) little bit faster on the Pentium 4, while Medieval: Total War runs a bit faster on the Athlon and Age of Mythology runs much better on the Athlon. All in all, it seems like the Pentium 4 has a small advantage. That is why I feel that giving the 3000+ rating to a 2250 MHz Athlon "Barton" would have been more accurate. We could not test with the "Barton" Athlon XP 2800+, but it is likely the Barton 2800+ will live up to its claim, and probably even deserve the "+" behind its name by outperforming the 2.8 GHz Pentium 4. It is only logical that the extra 83 MHz that the Barton 3000+ has, is not enough to compete with a Pentium 4, which is clocked higher AND has Hyperthreading enabled.

We promise you more benchmarks on Barton in upcoming articles...