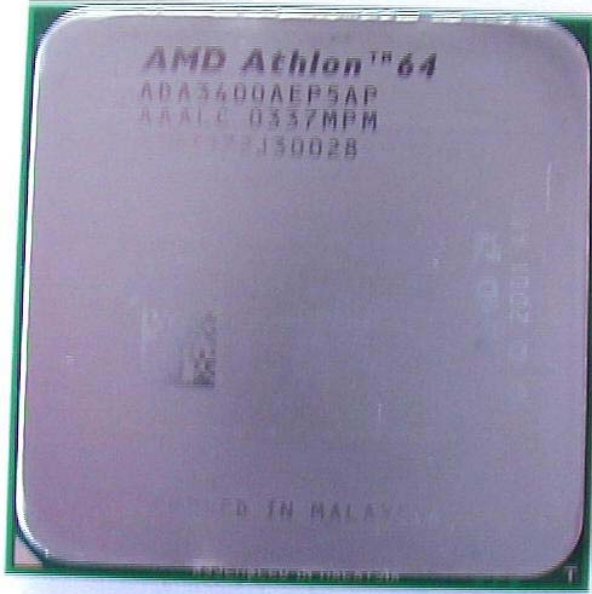


2004 Gamers' Hardware Upgrade Guide

By Johan De Gelas – January 2004

Introduction



Last week, we showed you a **preview** of the Athlon 64 3400+. Today, we'll investigate this new CPU as an upgrade to an existing system. How much performance do you gain when upgrading? What about the other features aside from performance, such as Cool'n'Quiet and more thermal and mechanical safety?

As always, we start with a base system to be upgraded. This time around, our base system is equipped with an Athlon XP 2100+, as previous polls among our readers show that the faster versions of the Athlon XP "Palomino" were very popular in the early days of 2003. Now in 2004, Palomino is getting a little long in the tooth, so it's interesting to know whether or not an upgrade may be worthwhile. Our old system also contains a GeForce Ti 4200 and 512 MB of DDR266 (PC2100) memory. We will upgrade the CPU (to the Athlon 4 3400+) and memory (to DDR400 CAS 2) and compare that upgrade with one that simply upgrades the video card. As mentioned previously, we've done this before in many of **our Gamer's Upgrade Guides**. However, the gaming industry is not sitting still, and we are moving from hybrid DirectX 7/8 games to DirectX 8/9 games, which - as you will see - behave quite differently.

The games you'll see tested in detail today are Halo 1.03, Return to Castle Wolfenstein: Enemy Territory, and X2- The Threat. But that's not all, in our category of "mostly CPU limited" games, we welcome Blitzkrieg, Civilization III, and Battlefield 1942: Secret Weapons (V1.45).

The 2.2 GHz 754-pin Athlon 64 3400+ might seem like a rather expensive (\$417) upgrade, but that might be changing very soon. Before the end of the second quarter, an Athlon 64 3700+ at 2.4 GHz should see the light of day. And each new speedbump seems to push the price of the previous one considerably lower. So let us see what makes the most sense: upgrade that XP 2100+ to a Athlon 64 3400+ or buy a GeForce FX 5900 Ultra instead of that GeForce 4 Ti 4200. Or could a GeForce FX 5700 already be more than enough? Maybe an upgrade is not necessary at all and our base system is still just fine? Enjoy as you make up your mind!

In a nutshell, this article will try to answer six typical upgrade questions:

- Can my upgrade really give me a cooler and therefore quieter PC?
- Is the Athlon 64 really safer than the Athlon XP?
- How future proof is Socket 754?
- How much more raw power does the Athlon 64 3400+ offer over my Athlon XP 2100+?
- Should I invest in fast CAS 2 DDR400 or will less expensive CAS 2.5/3 do?
- Should I invest in a fast video card first or do I really need a faster CPU if I am heavy gamer?

Before we concentrate on the performance questions we take a look at the other features that might make a transition to the Athlon 64 interesting: Cool'n'Quiet and the heat spreader with built in thermtrip.

As mentioned above, the 3400+ is a 754-pin chip, meaning it sports only a 64-bit DDR400 memory interface, but it does not require registered memory and therefore becomes a friendlier and more familiar solution for the average computing user or enthusiast who just wants to put together a high-performance system with a minimum of caveats, not to mention costs.

Upgrade Question 1: Cool and Quiet?

Cool'n'Quiet is a mobile CPU technology that is now also available in the Athlon 64. Cool 'n' Quiet provides three different modes of operation (Normal, Intermediate, and Minimum). The chip normally runs at 1.5V with a maximum TDP specified as 89W and a clockspeed of 2.2 GHz. Shifting into intermediate mode, the clockspeed drops to 2.0 GHz, while the voltage drops to 1.4V. At the lowest level, the minimum state drops the clockspeed down to 800 MHz and the voltage to 1.3V. The maximum TDPs are 70W and 35W for intermediate and minimum, respectively.

Our first measurements indicate that the total power consumption - the one that determines your electricity bill - of your system lowers by more than 35 Watts, about 45-50 Watts (135/140 Watt - 90 Watt). This is a very nice power saving feature that will not only save quite a bit of money due to a lower electricity bill, but it also allows the motherboard to slow the fans down (hence the "Quiet" part).

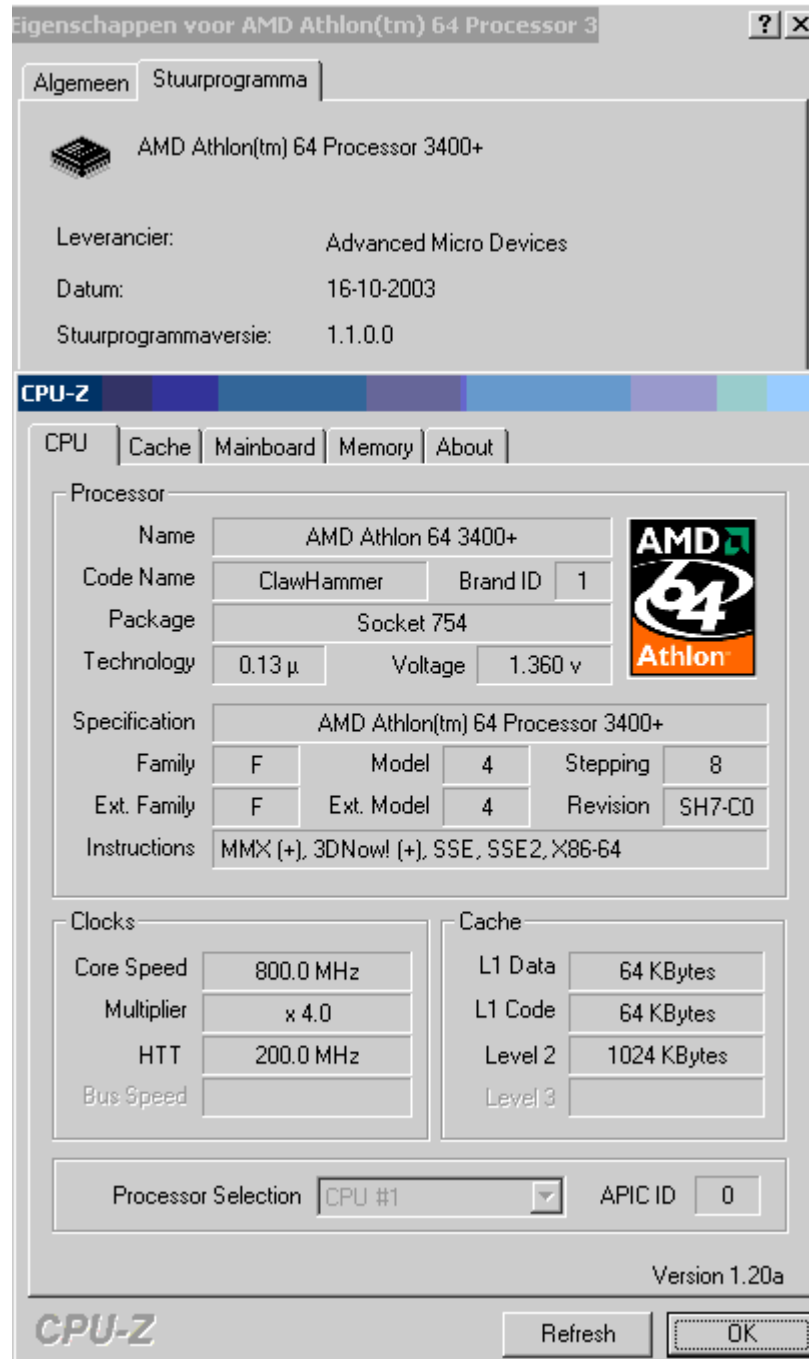
Cool'n'Quiet is unfortunately **not available** for the owners of an **Athlon 64 FX or Opteron**. The most likely reason is that registered memory can not change its frequency as fast as unbuffered memory. Also, the Athlon 64 FX is intended as a high-end CPU based upon a server CPU, so such a feature is less critical in these markets. So how can you make sure you can save power and lower noise levels thanks to Cool'n'Quiet? You need:

- Windows XP SP1 and AMD's CPU driver
- or Linux SuSE 9.0 and the powernowk8 driver
- Athlon 64
- A Motherboard with BIOS support for Cool'n'Quiet. So far we are sure that the following boards work: MSI K8T Neo, ASUS K8V and EPOX 8HDA3+.

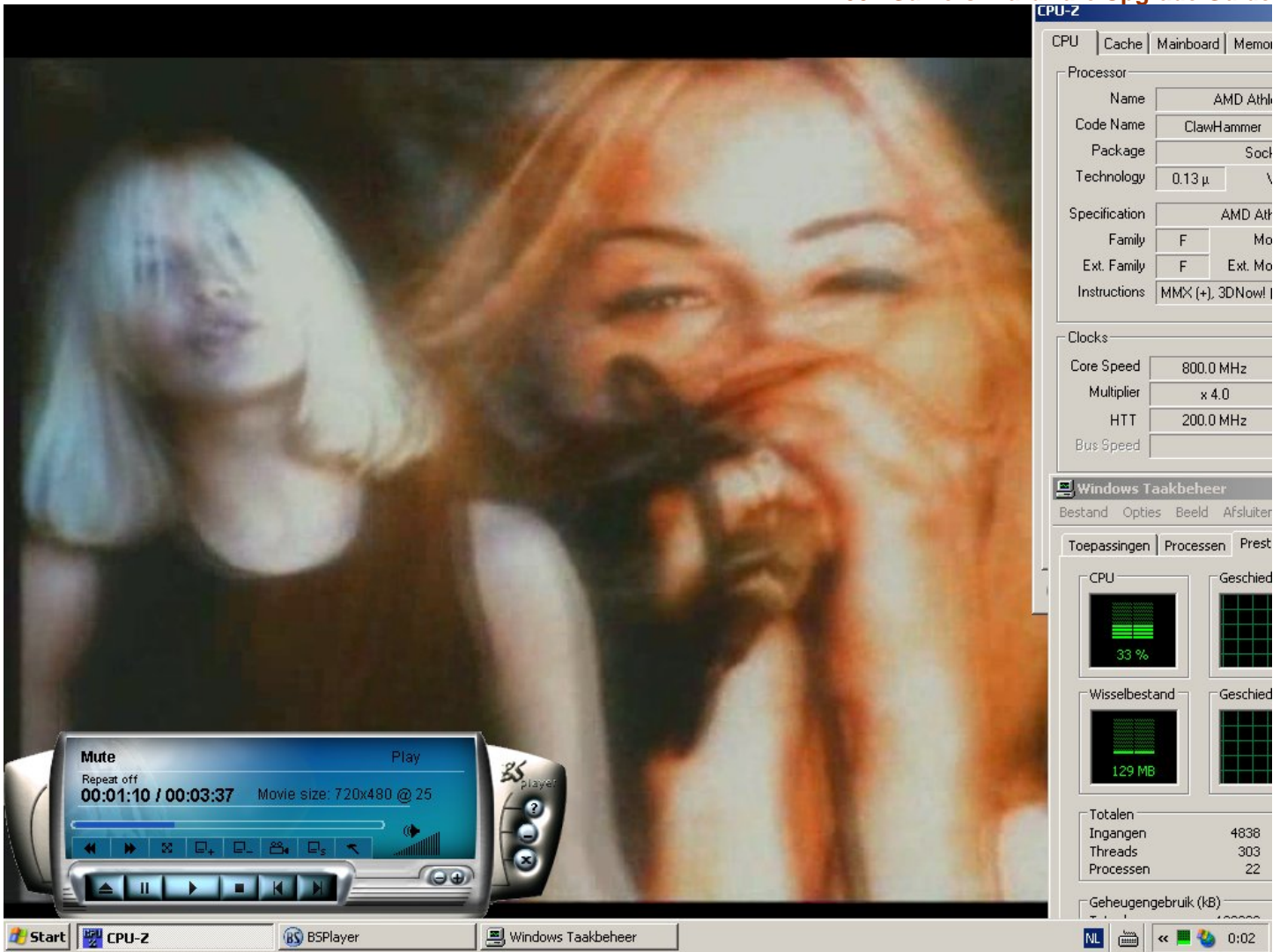
These are the steps you have to take to activate Cool'n'Quiet:

- Flash the BIOS to a version that includes Cool'n'Quiet (for example, MSI K8T Neo: BIOS version 1.1)
- Enable Cool'n'Quiet in the BIOS
- **Download and install AMD's Athlon 64 CPU driver.**
- Set XP's energy management to minimal

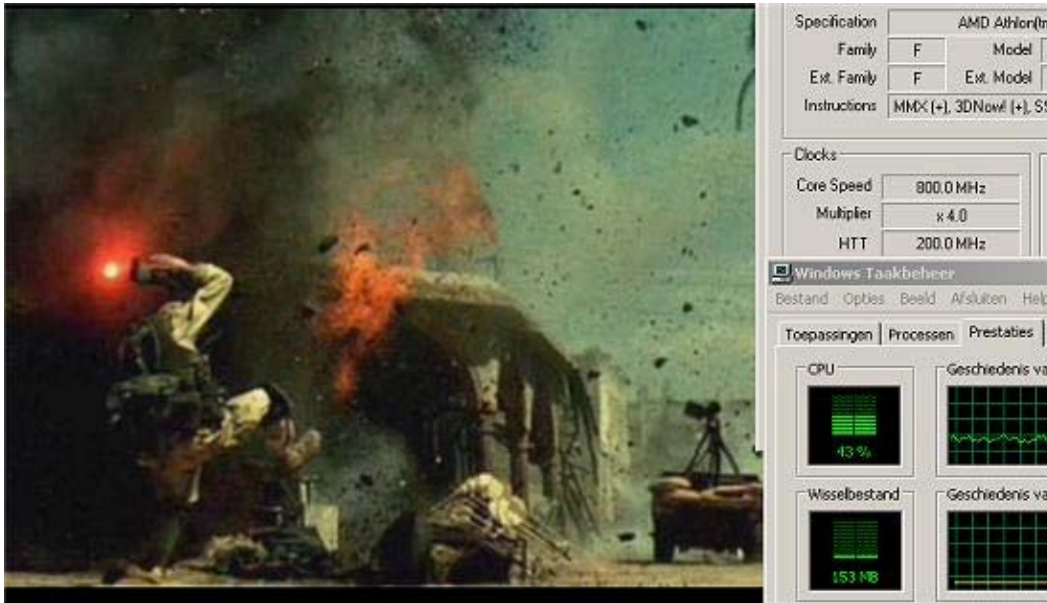
Below you can see the special AMD CPU driver for the Athlon 64. If Cool'n'Quiet works, Windows XP will run the CPU at 800 MHz as long as you do not perform a CPU intensive task. Loading a program causes the CPU to briefly throttle up to 2 GHz, running games, rendering, or media encoding will of course also bring the Athlon 64 3400+ to its maximum frequency.



I ran a few benchmarks with Cool 'n' Quiet enabled and it is safe to say that Cool 'n' Quiet does not lower the overall performance. Both Comanche, Halo, Cinebench and 3DSMax do not show any measurable performance loss. Most benchmarks were about 0.3 - 0.7% lower, well within the error of margin.



A nice example to illustrate how useful Cool 'n' Quiet is in running a DIVX movie on such a system. As you can see, even the beautiful blonde Dutch singer **Anouk** can't heat up the 800 MHz Athlon 64, as Windows XP indicates a 33% CPU load. Even more interesting is the fact that the MSI K8T Neo slowed the fan down to no rotation at all. In combination with the MSI FX 5700, which is equipped with a fan that has a noise level below 28 Db, I must say that AMD and MSI have succeeded in offering a very quiet and cool system. Needless to say, it's nice to watch a movie or listen to some music without the constant hum of the system in the background. Now I only have to search for a quiet DVD player, because the Pioneer 500M doesn't make a lot of noise, but it's definitely audible now that fans have shut up.



Even an intense scene from *Black Hawk Down* isn't enough to get the fans running. The CPU remains in its minimal (800 MHz) power state while the movie plays flawlessly at 43% CPU utilization.

Upgrade Question 2: Safe and Sound?

As the 3400+ is our only Athlon 64 sample right now, extreme thermal stress tests seemed a little dangerous. So I asked Damon Muzny, AMD PR, how firm AMD's believe is in the heatspreader and Thermtrip solution on the Athlon 64:

Ace's: How well does the heatspreader/Thermtrip work on the Athlon 64? Could a CPU survive when I forget to attach a heatsink?

Damon Muzny: The integrated thermal diode and circuitry was designed to prevent the CPU from being destroyed by thermal runaway, should the heatsink fail for some reason. AMD has already run each processor it sells through rigorous testing to make sure they meet specifications before they ship.

Based on this comment, I'd like to advise our readers to avoid investing in an Athlon XP platform. A poorly attached heatsink or similar accident will no longer result in the loss of your CPU, as AMD guarantees that the Athlon 64 can survive a heatsink failure.

Upgrade Question 3: Future Proof?

With rumors about AMD's roadmap popping out of the ground like mushrooms, it is no wonder that people are confused about whether or not a platform will be upgradable or not. The past history shows us that upgrading is always very limited, especially if you buy a top of line CPU. Even if the socket doesn't change, new CPUs require better voltage regulators, higher TDP currents, faster chipsets (higher FSB), higher speed memory, and more.

To optimize your upgrade path, you have to buy the most modern available motherboard and combine with an older CPU that is affordable yet also sufficiently powerful. If you bought a 2.4 GHz "C" (800 MHz FSB) Pentium 4 together with a decent i865/875p, you will - very likely (unless the voltage regulators are of mediocre quality) - be able to upgrade to a 3.6 GHz Prescott. But most of the time, upgrading a motherboard to a faster CPU is not easy. Still, the people who buy an Athlon 64 3000+ now, will probably want to know if they will be able to upgrade it later. So we asked Damon Muzny again:

Ace's: How much future does the current Athlon 64 have? Will the current AMD recommended boards also support the 90 nm versions? In other words, will people be able to upgrade beyond 3700+ (2.4 GHz)?

Damon Muzny: While we don't comment on unreleased products, you can be sure that the Athlon 64 line of processors -- having just launched -- has a good life ahead.

I can't get into all the revisions to come or motherboards or such. AMD recognizes that customers liked Socket A because it kept a stable footprint on motherboards.

We've learned from that. Also, this time around, we've speced for motherboards to have high tolerances, so that boards will be built with power handling that will enable future CPU support.

We all know that the early socket A mobos couldn't handle power requirements of say an Athlon XP 3200+, and that's partly because power specs changed with each CPU. PCI-Express is coming and we'll tie Socket 939 to that so folks have a good point to jump across if they want to update platforms.

Remember, even though we will introduce 939, we'll still have Athlon 64 processors coming out on 754 in parallel to 939s! our customers will have a choice to upgrade boards or not. Again, I can't tell you the exact number of processors coming to upgrade socket 754 with, but notice that we recently introduced 3 new speeds for Duron because our customers still asked for it. As a baseline there will be Athlon 64s on 754-pin at least through 2004, but ultimately our decisions for Athlon 64 on 754 will be based on what our customers want.

Ace's: Will the new generation of 90nm Athlon 64 CPUs get clock throttling?

Damon Muzny: All our Athlon 64 processors are "Cool'n'Quiet" enabled, a technology similar to PowerNow! that you're familiar with. Rather than choke off performance just when you need it (under a heavy CPU load)... Athlon 64 processors with Cool'n'Quiet (when paired with a C'n'Q-enabled motherboard) let the CPU run at lower frequency and voltage when not under heavy load. Then, when computation demands increase, C'n'Q raises voltage and frequency to get the job done. Don't fall for the FUD of "what if your CPU gets too hot." AMD processors when used with an approved heatsink are tested and rated to run at full frequency all day long. And if the heatsink should fail, AMD64 processors still have their own internal thermal safety mechanism to shut down and prevent thermal run away.

As for any new specs or changes or features specific to the 90nm parts, we haven't released specifications on those chips yet, but it's fair to expect a straight-forward die shrink.

I tried to interpret these comments as well as possible. Essentially, Socket 754 should be quite easy to upgrade: AMD requires motherboard makers to assume that they have to support a CPU that consumes up to 89 Watts, which is much more than the current Athlon 64 CPUs require. Faster FSB speeds are no longer a problem either, as each memory controller is part of the CPU itself. "A straight-forward die shrink" indicates that there should be no problem with upgrading to a faster 90 nm Athlon 64 with current motherboards. We are also hearing from other, reliable industry sources that there should be no difficulty in upgrading a current socket 754 Athlon 64 to a 90 nm Athlon 64.

Ultimately, however, it is still possible that the **fastest** 90 nm CPUs require even higher currents than what the current socket 754 boards can provide. Yes, DDR2 will appear in the market in the second half of this year. But the memory industry moves rather slowly, and DDR400 will remain the most important type of memory for quite some time.

With the information we have today, we think it is safe to say that Socket 754 should have decent upgrade potential, much better than Socket 940, socket 423, and other transitional sockets.

Benchmarked Configurations

Our test platform is similar to that of **our first Athlon 64 review**, with the exception of BIOS revisions and drivers. The 53.03 drivers were used for our GeForce FX 5900 Ultra (256 MB) video card and NVIDIA's nForce 3.13 driver was used for the ASUS SK8N motherboard. For the MSI K8T Neo, we used the VIA Hyperion 4-in-1 4.51 drivers. All motherboards were flashed with the latest BIOSes. All systems used 400 MHz DDR SDRAM (CAS 2, 2-3-3-7), except the Athlon 64 FX-51, which used 400 MHz CAS 2.5 Registered memory.

I'd also like to thank Johan Verhoeven from **Stein Belgium** for letting use the Stein Astra, one of the first Athlon 64 based PCs in Europe, as our test platform for the Athlon 64 CPUs.



The Stein Astra differentiates itself from the typical DIY PC by being a very quiet and completely screw free PC. No screwdriver is required to remove hard disks, DVD-ROM drives, PCI or AGP cards.

Athlon 64 3200+, 3400+

- MSI K8T Neo, VIA K8T800 (bios version 1.1)
- 2x512 MB Corsair PC3200 XMS (DDR-SDRAM) running at 400 MHz CAS 2 (2-3-3-7)
- VIA Hyperion 4.51

Athlon 64 FX-51

- Asus SK8N rev. 1.03, NVIDIA nForce3 150 chipset (bios version 1.04)
- Legacy PC3200 Registered (2x512MB) CAS2.5, 1GB total Memory
- Nforce 3.13 driver

Athlon XP 2100+ and 3200+

- ASUS A7N-8X Nforce 2
- 2x512 MB Corsair PC3200 XMS (DDR-SDRAM) running at 400 MHz CAS 2 (2-3-3-7)
- Nforce 3.13 driver

Pentium 4 3.2 GHz C (Hyperthreading enabled) - 800 MHz FSB

- AOPEN AX4C-MAX, BIOS 1.10, i875P "Canterwood" Chipset Dual DDR400
- 2x512 MB Corsair PC3200 XMS (DDR-SDRAM) running at 400 MHz CAS 2 (2-3-3-7)
- Intel chipset INF update 5.09.1012

Shared Components

- Abit Geforce Ti 4200 64 MB
- Leadtek Geforce FX5900 Ultra 256 MB
- AC '97 Sound (integrated on all boards)
- Maxtor 80 GB DiamondMax 740X (7200 rpm, ATA-100/133)

Software

- NVIDIA 53.03 Forceware- Drivers (Video Card)
- Windows XP Service Pack 1A
- DirectX 9b

We'd like to thank the following helpful people for their support and important contributions to this review:

- Damon Muzny (**AMD**)
- Kristof Semhke, Matty Bakkeren and Markus Weingarter (**Intel**)
- Marga Zanders, Ilona van Poppel and Angelique Berden (**MSI**)
- Sandra Kuo (**Aopen**)
- Robert Pearce (**Corsair**)

Now to our next upgrade question...

Upgrade Question 4: How much extra CPU performance?

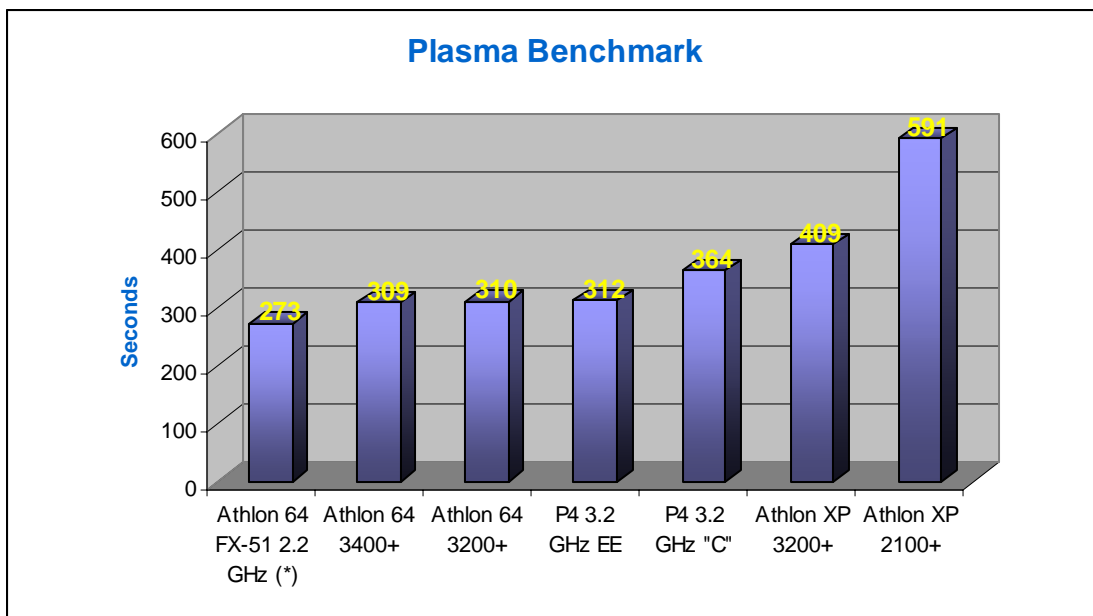
I have listed a few of our most CPU intensive benchmarks to give you an idea how much extra CPU power you get when upgrading from an Athlon XP 2100+ to one of the latest CPUs, whether it is one of the best Pentium 4s or the Athlon 64 3400+. Our main focus, however, is gaming performance.

Plasma Benchmark

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

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.

Basically, performance of this scientific simulation depends heavily upon memory latency, a little on memory bandwidth, and FPU power.

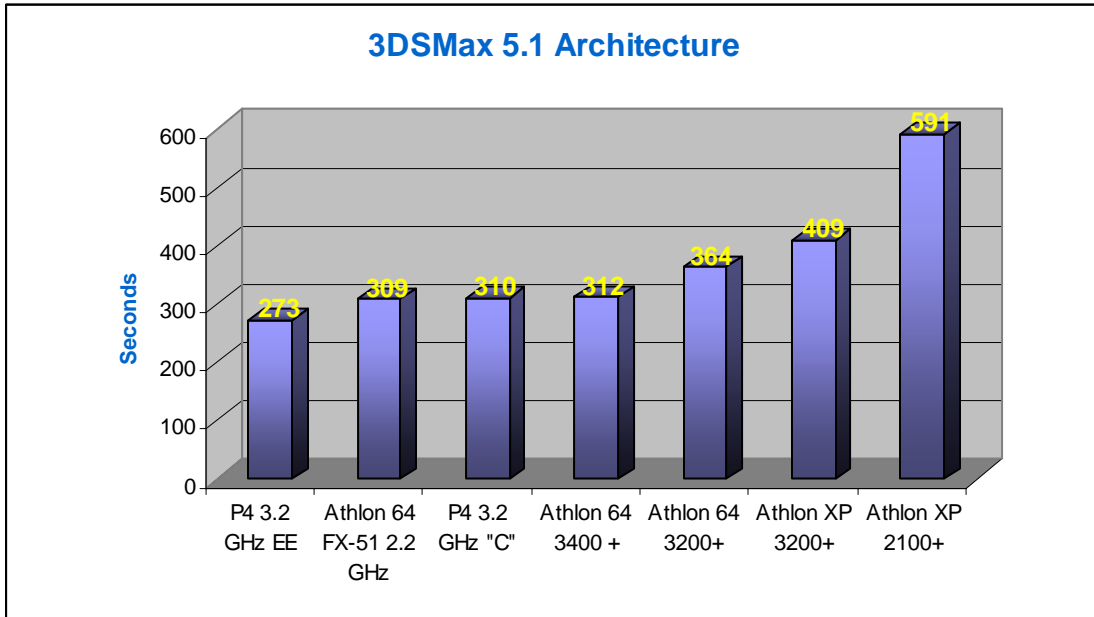


(*) P4 optimized binary

Huge matrix multiplications result in a benchmark that makes clear that the Athlon 64 is a whole generation better than the older Athlon XP with a 266 MHz FSB. With a 15% higher clockspeed, the Athlon 64 3200+ is able to cut the time of the Athlon XP 2100+ in half. The extra bandwidth of the second 64-bit channel makes the Athlon FX-51 almost 20% faster than the Athlon 64 3400+, clock for clock.

3D Studio Max

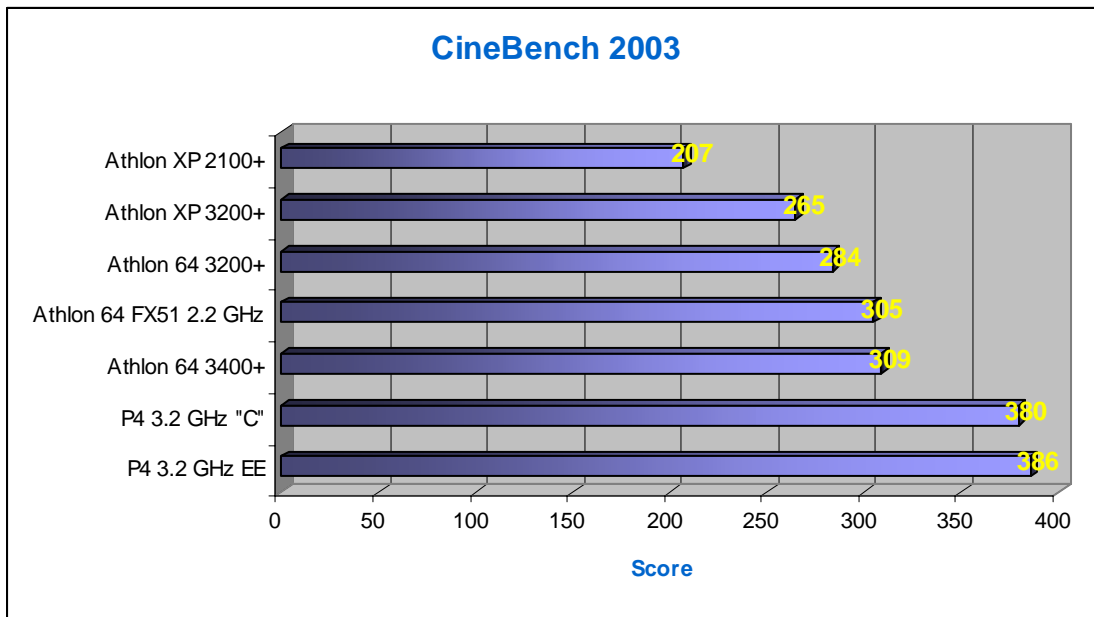
Our first test is a 3DSMax rendering test. We tested the Architecture scene from the SPECapc 3DS MAX R4.2 benchmark. This test has a moving camera that shows a complicated building - a virtual tour of a scale model. This complex scene has no less than 600,000 polygons and 7 lights. It runs with raytracing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



There is almost no difference between the Athlon FX-51 and the Athlon 64 3400+. More interesting is the fact that upgrading to the Athlon 64 pays off for our Athlon XP owner: he gets a CPU capable of rendering the same scene in nearly half the time of his old one.

Cinema4D: Cinebench 2003 (MP)

Derived from Maxon's Cinema4D modeling and rendering package comes the Cinebench 2003 benchmark. Cinebench is multithreaded and is therefore able to take advantage of Hyperthreading on the Pentium 4.



As you know this benchmark performs best on a Pentium 4. The speed gain (50%) from upgrading the Athlon XP to the Athlon 64 is not as spectacular as in the two previous benchmarks, but still better than the PR ratings would indicate.

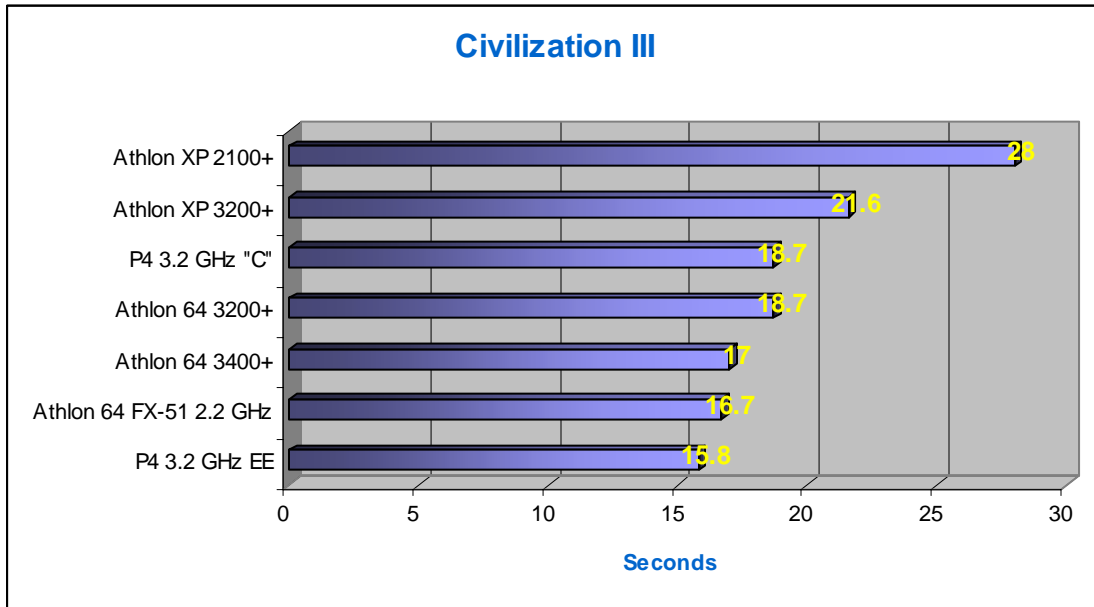
Introduction to Gaming Benchmarks

The following benchmarks are known to be mostly CPU limited, with the exception of Battlefield 1942. The latter benchmark is too imprecise to perform a lot of tests with. We have to restart the game several times to make sure we are in the same position again, and it takes a lot of time to benchmark. Therefore we also limit ourselves to benchmarks with the same video card (GeForce FX 5900 Ultra).

Civilization III v1.29F

Civilization is a classic, a legendary game. We noticed that in many situations the AI of the computer opponents thinks quite long between each turn. As you can see below this thinking time can be up to 23 seconds on fast CPU, so you can imagine that this can seriously impact the gaming experience when you are playing hundreds of turns.

"Fuego" sent us a rather large and complex CIV III map. We made sure that no movements were shown after pushing the "next turn" button, i.e. only AI time is recorded, not the animation of moving units. The screen stays where it was. we tested the time the hourglass was shown, i.e. the time that the game is not responsive. this proved to be very consistent as long as we restarted the game each time we benched.

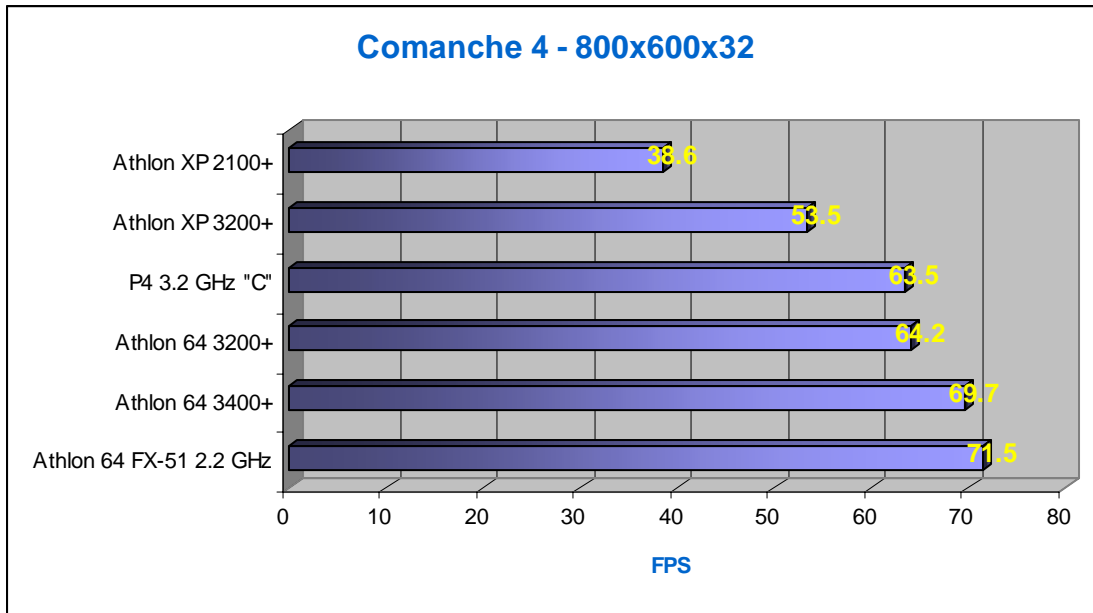


In civilization, the video card didn't play any role of importance, so we have incorporated **our Pentium 4 EE results** from our **Athlon 64 FX vs Pentium 4 EE review**. The Athlon 64 3400+ is 65% faster than our Athlon XP system, and keeps up with the best of the pack. Only the huge L3-cache of the P4 EE can keep the Athlon 64 3400+ from the top spot.

Also, please note that these numbers are invaluable for every turn based strategy player. If your girlfriend/wife doesn't agree with your newest CPU upgrade, you can convince her by telling that you will spend 65% less time behind the monitor when playing Civ III and other turn-based games!

Comanche 4

Few people still play Comanche, but the military helicopter simulator, is one of the easiest and most consistent benchmarks. We keep it in our testbed to make comparisons with older reviews possible.



The new 53.03 driver improves the scores quite a bit compared to previous 4x.xx drivers. The Athlon 64 3200+ (from 61.5 to 64.2) jumps over the 3.2 GHz Pentium 4 (from 61.8 to 63.5), which might indicate that the Athlon 64 benefits a tiny bit more from the new drivers.

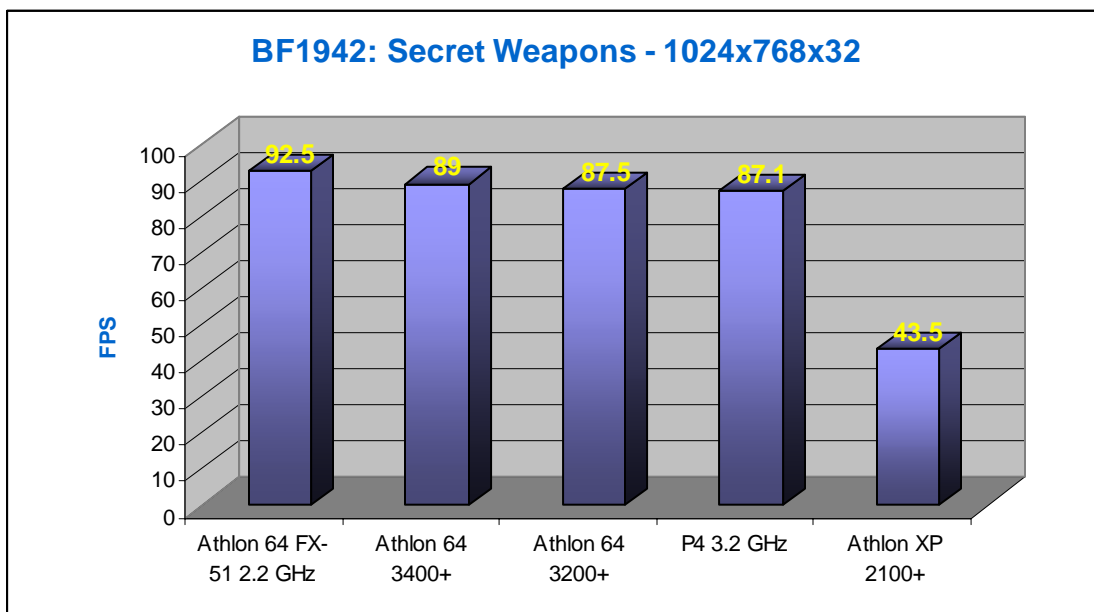
The 3400+ is pretty good investment, boosting our framerates by 80%.

Battlefield 1942 - Secret Weapons

Our Battlefield 1942 benchmark has been upgraded from version 1.03 to 1.45, the upgrade that comes with the add-on "Secret Weapons." Our new test scene is "Eagle's nest," which shows a few SturmTigers rumbling down the snowy hills. AI takes up at default 20% of the CPU power, and we raised it manually to its maximum of 25%. You can find **the other settings and more benchmarks here**.



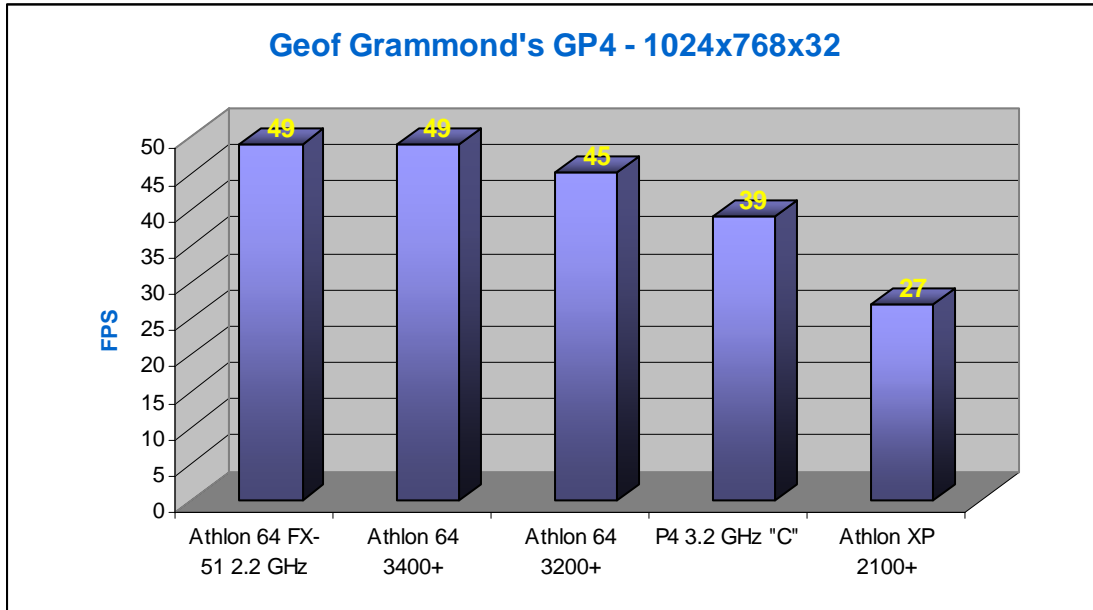
Shadows are calculated by the videocard, and if a DirectX 8 compliant videocard is available, it takes over the calculations of Hardware skinning on animated meshes, what makes the soldiers look more life like. We repeated our benchmarking with FRAPS several times to make sure we get a decent result. Unfortunately this benchmark requires many trials before it becomes somewhat consistent. Be careful with this benchmark, because we still do not get very accurate numbers. The error margin between repeated tests is rather high (5%).



The upgrade from our Athlon XP 2100+ to the Athlon 64 is pretty spectacular: performance is more than two times better!

Simulator: Grand Prix 4

We finish with one of the more popular Formula one simulators, Grand Prix 4. This engine is a typical directX 7 engine, which takes advantage of hardware transform and lighting, environment mapping (cars, reflections in wet surfaces) and bump mapping (heat haze from engine heat). We used the built in benchmark of Grand Prix 4 which is rather "coarse grained" as it can only report whole numbers.

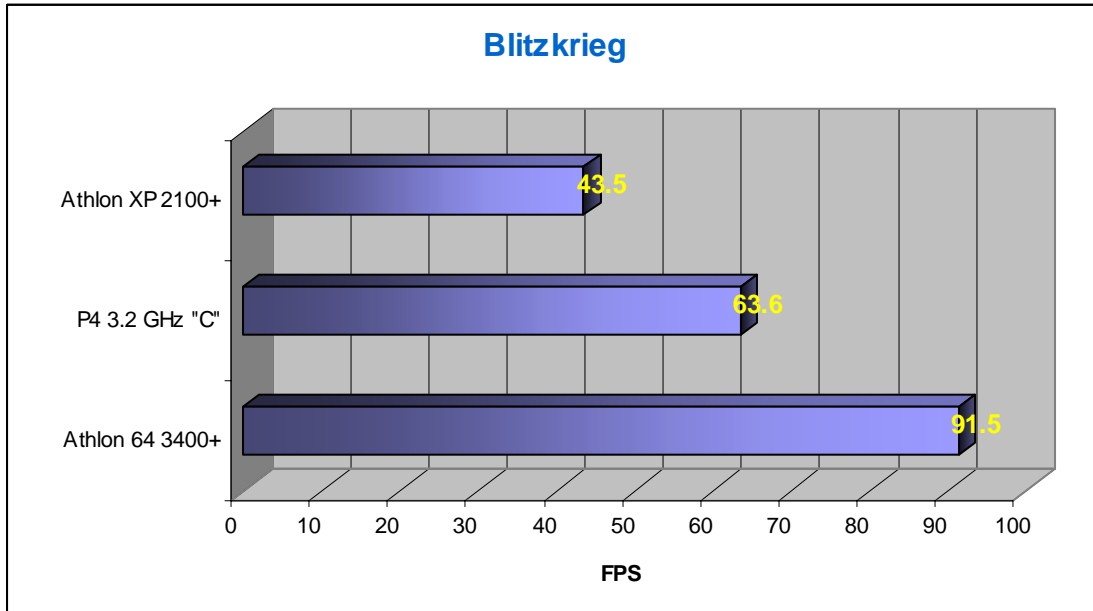


81.5% better performance, nothing to sneeze at!

Blitzkrieg

Blitzkrieg is not another C&C or Age of Empires clone – there is no micromanagement or building involved, which makes for a refreshing change in the RTS genre. No longer is a superior tactical mind useless against mouse moving athletes which simply build a lot units and sweep you off the map by the power of sheer overwhelming force. To cut a long story short, I really like this game. So we did a very short benchmark session with an intensive battle which involves both artillery, planes, tanks, and infantry. All quality settings were set to the maximum.





We have repeated the test a dozen times on both machines but the numbers have remained the same. In Blitzkrieg, the Athlon 64 behaves like the Tiger tank against the early allied tanks: it simply blows the competition away. Even more interesting is the fact that once again, the Athlon 64 platform more than doubles the performance of our old "to be upgraded" system.

Upgrade Question 5: CAS 3 versus CAS 2

The best CAS 2 DDR400 still carries a premium over cheaper CAS 3 and CAS 2.5 DDR400. To give you an idea how well an investment in more expensive RAMs pays off, we decided to do a few test with CAS 2 and CAS 3 memory. It is important to remember that the CAS latency impacts each initial memory access, while RAS and precharge latencies come into play less frequently. Therefore CAS latency is easily twice as important as the other two combined.

Gaming Benchmark	CAS 3	CAS 2	Speed up
Enemy Territory	132.6	135.2	2% faster
Enemy Territory	80.3	81.7	1.7% faster
Comanche	69	69.7	1% faster
Halo	48.9	50.93	4.2% faster
X ²	75.2	76	1.1% slower

The performance differences between CAS 3 and CAS 2 are fairly small with the exception of Halo. It is safe to say that the differences between rather expensive CAS 2 and the very popular CAS 2.5 DIMMs are almost insignificant. High speed memory is therefore most interesting to overclockers, who need to make sure that the DIMMs are not the reason why they are not able to overclock to higher motherboard/FSB speeds. If you are not interested in overclocking, decent CAS 2.5 memory will allow you to save some money.

Upgrade Question 6: Video Card Upgrade versus CPU Upgrade

In the next 3 game benchmarks we will investigate whether or not a video card upgrade may be more interesting than a CPU upgrade. We tried to choose our benchmarks as carefully as possible and opted for X², Enemy Territory and Halo. Halo makes use of 2.0 shaders, which shift a lot of work from the CPU to the video card. Enemy territory is still based on the good old Quake 3 engine, but being a fast paced online shooter that can be downloaded for free, it is immensely popular. X² is a state of the art DirectX 8 game. All 3 games offer very accurate benchmarks, which should make our conclusions more precise.

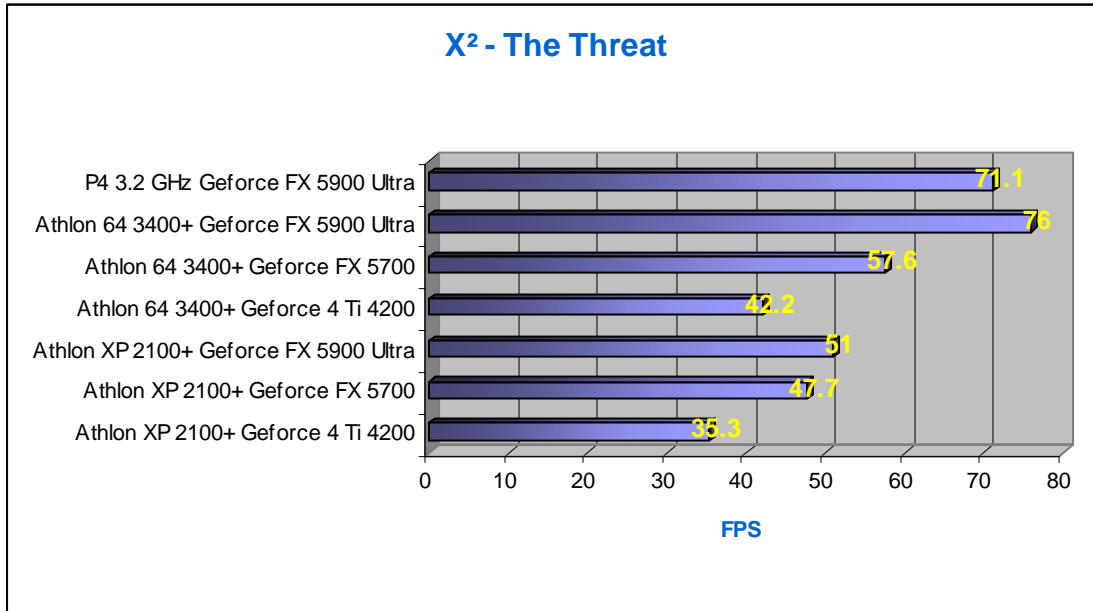
X² - The Threat

X² is beautiful Space Simulator. X² features:

"... a completely rewritten 3D engine based on DirectX8 encompasses many visual effects such as volumetric Nebulae (gas clouds) that have a real impact in the game (you can hide in them), many new engine, shield, weapon and explosion effects. Objects cast real dynamic 3D shadows! Dynamic DP3 bump mapping allows a previously unseen level of detail."

All of this and a built-in benchmark tool. You can **download it here**. To compare your results with ours, simply enable "shadows" and "run as benchmark" before you start the demo.





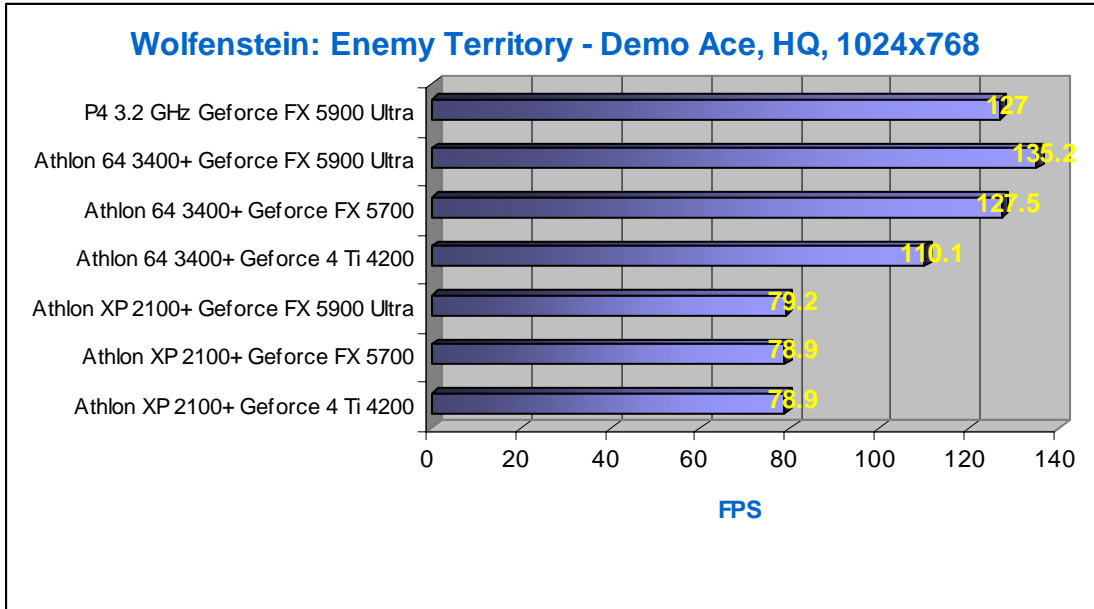
You might wonder why we still insist on running at 1024x768 when we are testing with monster graphic cards like the Geforce FX 5900 Ultra. Well, at 1600x1200, framerates went as low as 20 fps and the average rate tumbled down from 76 to 47 fps. Below you will find a small summary. The first two lines show the speed up when we upgrade our Athlon XP system with a video card. The third line shows what happens if we only upgrade the CPU. The last line shows the effect of upgrading both motherboard, CPU and videocard.

Upgrade operation	Speed up
Geforce Ti 4200 to Geforce FX 5700	35% faster
Geforce Ti 4200 to Geforce FX 5900 Ultra	44% faster
Athlon XP 2100+ to Athlon 64 3400+ (Geforce Ti 4200)	20% faster
Complete upgrade	115% faster

Still, X² is mostly a video card limited game, and a simple upgrade to a Geforce FX 5700 should make X² pretty playable on our older Athlon XP machine.

Wolfenstein: Enemy Territory

Veteran Ace's hardware contributor and reader Uffe "Hawski" Merrild, contacted me with two very interesting Enemy Territory benchmarks. Wolfenstein: EE is an incredibly popular multiplayer online FPS that is a lot of fun to play as assault trooper, engineer or medic.



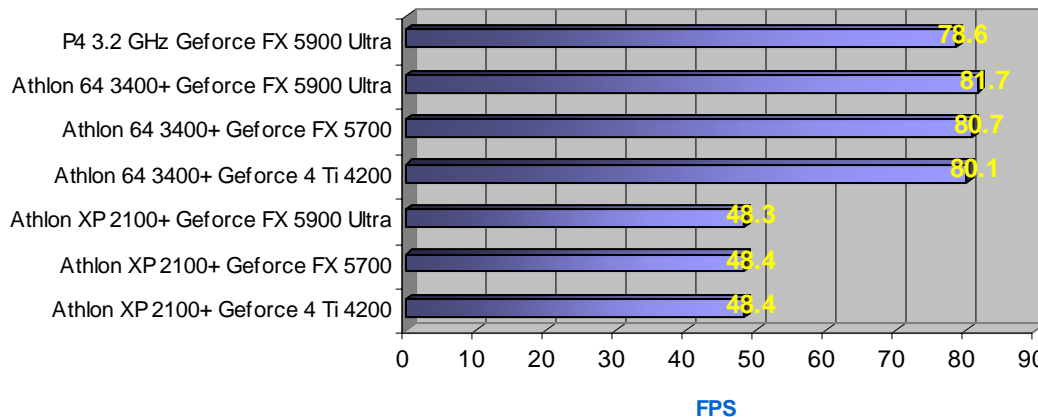
Although the video card does play a minor role when the Athlon 64 3400+ tries to push the framerate beyond 130 fps, it is clear that this is a CPU limited game. No upgrade is necessary, as our Athlon XP 2100+ is more than powerful enough.

Upgrade Operation	Speed Up
Geforce Ti 4200 to Geforce FX 5700	0% faster
Geforce Ti 4200 to Geforce FX 5900 Ultra	0% faster
Athlon XP 2100+ to Athlon 64 3400+ (Geforce Ti 4200)	40% faster
Complete upgrade	71% faster

The first demo does not contain massive movement of troops and explosions, and when we are testing CPU performance, we want a worst-case scenario. Meet the "AceHawski" demo, where the allies take on the Germans in icy Scandanavia.



**Wolfenstein: Enemy Territory - Demo Ace Hawski, HQ,
1024x768x32**



Our second "Ace Hawski" demo brings back memories of the "crusher" demo. A GeForce 4 Ti 4200 will do, but the Athlon XP 2100+ machine is becoming less comfortable. This illustrates how massive multiplayer online games will probably always need rather powerful CPUs: once you have a considerable number of people running and shouting all over the place, the video card still has the same amount of pixels to fill, but the CPU needs to keep track of all the enemies and allies.

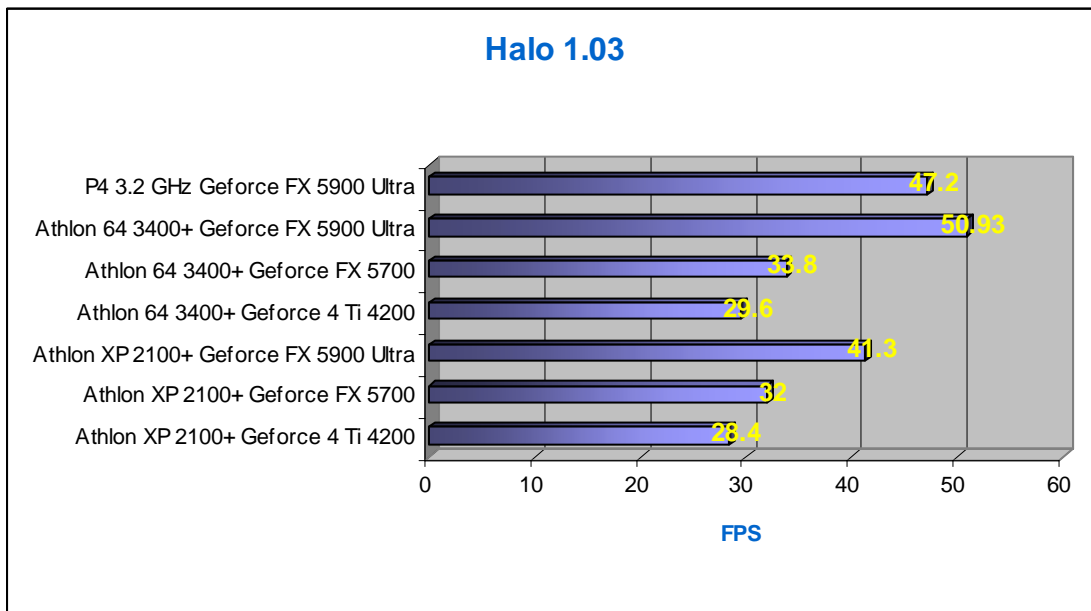
Upgrade Operation	Speed Up
Geforce Ti 4200 to Geforce FX 5700	0% faster
Geforce Ti 4200 to Geforce FX 5900 Ultra	0% faster
Athlon XP 2100+ to Athlon 64 3400+ (Geforce Ti 4200)	65% faster
Complete upgrade	69% faster

Halo 1.03

Ported from Microsoft's Xbox console, Halo serves up some astonishing effects and really beautiful surroundings, but performs really sluggishly on anything less than a top PC.



Halo supports the latest version 2.0 pixel shaders specification of DirectX 9 and enters the very elite club of games that utilizing DirectX 9 at this point in time.



Even on our best machines, we have to cope with framerates that are below 20 FPS. This is even more amazing when you consider that Halo makes use of partial-precision hints, which allow the GeForce FX cards to use 16-bit floating point operations. You might remember from the Half-Life 2 benchmarks that the GeForce FX line performs rather poorly when it has use the standard DirectX 9 24-bit floating point operations.

Upgrade operation	Speed up
Geforce Ti 4200 to Geforce FX 5700	13% faster
Geforce Ti 4200 to Geforce FX 5900 Ultra	45% faster
Athlon XP 2100+ to Athlon 64 3400+ (Geforce Ti 4200)	4% faster
Complete upgrade	79% faster

Good news for the Athlon XP owners: a simple videocard upgrade should be enough to play Halo. It won't be superb but should be bearable.

Conclusion

To make sure our conclusion is based on solid numbers, you can find a summary of most of our benchmarks below. Please note that the "Athlon 64 3400+ versus XP 2100+" is different from our "CPU upgrade" results. Our goal there was to measure how much a motherboard and CPU upgrade would bring for the user of an older Athlon XP system. In the table below we are comparing the CPU power both the Athlon 64 and Athlon XP bring to the table, without being limited by a slower videocard.

Gaming Benchmark	Athlon 64 3400+ versus Athlon XP 2100+ Geforce FX 5900 Ultra	Athlon 64 3400+ versus Pentium 4 3.2 GHz Geforce FX 5900 Ultra
Blitzkrieg	110% faster	44% faster
Battlefield 1942 1.45	105% faster	7% faster
Comanche	80% faster	10% faster
Civilization III	65% faster	10% faster
Enemy Territory	70% faster	4% faster
Halo	23% faster	8% faster
Grand Prix 4	81% faster	26% faster
X ²	40% faster	7% faster
Application benchmark	Upgrade result (Athlon 64 3400+ versus Athlon XP 2100+) Geforce FX 5900 Ultra	Athlon 64 3400+ versus Pentium 4 3.2 GHz Geforce FX 5900 Ultra
3DS Max	91% faster	Equal
Cinebench	49% faster	19% slower
Plasma	105% faster	18% faster

With the exception of Halo and X², most of the benchmarked software shows speedups from 80 to 110%. The 2.2 GHz Athlon 64 3400+ is a lot faster than the 1.73 GHz Athlon XP, much more than both the PR rating and the clockspeeds numbers indicate.

The Athlon 64 platform offers much more than excellent performance figures:

- Cool'n'Quiet helps to minimize fan noise and power consumption, and not only when you are typing in Word or browsing the web. Watching DVDs and MPEG-4 encoded movies, listening to MP3 music, it can all happen cool and quiet
- You don't have to worry about a broken or a poorly attached heatsink killing your CPU
- With the information we have right now, Socket 754 owners should be able to upgrade to 90 nm Athlon 64 CPUs

Therefore there is little incentive to invest money in the cheaper but clearly inferior Athlon XP platform. Of course, the Pentium 4 still makes a good alternative, especially if you are into 3D rendering and media encoding. But we will investigate that alternative in more detail somewhere around February the second...

The decision to upgrade either your CPU or your video card depends upon your gaming profile. If you prefer first person shooters with the latest DirectX 9 eye candy, your videocard is definitely the first priority. If not, the Athlon 64 has proven to offer a lot of extra CPU power over our Athlon XP.