0.13µ Athlon XP: Your Next Upgrade?

By Johan De Gelas – June 2002

At last, AMD's 0.13µ Athlon XP, codenamed Thoroughbred, has finally arrived for the mass market. This new 0.13µ Athlon XP has a model rating of 2200+ and runs at 1.8 GHz. It has the same architecture as the 0.18µ Palomino, including the same 256 KB L2 cache and 133 MHz DDR front-side bus.

But while the Athlon is on a new manufacturing process, the Athlon XP 2200+ is clocked only 66 MHz above that of the older Athlon XP 2100+, meaning its chances of outperforming the 2.53 GHz Northwood Pentium 4 overall are rather slim at best. So, while we will be comparing the performance of the Thoroughbred Athlon XP to the Pentium 4, our primary focus will fall more along the lines of someone looking to upgrade an existing Socket A system with the latest Athlon XP. After all, an Athlon XP produced on a 0.13µ process will be smaller (80 mm^2) and should run cooler, while also being more overclockable. Furthermore, with no architectural changes or a new FSB frequency, the Thoroughbred should also make for an easy upgrade.

This is what we are going to find out today, and just like our previous upgrade article, we'll also consider another important upgrade possibility: a better video card. Our base system from which we'll upgrade will be a 1 GHz Athlon Thunderbird and a GeForce 2 Ti on a KT133A platform.

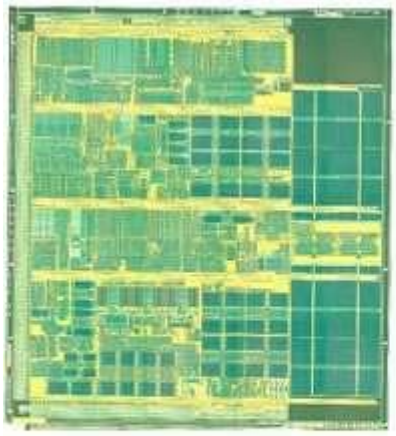
A 1.4 GHz Athlon Thunderbird is also included to give most of our readers a good idea of what return on investment they may expect from the Athlon XP 2200+. Back to the Athlon XP "Thoroughbred" 2200+. Will the new 130-nanometer process take the Athlon XP to new heights while still running cool? Let's take a look at the table below:

Processor Model	Frequency (MHz)	Nominal Voltage	Typical Thermal Power (130 nm "Thoroughbred")	Typical Thermal Power (180 nm- 1.75V- "Palomino")	Difference	Maximum Thermal Power (130 nm "Thoroughbred)"	Maximum Thermal Power (180 nm- 1.75V "Palomino")
1700+	**1467**	1.50V	44.9W	57.4 W	28%	49.4W	64.0 W
1800+	**1533**		46.3W	59.2 W	28%	51.0W	66.0 W
1900+	**1600**		47.7W	60.7 W	27%	52.5W	68.0 W
2000+	**1667**	1.60V	54.7W	62.5 W	14%	60.3W	70.0 W
2100+	**1733**		56.4W	64.3 W	14%	62.1W	72.0 W
2200+	**1800**	1.65V	61.7W	N/A	N/A	67.9W	N/A

While Intel's power dissipation numbers do not compare exactly to AMD's (they are very likely somewhat lower than the Pentium 4's real maximum power dissipation), it is clear that AMD has still a lot of work to do. **The 2.2 GHz Pentium 4** runs at a 400 MHz higher clockspeed, is quite a bit larger (131 mm² versus 80 mm²), and it dissipates 55W average, 70W peak. The reason behind the fact that the Athlon XP 2200+ is not running very cool is due to the high voltage that AMD suggests for its flagship CPU.

Our sources indicate that AMD's yields at 0.13µ are pretty good, but that the binsplits have a lot of room for improvement. While 1.5V is good enough to get the Thoroughbred up to 1600 MHz, higher clockspeeds are only attained with some kind of overclocking. Now this is hardly of a reason for panic, as it is even sort of a "tradition" for AMD. With far fewer resources for debugging and tuning, new process technology almost always experiences some teething problems. The highest speed grade (233 MHz) of the 0.35µ K6 needed 3.2V instead of 2.9V, and the first K6-2 batch ran at only 333 MHz, but achieved 450 MHz after some tweaking. At first, the 0.18µ Athlon K75 needed 1.8V to reach 1 GHz, while a few months later, the 1 GHz Athlon Thunderbird happily ran at 1.75V. The first Palominos were limited to 1200 MHz, but achieved 1733 MHz a few months ago. So, as you can see, there's a history here where it always takes a little time to get the most from a particular process/core.

To understand why it can be difficult to get high clockspeeds out of a new process from the start, you just need to take a look at the picture below.



AMD Athlon XP processor on the "Palomino" core

Process Size:	180nm
Die Size:	128mm²

AMD Athlon XP processor on the "Thoroughbred" core

Process Size:	130nm
Die Size:	80mm²

As you can see, the floor plan of the Athlon XP has fundamentally changed. A new floor plan and process technology can introduce new bugs even if there are no design errors at all. For now, we should give AMD the benefit of a doubt. It is rather likely that the "Palomino story" will repeat: pretty bad bin splits at first, but at the end, the architecture reaches higher clockspeeds than estimated. We hope, however, that AMD will be able to lower the voltage requirements. With a very silent GlobalWin TAK 58 (2 fans at 3000 rpm), Our Athlon XP 2200+ was 54 to 59 degrees Celsius, while the Athlon XP "Palomino" 2100+ was running at 61 to 63°C. That is a pretty small improvement.

Admittedly, the TAK 58 is no superb heatsink/fan combination, but many readers will appreciate a cooler CPU if it means it can be cooled with a silent fan.
Nevertheless, the very small die will make the Athlon XP a fierce competitor for the Celeron in the long run. Once Hammer hits the market, AMD will be able to offer the Athlon at very low prices. AMD will mostly push their long term plans to keep CPU sizes relatively small as a way to undercut Intel and to have large volumes with less manufacturing space - a strategy that has been relatively successful and that has kept AMD going for many years now.

Benchmarked Configurations

All systems were tested with NVIDIA's Detonator 28.32 drivers. The desktop was set at a resolution of 1024x768x32bpp with an 85 Hz refresh rate. V-sync was off at all times. Our testbed still runs Windows 2000 SP2, as most professionals and hardware enthusiasts prefer the mature Windows 2000 SP2.

We configured all systems with a CAS latency of 2.5, as most DDR333 (PC2700) available is CAS 2.5 memory. To make the comparison as fair as possible both the Athlon and the Pentium 4 were tested on platforms supporting DDR333.

Athlon KT133A Platform

- **AOPEN AK73 (A) (VIAKT133A) bios version 1.17**
- **512 MB of Corsair PC133 SDRAM CAS 2**

1 GHz, 1.4 GHz Athlon (Thunderbird), Athlon XP 2000+, 2100+ (Palomino), Athlon XP 2200+ (Thoroughbred)

- **Gigabyte GA-7VRX bios version F2**

2 GHz, 2.2 GHz, 2.26 GHz, 2.4 GHz, 2.53 GHz Pentium 4 (Northwood)

- **MSI 845G-MAX (i845G chipset) bios version 1.2**

Common Hardware

- **512 MB Corsair PC2700 XMS (DDR-SDRAM), CAS 2.5 at 333 MHz**
- **Seagate Barracuda ATA III ST320414A Model ST320414A (7200 rpm, ATA-100)**
- **ASUS GeForce Ti4400 128 MB**
- **Leadtek GeForce 2 Ti 200**
- **AT 2700 10/100 NIC**
- **Sound Blaster Live!**

Software

- **Via 4 in 1 Drivers 4.38**
- **Intel chipset inf update 4.09.1011**
- **Windows 2000 Service Pack 2**
- **DirectX 8.1**

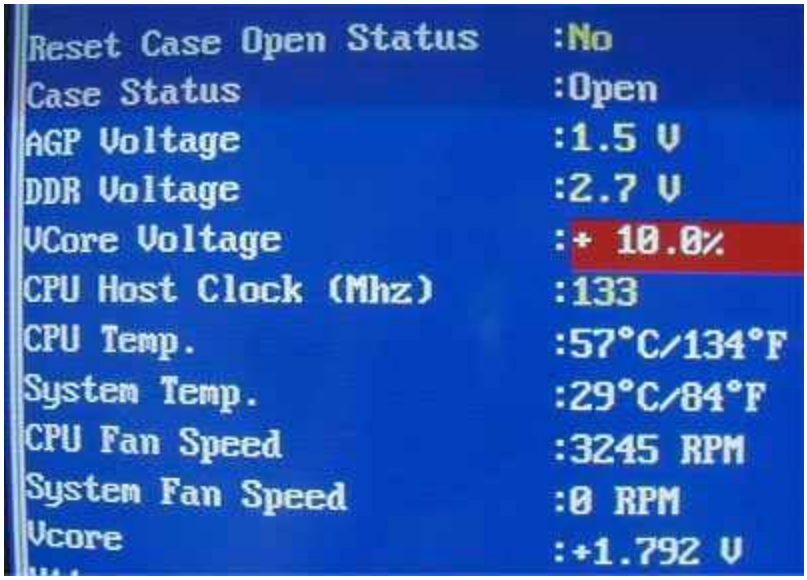
We'd like to thank the following helpful people for their support and important contributions to this review:

Damon Muzny (**AMD**) made sure we were able to test the Athlon XP 2200+ Thoroughbred.
Thanks to Augustine Chen, Carol Chang (**ASUS**) and Sharon Tan (**BAS computers Netherlands**) for the ASUS motherboards.
Angelique Berden and Saskia Verhappen of **MSI** provided us with the MSI 845 GMax
Jurgen Eymberts (**Intel**) and Marieke Leenhouts (**MCS**) made sure we could test the Pentium 4 2.0A GHz and 2.2 GHz.
Robert Pearce of **Corsair**, provided us with Corsair's **PC2700 XMS** and PC133 CAS2 SDRAM.

Overclocking the 0.13µ Athlon XP

I can imagine that one of the first questions in the minds of our readers is how well the new Athlon XP overclocks. As I have indicated in the introduction, the Athlon XP 2200+ is already somewhat overclocked as it is, with a core voltage of 1.65V instead of the 1.5V and 1.6V that its lower-clocked siblings use.

Gigabyte's KT333 motherboard has all the requisite features necessary for overclocking, as you can see below. The core voltage can be raised by 2.5% (1.68V), 5%, 7.5% and 10% (1.8V). We set the DDR SDRAM speed to DDR266 to make sure our Corsair PC2700 were not the bottleneck. We also tested with PC2700 from Mushkin and Samsung to convince ourselves that in no way the overclocking experiment was limited by the quality of the DRAMs.



Our first attempt was encouraging, as 1.68V allowed the 0.13µ Athlon XP to reach 1917 MHz (13.5x 143 MHz), a 7% overclock. Unfortunately, this initial feeling of success was replaced with one of dissapointment, as increasing the voltage to 1.78V hardly improved our overclocking experience. The Athlon XP froze completely at 1957 MHz (13.5 x 145 MHz). No problem, probably a heat issue as the core temperature of our Athlon XP was 61°C at this clockrate.

We used the large Taisol heatsink that AMD shipped with the Athlon XP, and installed a 6800 RPM Delta AFB-60HP fan on top of it. This thing makes more noise than an old Russian chopper, but for the sake of the experiment we coped with the deafening noise. We were now able to run at 1980 mHz, but we can not claim that the system was completely stable. Lowering the voltage to 1.7V gave us the same results, but the CPU ran rather cool: between 49-50°C.

This disappointing experience is not at all surprising, as the 1800 MHz Athlon XP already runs at a higher voltage. You might say that AMD already used part of the "voltage overclocking margin." Overall, our experience with the 0.13µ Athlon XP was slightly better than with the latest Palomino, which could not clock higher than 13 x 142 MHz (1846 MHz) without becoming unstable when using air cooling.

If you are a hardcore overclocker, we advise you to wait a little longer, as it is possible that in a few months the current "low binsplit problem" will have been resolved.

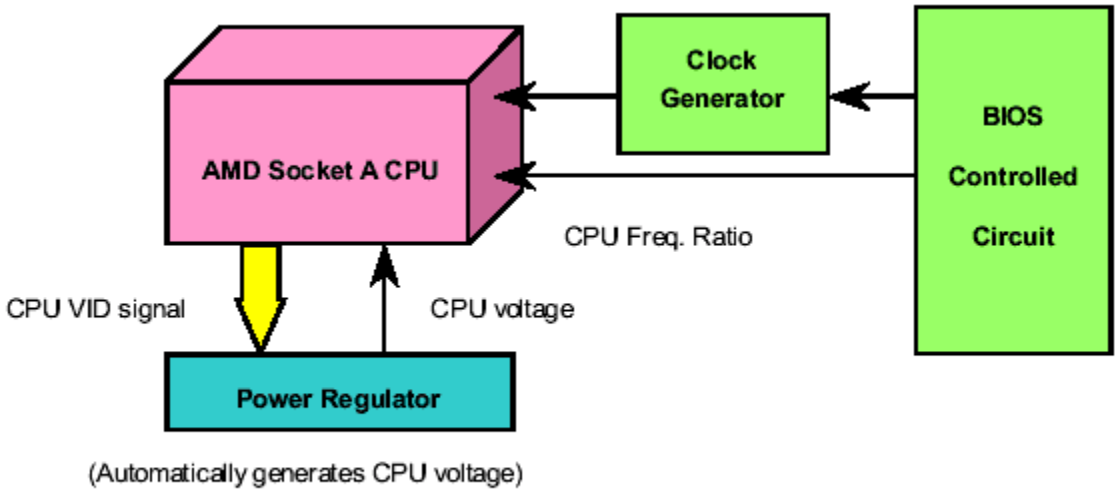
Upgrading to the 0.13µ Athlon XP

Anyway, a 1900 MHz Athlon XP might still be a very nice upgrade if you are stuck with an Athlon Thunderbird at 1 GHz. The following motherboards have been validated by AMD for the new Athlon XP:

- MSI KT3 Ultra (MS-6380E) v1.0 (KT333)
- Gigabyte GA-7VRXP (KT333)
- Gigabyte GA-7VTXH+ v1.00 (KT266A)
- Asus A7N266-C v1.04 (nForce415)
- Asus A7N266-E v1.03a (nForce420)
- MSI MS-6373 (nForce420)
- Biostar M7VIF v1.0 (KT333)

Notice that the ASUS A7N266 (nForce) series - which is one of the oldest boards of the list - is included. This is the motherboard that was our favorite in our **Socket A shootout**.

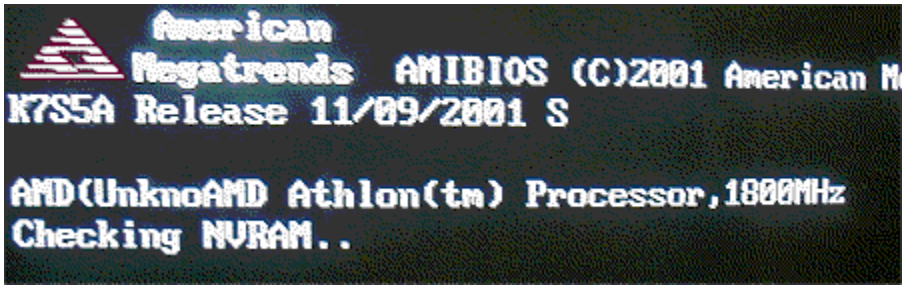
Nevertheless, it is pretty likely that your motherboard is not included in the list above, as most motherboards included are new KT333 boards. So, can you upgrade to the 0.13µ Athlon XP? Two problems could occur: the board does not support the right multiplier or the board does not support the proper voltage. The latter is unlikely, as illustrated by the scheme below (courtesy of AOPEN's manual). The Athlon XP CPU indicates which voltage it needs, so it shouldn't be difficult for the voltage regulator to provide a lower voltage.



The clock frequency should not be a problem either, as the BIOS and the clock generator drive the CPU. The real problem is, of course, that AMD locks the multiplier (i.e. the CPU only accepts one multiplier). It is a fact that most boards support a 13x and 14x multiplier, as an Athlon Thunderbird running at 1300 MHz (13x100 MHz) and 1400 (14x100 MHz) exist. The Athlon XP 2200+, however, needs a 13.5x multiplier and the result was that AOPEN AK73 (KT133A), MSI KT133A and MSI KT266 Pro motherboards could not make the CPU work. This is probably only a temporary problem of course, as a simple BIOS update can resolve these problems.

The ASUS A7V266 (KT266A) automatically booted the Athlon XP 2200+ with a 5.5x multiplier set in the CMOS, but the CPU actually ran at 1800 MHz (13.5x multiplier). The voltage was correctly set at 1.65V, but once we booted up in Windows 2000, the ASUS monitoring utility reported that the voltage was set to 1.75V. We are not sure whether this is misreported, but considering that the CPU ran pretty hot, we think it was probably running at 1.75V. Once again, no harm done, as a simple bios update can solve this problem.

The best surprise was the very inexpensive and extremely popular ECS K7S5A, based on the SIS735 chipset. Running with a slightly old BIOS, the board immediately set the multiplier to 13.5 and the voltage to 1.65V (1.632 reported).



The processor is reported to be unknown, but who cares, it works perfectly.

Kudos to ECS and SiS, as they did not limit themselves to the CPUs that were available upon the launch of this motherboard.

So, it is very likely that the 0.13µ Athlon XP works fine in your motherboard, just avoid the Athlon XP 2200+ with its "rare" 13.5x multiplier. If you wish to upgrade, we recommend you choose the 0.13µ Athlon XP 2100+ (or lower), which runs cooler (1.6V instead of 1.65V), and has a 13x multiplier, which is better supported by most motherboards. This way you avoid waiting for a BIOS update. Check the BIOS updates and manual to verify which multipliers are supported by your board.

0.13µ Athlon XP versus 0.13µ Pentium 4

The Pentium 4, now equipped with 512 KB of cache, a 533 MHz FSB, and a more attractive price tag, is a more fierce competitor than ever. As you can see in the table below, the 2.26 GHz Pentium 4 is especially attractive. The Athlon XP 2200+, however, is priced a good $40 less than the similarly rated/clocked 2.26 GHz Pentium 4. At lower speed grades, the difference is perhaps more significant, as the Willamette Pentium 4 CPUs, with their smaller caches and lower FSBs, are not as competitive in terms of performance.

AMD CPU	Official Price	Lowest Price Watch Price	Intel CPU	Lowest Price Watch Price
Athlon XP 2500	N/A	N/A	Pentium 4 2.53GHz	$533
Athlon XP 2400	N/A	N/A	Pentium 4 2.4 GHz (533 MHz FSB)	$383
Athlon XP 2200	$241	$220	Pentium 4 2.26 GHz (533 MHz FSB)	$262
Athlon XP 2100	$224	$177	Pentium 4 2.2 GHz (400 MHz FSB)	$228
Athlon XP 2000	$193	$141	Pentium 4 2.0 GHz (400 MHz FSB)	$185
Athlon XP 1800	$160	$ 90	Pentium 4 1.8 GHz (400 MHz FSB)	$161

Take the numbers above with a sack of salt if you are not living in the US. Typical Prices in Europe, Australia, and Asia tend to be up to 20-30% higher, which makes the absolute difference between the Athlon XP and the Pentium 4 more important. But contrary to the Athlon XP 1800+, which had to face an overpriced and much slower 2 GHz Willamette Pentium 4, the Athlon XP 2200+ must compete with a pretty dangerous opponent, the 2.26 GHz Northwood Pentium 4. Let's find out how they compare.

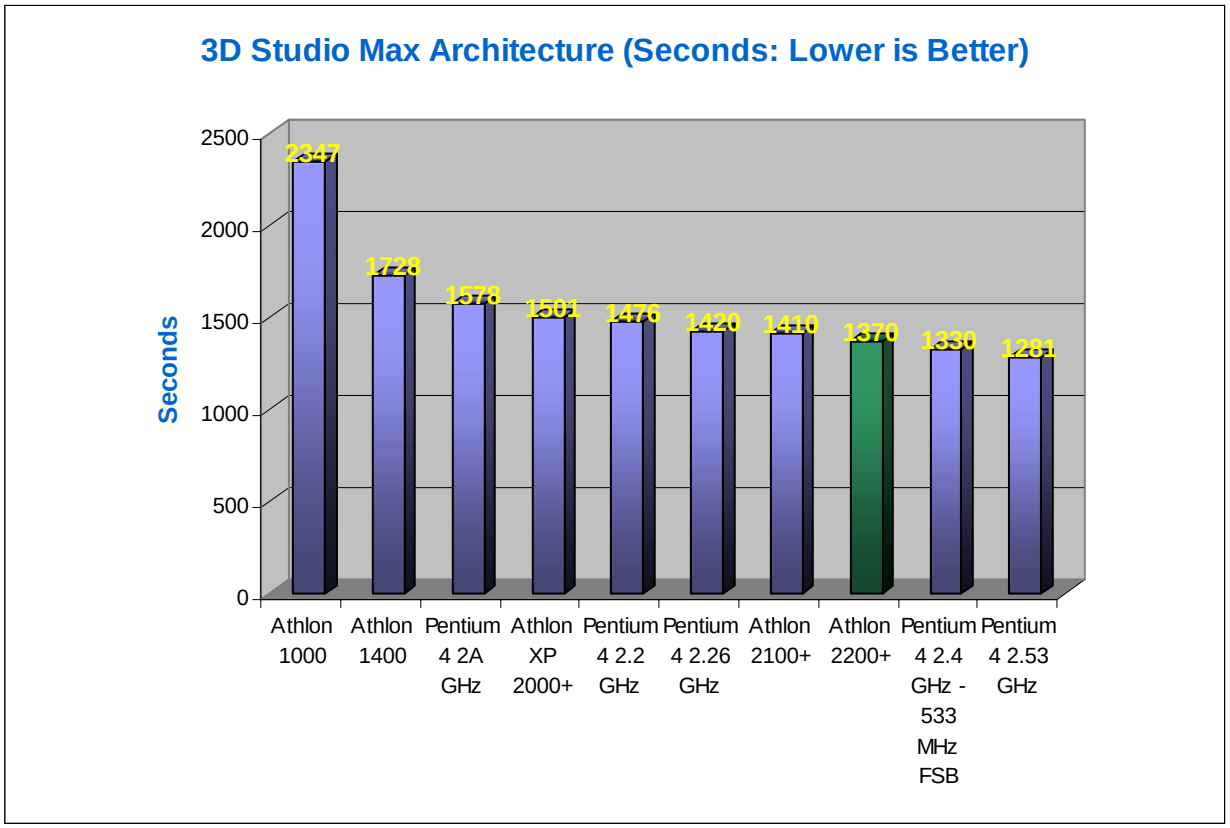
Many of our readers demand CPU power for two reasons: games and/or rendering. So, we have focused on these applications for the time being. Please rest assured that future reviews will feature a wider variety of different applications. Take a look at our previous article, **CPUs For Workstations and Small Business Servers** for an example.

In the following tests, the KT333 platform was used for the Athlon XP, and all systems used the Geforce4 Ti4400. We will study the influence of the different components (chipset, video card) further.

3D Studio Max

3D Studio Max is one of the most popular tool for game developers and probably the most wide spread 3D animation and rendering package in use today. Specifically, we have tested with the 4.2.6 version, which is optimized for the Pentium 4 and Pentium III, and should provide up to 30% better performance for Pentium 4 and Pentium III configurations.

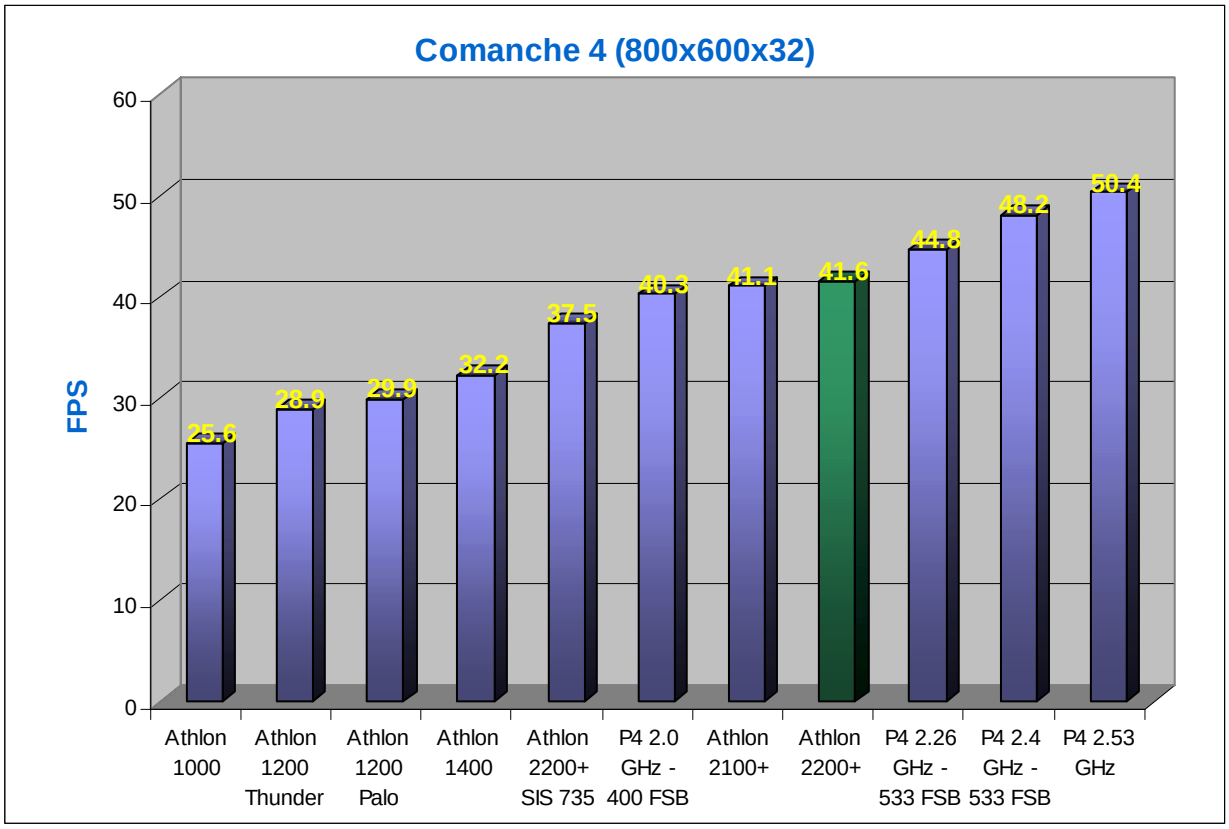
Our first test is the architecture scene from the SPECapc 3DS MAX R3.1 benchmark. This test has a moving camera that shows a complicated building, a virtual tour of a scale model. This complex scene has no less than 600,000 polygons and 7 lights. It runs with raytracing and fog enabled. Frames 20 to 22 were rendered at 500x300 to the virtual frame buffer (memory). The Athlon XP 2200+ result has been highlighted in green.



The Athlon XP outperforms its primary competitor the 2.26 GHz Northwood Pentium 4, and at $40 less and 50 seconds faster, it remains the top choice for creative people in search of an inexpensive workstation CPU. Those in search of top performance without as much consideration of price will look no further than the 2.53 GHz Pentium 4.

3D Gaming

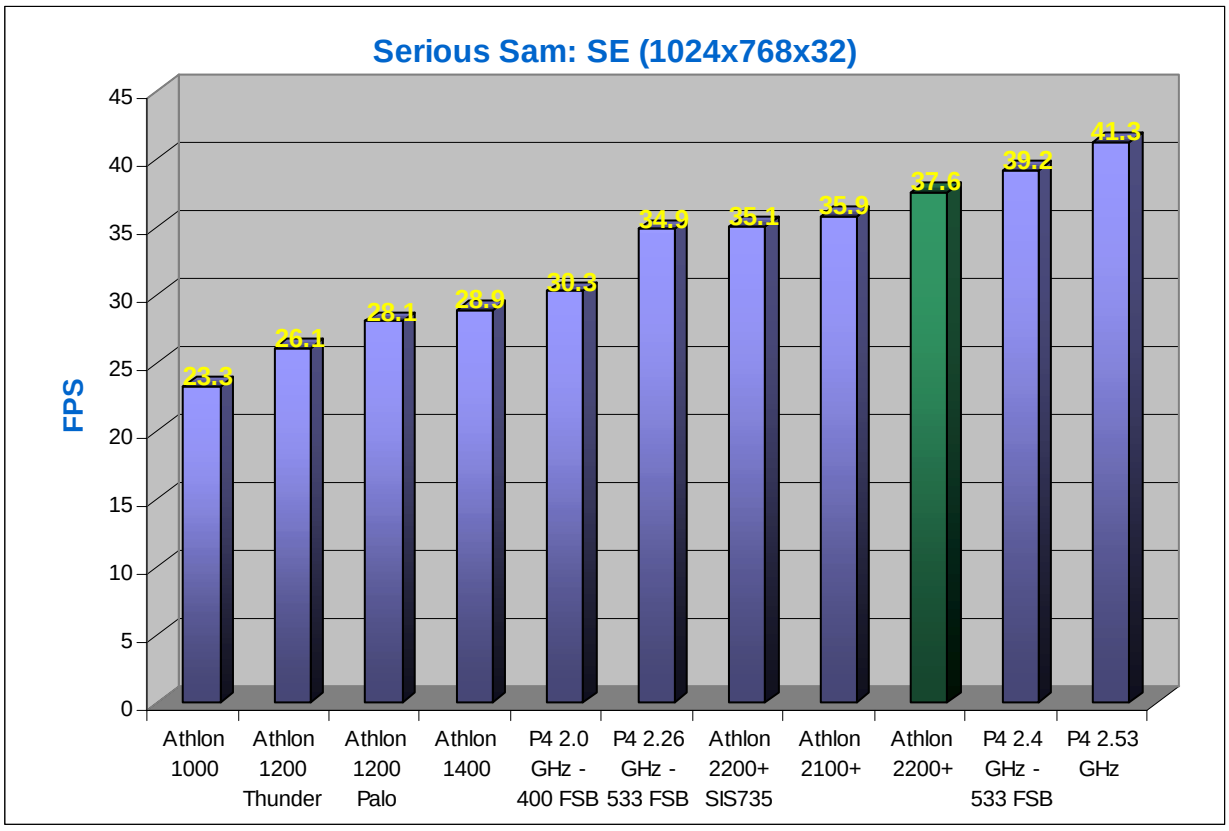
Our first 3D Gaming test is NovaLogic's DirectX 8.1 Comanche 4 flight sim. We've used the publicly available demo with all options set to high, along with sound and texture compression enabled.



Our loyal readers will recall **from previous reviews** that flight simulators are typically very CPU intensive. Comanche 4 is no exception, and it seems that NovaLogic has done some good optimization for the Pentium 4. Flight simulators use very complex physics simulations and are therefore FP intensive. It seems that Novalogic has incorporated SSE (-2?) code, because it is a home run for the Pentium 4 family. The 2.26 GHz Pentium 4 outperforms the newest Athlon XP by 7%, with the two chips essentially reversing the roles they took in 3D Studio Max, where the Athlon XP delivered higher performance.

Serious Sam: SE

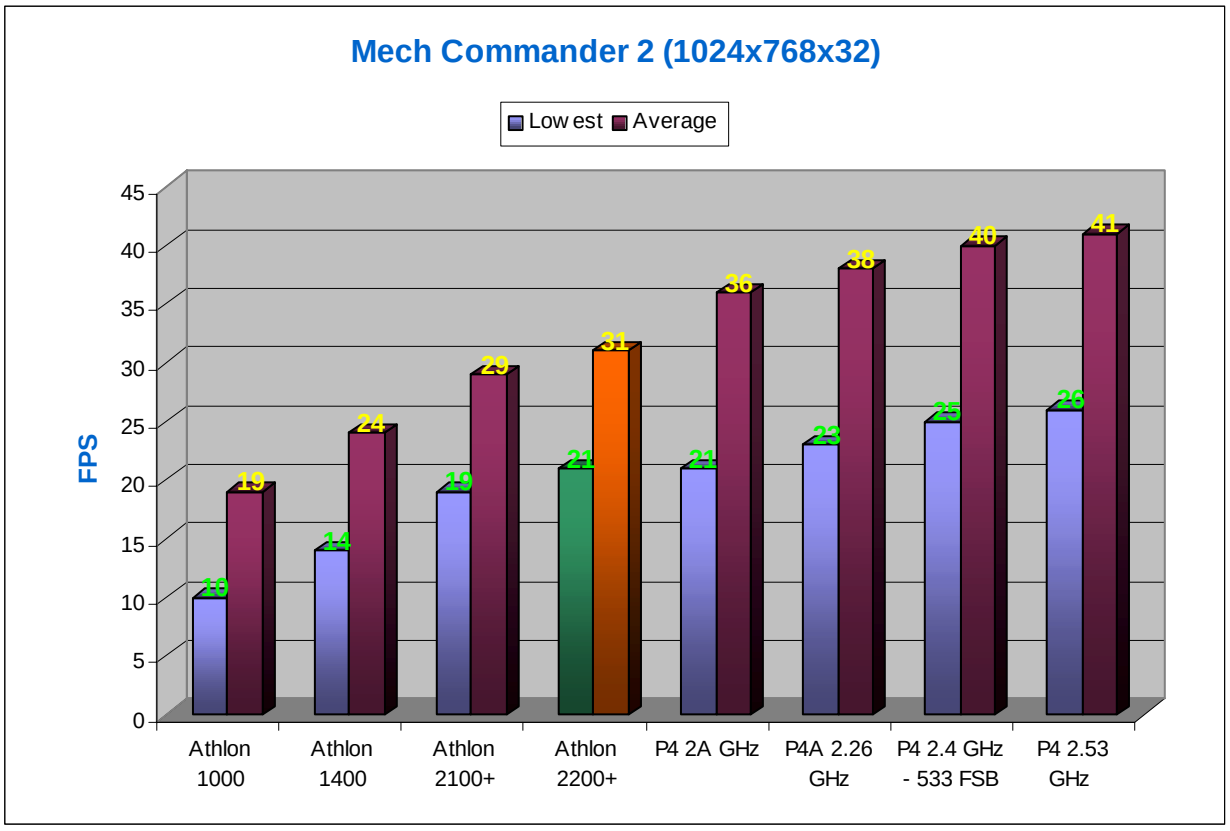
Next up is a classic, Serious Sam: Second Encounter. We tested with the demo version of this "shoot huge amounts of monsters" game. As we have often benchmarked the original in the past, we were interested in seeing how the sequel would perform.



Here we see that Serious Sam SE, an Athlon 1400 is just about required to run this thing at decent speed. Serious Sam prefers the Athlon XP 2200+ over the 2.26 GHz Pentium 4 and the former is 8% faster. The Athlon XP 2100+ is also slightly faster as well. Only the significantly higher-clocked 2.4 and 2.53 GHz Northwoods can outperform the Thoroughbred here.

Mech Commander 2

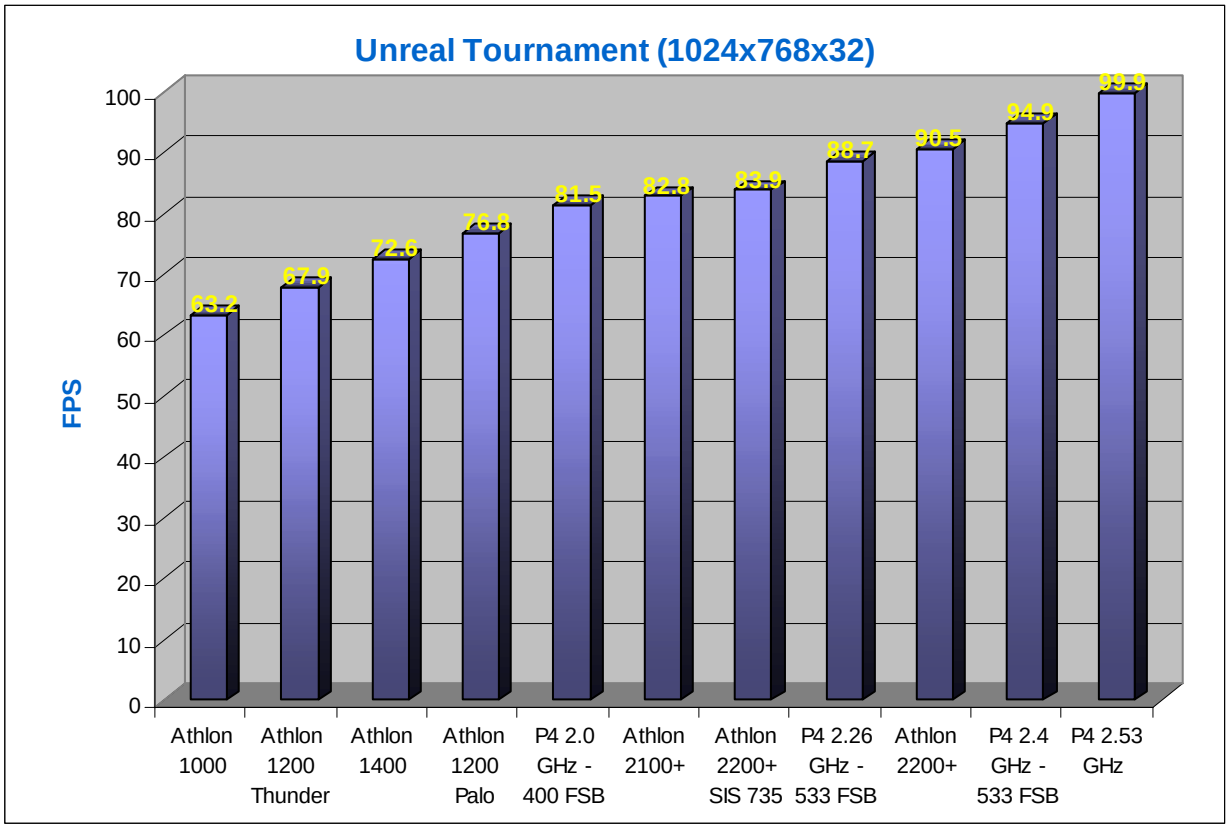
As most benchmarked games are first person shooters, I decided to make use of FRAPS once again. The latest versions of FRAPS can now automatically measure an average framerate over a given period of time, but take the results with a grain of salt as the error margin is around 5% instead of the typical 1% error margin we experience with "non-FRAPS" benchmarks. Mech Commander 2 is a real time strategy game and this game is a real CPU hog. At certain times, the game was almost unplayable on a Pentium III-800 PC, with frame rates as low as 9 fps. We ran benchmarks at 1024x768x32bpp.



It's important to keep in mind that these results are rough estimates at best, but it is clear the Pentium 4 is on a winning streak in Mech Commander 2, with the Athlon XP 2200+'s lowest framerate equalling that of the 2 GHz Northwood Pentium 4.

Unreal Tournament

To finish up, we tested with good old Unreal Tournament, still one of the most popular online shooters.



The Athlon XP simply wiped the floor with the Willamette in this benchmark, but the newest Northwood Pentium 4 CPUs are much tougher. Even so, the Athlon XP 2200+ still beats the most important competitor, managing a much better showing than in Mech Commander 2, but the highest-clocked P4s are still on top.

So far we can conclude that the Athlon 2200+ can compete rather effectively with the 2.26 GHz Pentium, as it has managed to outperform the 2.26 GHz Pentium 4 in 3 of our 5 benchmark tests above. As the 2.26 GHz Pentium 4 is more expensive (and a lot more expensive outside the USA), the Athlon 2200+ is a very competitive product. It is clear, however, that the Athlon can definitely use a larger cache to compete with the Pentium 4, as the latter has improved vastly and is delivering the best performance at its top speed grades.

Best Upgrade?

Contrary to pampered reviewers (myself included), most of our readers can not simply swap out an older motherboard for the latest one. We have been testing the Athlon XP 2200+ and Athlon Thunderbird 1000 on the latest motherboard (VIA KT333 based) with one of the best video cards around (GeForce 4 Ti4400). For most of our readers, however, this is not a real world situation.

As we have indicated earlier, we want this review to be useful for the people who like to upgrade. Therefore we'll start from a typical "best bang for your buck" system from last year:

- Athlon 1000 - 1400 Thunderbird
- VIA KT133A (or similar)
- GeForce 2 Ti (or similar)
- PC133 CAS2

The big question is this: will you get the best return on investment if you invest in the new Athlon XP 2200+? Or is that money better spent on a newer video card or motherboard? Let us find out!

We upgraded each component while keeping the rest of system intact. For example, we tested with the original system but we replace the 1 GHz Athlon Thunderbird with an Athlon XP 2200+ on the KT133A system. Next we kept the 1 GHz Athlon, but replaced the video card, and so forth.

As our only KT133A board, AOPEN AK73, wouldn't work with the 13.5x multiplier, the Athlon XP 2200+ (on the KT133A system) is in fact a Palomino 2100+ running at 13x 137 MHz. The slightly higher bus speed (137 MHz) and slightly lower total clockspeed (1781 MHz) make it perform almost identically to that of an Athlon XP 2200+, as confirmed by our benchmarks on other boards.

Comanche 4: CPU, Motherboard Video

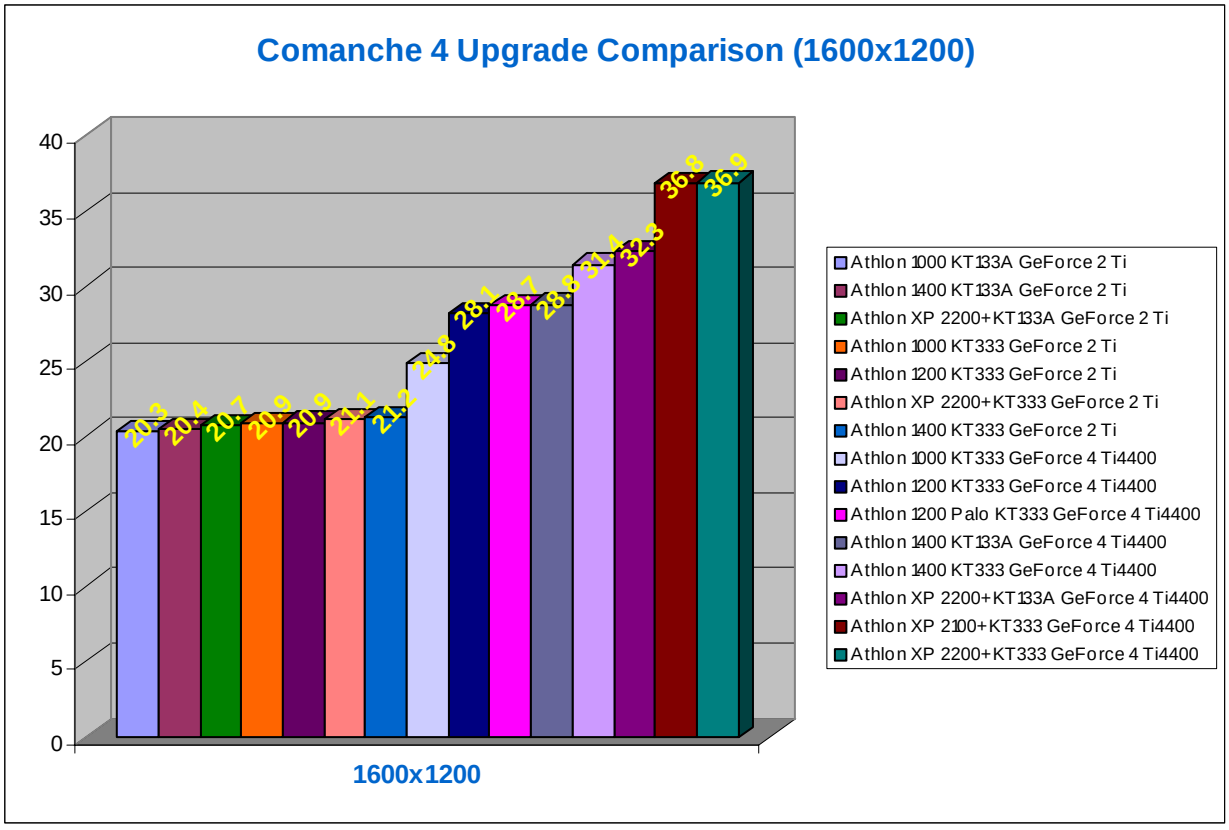
CPU	Chipset	Video	Comanche 4 800x600x32	Comanche 4 1024x768x32
Athlon 1000	KT133A	GeForce 2 Ti	22.9	22.9
Athlon 1000	KT333	GeForce 2 Ti	25.0	24.6
Athlon 1000	KT333	GeForce 4 Ti4400	25.6	25.3
Athlon 1400	KT133A	GeForce 2 Ti	28.1	27.6
Athlon 1200	KT333	GeForce 2 Ti	28.4	27.4
Athlon 1200	KT333	GeForce 4 Ti4400	28.9	28.6
Athlon 1400	KT133A	GeForce 4 Ti4400	29.2	29.1
Athlon 1200	KT333	GeForce 4 Ti4400	29.9	28.9
Athlon 1400	KT333	GeForce 2 Ti	30.6	29.3
Athlon XP 2200+	KT133A	GeForce 2 Ti	31.0	30.4
Athlon 1400	KT333	GeForce 4 Ti4400	32.2	32.0
Athlon XP 2200+	KT333	GeForce 2 Ti	33.8	31.1
Athlon XP 2200+	KT133A	GeForce 4 Ti4400	34.3	34.3
Athlon XP 2100+	KT333	GeForce 4 Ti4400	41.1	39.3
Athlon XP 2200+	KT333	GeForce 4 Ti4400	41.6	40.0

The table above contains a lot of information, and it impossible to discuss every single situation, so we've summarized our findings below:

Upgraded Component	Improvement
Athlon 1000 -> 2200+	+30-40%
Motherboard: KT133A-> KT333	+10%
Video Card: GeForce 2 Ti -> GeForce 4 Ti4400	+10%
Video Card + CPU	+50%
Video Card + CPU + Motherboard	+75-80%

Flight simulators clearly benefit the most from a CPU upgrade. There is no point in plugging a GeForce 4 in our original 1 GHz system. The 1 GHz Athlon simply cannot feed the GeForce 4 fast enough to make any difference. Once we have a faster CPU, we get more return on investment if we invest later in a faster video card. It is pretty subjective, of course, but at first glance, a 1400 Mhz system does not really need an upgrade. At best you can get a 40% improvement if you upgrade everything. Anyway, it is up to you to make up your mind...

Of course, it is clear that if you have your heart set on high resolutions like 1600x1200, you will need a better video card. We also recommend a 19" monitor or larger for such resolutions.



In this case, investing in a video card and CPU makes a lot of sense. Simply upgrading the video card will hardly help, as performance improves by only 20%. Notice also that the KT133A is really slowing down the Athlon XP 2200+ and GeForce 4: it is almost 15% slower. The faster chipset can make an important difference with a high-clocked CPU.

Serious Sam SE, Valley of the Jaguar

Some of our benchmark numbers with Serious Sam seemed really odd. We retested most of them 3 or 4 times, and yes, it seems that even those odd numbers are correct...

CPU	Chipset	Video	800x600x32	1024x768x32 - Quality
Athlon 1000	KT333	GeForce 4 Ti4400	24.4	23.3
Athlon 1200 Thunder	KT333	GeForce 4 Ti4400	27.9	26.1
Athlon 1400	KT133A	GeForce 4 Ti4400	29.0	27.6
Athlon 1000	KT133A	GeForce 2 Ti	29.9	24.0
Athlon 1200 Palo	KT333	GeForce 4 Ti4400	30.0	28.1
Athlon 1400	KT333	GeForce 4 Ti4400	31.5	28.9
Athlon 1000	KT333	GeForce 2 Ti	32.1	25.6
Athlon 1400	KT133A	GeForce 2 Ti	33.3	26.0
Athlon 2200+	KT133A	GeForce 4 Ti4400	35.0	31.8
Athlon 1400	KT333	GeForce 2 Ti	35.6	27.7
Athlon 2200+	KT133A	GeForce 2 Ti	35.8	26.8
Athlon 1200 Palo	KT333	GeForce 2 Ti	35.8	27.6
Athlon 2100+	KT333	GeForce 4 Ti4400	38.8	35.9
Athlon 2200+	KT333	GeForce 2 Ti	39.7	29.0
Athlon 2200+	KT333	GeForce 4 Ti4400	40.0	37.6

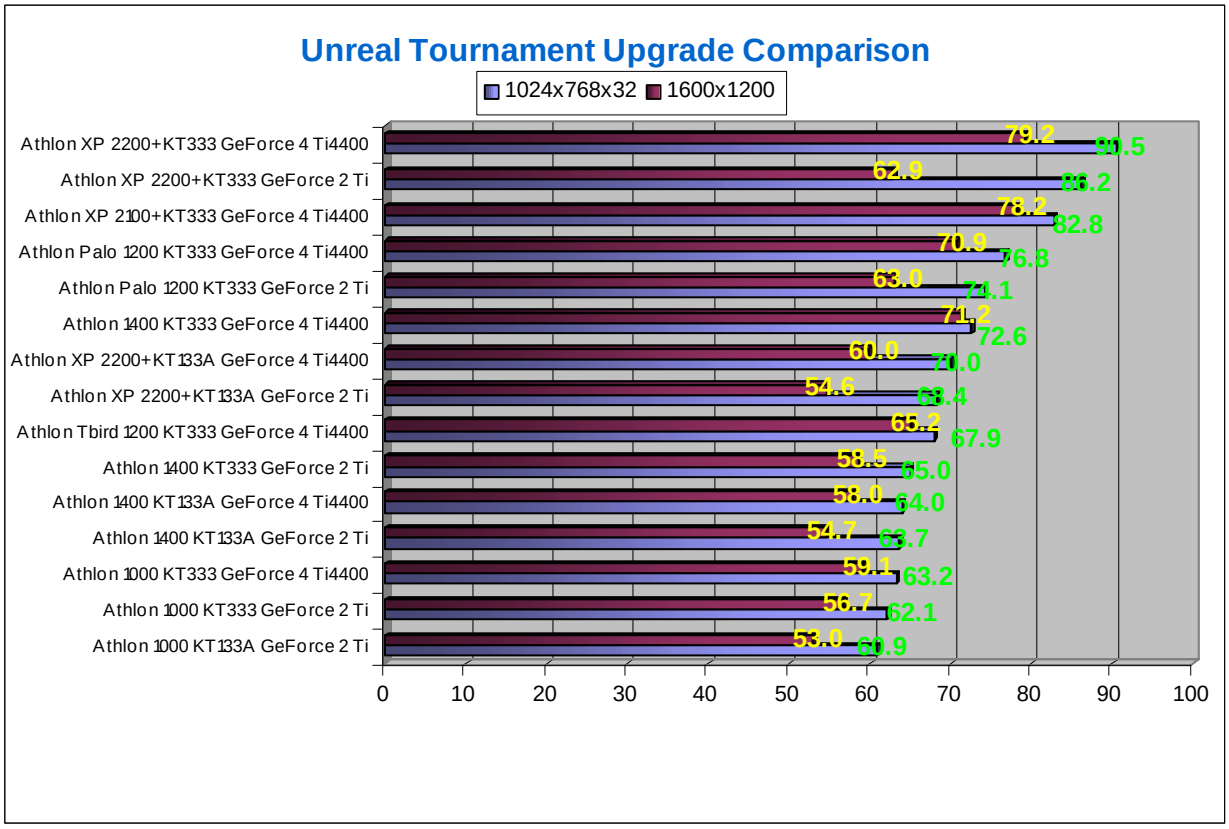
You cannot make sense out of these numbers? Well, I must admit at first, I wasn't sure what I saw either. But at closer examination, the stats started to make sense. Take a look at the table below.

Upgraded Component	Improvement
Athlon 1000 -> 2200+	+10-20%
Motherboard: KT133A-> KT333	+10%
Motherboard + CPU	+20 to 30%
Video Card: GeForce 2 Ti -> GeForce 4 Ti4400 (Athlon 1000)	-20 to 0%
Video Card Upgrade (Athlon 2200)	+0 to 20%
Video Card Upgrade (Athlon 2200) & KT333 Upgrade	+10-40%

First of all, you must know that the Serious Engine features very large wide open spaces. The Second Encounter uses more polygons and even more wide open spaces. This particular scene features huge amount of monsters charging at the player in an incredibly huge arena. The result is that the CPU has to calculate huge amounts of data, putting a lot of stress on the FPU and the memory subsystem.

The Serious Engine has yet to be optimized for the vertex shader of the GeForce 4, and thus must the GeForce 4 emulate the fixed function T&L unit of the GeForce 2. This results in a performance penalty. This performance penalty is more specifically the result of CPU power that has been absorbed by the GeForce 4 driver, as a KT133A + Athlon 1400 performs much better than a KT333 + Athlon 1000 system. Once you get a much faster CPU like the Athlon XP 2200+, the CPU power bottleneck is no longer there. Instead performance is hampered by the memory bus (the CPU doesn't get it's data quickly enough). Therefore, the video card becomes a bottleneck at 1024x768x32 only when the CPU can be fed well and we see a 40% increase in performance.

Unreal Tournament Upgrade Comparison



As Unreal Tournament is an older game with less eye candy than newer games, it cannot really stress the video card at 1024x768. The result is a benchmark that is mostly limited by the CPU - at first sight. Our KT133A system seemed to be severely limited by the SDRAM memory subsystem. Performance scaled relatively poorly until we used the KT333 system. We thought that we might have forgotten to disable vsync but closer examination revealed that the maximum framerates of the Athlon XP 2200+ hovered around 116-118 FPS on the KT133A system. The Athlon 1400 benchmarks on the KT333 made it clear that UT performance scales very well on the KT333 system, but not on the KT133A.

Of course, every system in this list performs well, and if you are mostly interested in running older online first person shooters, any of the benchmarked systems will do. No upgrading necessary…

Conclusion

As it stands, the 0.13µ Thoroughbred Athlon XP is hardly a good overclocker -- overclocking only slightly better than the 0.18µ Palomino Athlon XP. The 1.65V core voltage already gives away the fact that the current batch of 0.13µ Athlons do not have a lot of headroom. But let us not forget that this new chip allows AMD to offer the Athlon XP at a much lower price without going bankrupt and that binsplits can improve rapidly as the the teething problems of a new process are resolved.

Still, AMD has much work to do, as the 2.26 GHz Pentium 4 has proven to be rather competitive with the newest Athlon XP. The Athlon XP 2200+ manages to lead the 2.26 GHz Pentium 4 slightly overall, by outperforming it in 3D Studio Max, Serious Sam SE, and Unreal Tournament. But it is not a clean victory, as the Athlon XP is outperformed in Comanche 4 and Mech Commander 2.

But there is also good news for both AMD and Intel: our first analysis of many gaming benchmarks indicate that even the fastest CPUs today are not really overkill for most modern games. Mech Commander 2, Serious Sam SE, and Comanche 4 all demand heavy CPU power if you want to play them at slightly better than decent framerates. The analysts who are shouting that all this gigahertz madness is not necessary for the average consumer have been proven wrong again... games continues to be "killer" applications!