2003 Gamers' Hardware Upgrade Guide

By Johan De Gelas – February 2003

Upgrading in 2003

Many Ace's Hardware readers are living in the northern hemisphere where it is winter again. Is there a better excuse than the fact that it is dark and cold outside to do some serious gaming? But when you start playing that new game, there is a good chance that your old trusted machine feels a bit slow.

So it is time for another "Ace's Upgrade" article. For those who are new to Ace's or who are not familiar with this kind of article, you can find an example **here** and **another one here**, hidden away in **our Athlon XP 2200+ review**. This time we focus completely on gaming systems.

The basic concept of our article is that, starting from a slightly "old" configuration, we investigate which upgrades give you the best return on your investment. This time our base configuration is a 1.4 GHz Athlon Thunderbird, on a KT266A motherboard, equipped with a Geforce 2 Ti 200. This might not be your exact configuration, but if your system features an Athlon 1200 - XP 1700 on a SiS735, AMD760, KT266A, the benchmarks shown here will not be very different to what your system performs. Remember our goal is not to discuss 5 to 10% differences between different CPUs or graphic processors, but to give you a rough idea what performance boost you can expect from upgrading one of your major hardware components.

The reason why we chose to start with a Athlon 1400 and KT266A is that our **polls** indicate that a large number of those who responded are running **an Athlon Thunderbird or one of the "slower" Athlon XPs** on a **KT266A/KT333** or similar board. In fact, less than 30% of our readers are still using SDRAM-based motherboards.

Concerning our CPU choice: we learned that the Athlon XP 2800+ "Thoroughbred" is a Limited Edition processor, which might not be available to you. But that does not invalidate our benchmarks as the Athlon XP 2700+ is clocked only 3.7% lower and performs about 2-3% slower.

We perform the following upgrades:

- **Video Card Upgrade**:
  We upgrade the Geforce 2 Ti 200 to more trendy video cards, such as the Geforce 4 MX 440, Geforce 4 Ti 4200/4600 and Radeon 9700 Pro (Tyan Tachyon G9700). We also check with a Geforce 3 Ti 200 and Radeon 8500, as both videoards featured an excellent price/performance ratio and have been very popular.
- **CPU Upgrade**:
  We swap our old Thunderbird for a brand new Thoroughbred Athlon XP.
- **Motherboard Upgrade**:
  We simply change the motherboard for one with the fastest Athlon chipset: the nForce 2
- **CPU + Motherboard Upgrade**
- **Everything**:
  CPU, motherboard and video card.

Should you get that flashy new 3D card or do you need more CPU power? Let's find out...

Games

The Internet is full of game benchmarks, but most of the time, you'll see the same benchmarks over and over again. Therefore we played around with game replays, fraps and scripts to make sure that we can offer you something new. Scanning our messageboards revealed the most popular games of today and we managed to benchmark six new game engines this time around:

- Ghost Recon: Desert Siege (FPS)
- Battlefield 1942 (Online FPS)
- NeverWinter Nights (RPG)
- Medieval: Total War (RTS)
- Age Of Mythology (RTS)
- Grand Prix 4 (Simulator)

Together with benchmark classics like Comanche (simulator) and Unreal Tournament 2003, this review should give you a pretty good idea of how your gaming rig will behave in the most popular games out there.

Tyan Tachyon G9700

Before we unleash all the benchmarks upon you, we take a look at the Tyan's Tachyon G9700, which was the card behind our Radeon 9700 Pro benchmarks. Contrary to most Radeon 9700 cards, Tyan's card is not another copy of ATI's reference design. A massive heatsink and a well-tuned PCB allow you to run the core at 390-400 MHz (At 400 MHz the card was not fully stable), while memory can be run at 340 to 350 MHz. Most Radeon 9700 Pro cards are limited to 350/330 MHz, with the exception of Gigabyte's card, of which the core is also capable of reaching almost 400 MHz. However, Tyan's card seems to reach the highest memory clocks, so we can say that it is probably the best overclocker out there.

The heatsink consists of two parts, one on the front and one on the back of the card, which give the impression of one massive heatsink.

Anyway, this massive heatsink does pay off, as it was significantely cooler than most Radeon 9700 cards after running hours of game benchmarks. Tyan also promises hardware monitoring, but unfortunately our engineering sample did not include this feature.

The card comes with a DVI-I to VGA converter, a S-Video to Composite, S-Video and Composite Video cable. While the Tyan Tachyon G9700 is a very good overclocker, we ran it at 325/310 MHz.

Benchmarked Configurations

All systems were tested with NVIDIA's Detonator 40.91 drivers and the ATI Catalyst drivers version 3.0. 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. In this review, the XMS3200 modules were running at 166 MHz DDR (333 MHz) on the nForce 2 system and configured in all systems to work with a CAS latency of 2. On the KT266A system, the DIMMs were running at 266 MHz CAS 2.

Note that AGP 8x or 4x did not make any difference in the benchmarks.

Systems

Athlon 1400, Athlon XP 2800+

- **ASUS A7V266A**
- **ASUS A7N8x Deluxe nForce 2 rev. 1.04 BIOS version "G"**

Shared Components

- **512 MB Corsair PC3200 XMS (DDR-SDRAM)**
- **20 GB Seagate Barracuda ATA III Model ST320414A (7200 rpm, ATA-100)**
- **Tyan Tachyon Radeon 9700 128 MB (AGP 8x)**
- **MSI Geforce Ti4600 128 MB (AGP 4x)**
- **Sparkle Ti 4200 128 MB (AGP 8x)**
- **ATI Radeon 8500 64 MB (AGP 4x)**
- **MSI Geforce MX440 64 MB (AGP 8x)**
- **ASUS Geforce 2 Ti 200 64 MB (AGP 4x)**
- **AT 2700 10/100 Mbit NIC**
- **Sound Blaster Live!**

Software

- **Via 4 in 1 Drivers 4.42**
- **Intel chipset inf update 4.09.1011**
- **Windows XP**
- **DirectX 8.1**

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

- Sandy Tsau (**Tyan**)
- Carol Chang (**ASUS**)
- Sharon Tan (**BAS computers Netherlands**)
- Angelique Berden (**MSI**)
- Damon Muzny (**AMD**)
- Robert Pearce (**Corsair**)

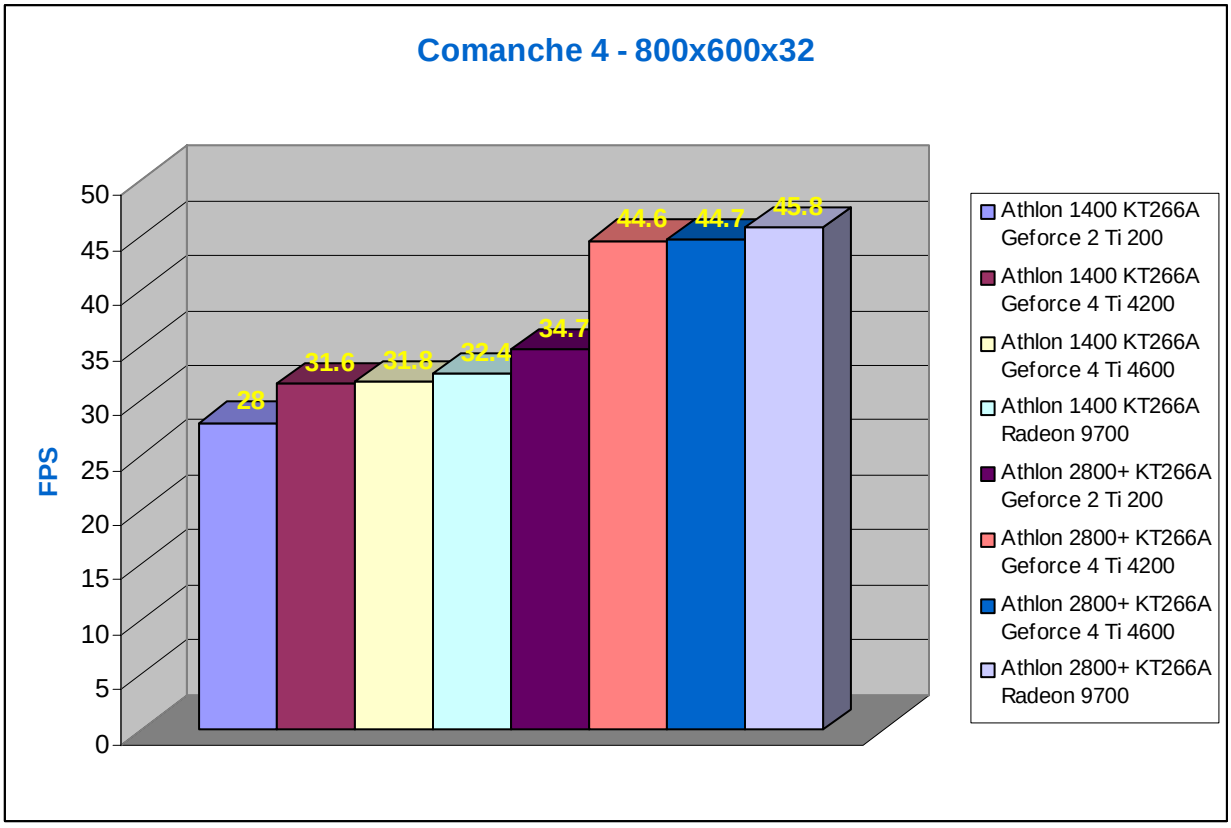
Benchmarks

Although we have used **fraps** for most of these benchmarks, the accuracy of the benchmarks is very good, sometimes even better than games where a benchmark demo exist. For example, the error margin of Medieval War, Battlefield 1942, and Ghost Recon is around 1-2%.

We start with an in depth analysis of Comanche 4 and Unreal Tournament.

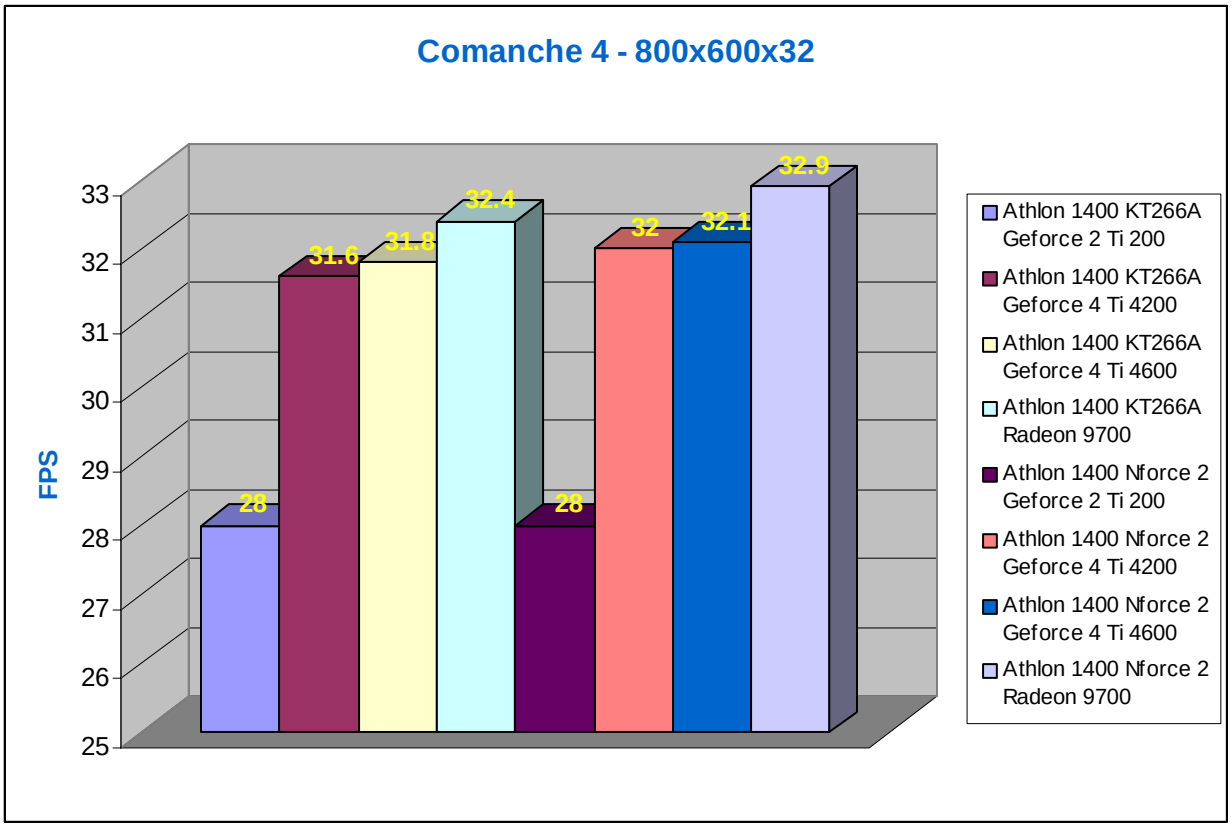
Simulator: Comanche 4

Our previous upgrade articles have always concluded the same thing about simulators: performance depends mostly on CPU power. And Comanche, a helicopter simulator, is no different. To upgrade our KT266A board the most, an unlocked Athlon 2800+ was run at 17 x 133.3, or 2266 MHz. Considering that the Athlon 2800+ is speced to run at 13.5x166.6 or 2250, we are not even overclocking.



These comanche benchmarks make clear that modern simulators still depend a lot on the CPU, but need some GPU power too. Upgrading the CPU is a decent investment, but only if you have a video card which is based on a GPU a generation more recent than the GeForce 2. Upgrading only the CPU boosts performance by 24%. Not bad, and still a lot better than plugging even the fastest video card in your old rig. When we upgraded the old machine with a Radeon 9700, we saw a meager performance boost of 16%.

The CPU is still the most important component in a gaming system that is primarily intented for simulators. Upgrading our old system with a Geforce Ti 4200 and Athlon 2800+ yielded a superb improvement 59%. Let us see what a motherboard upgrade bring us.

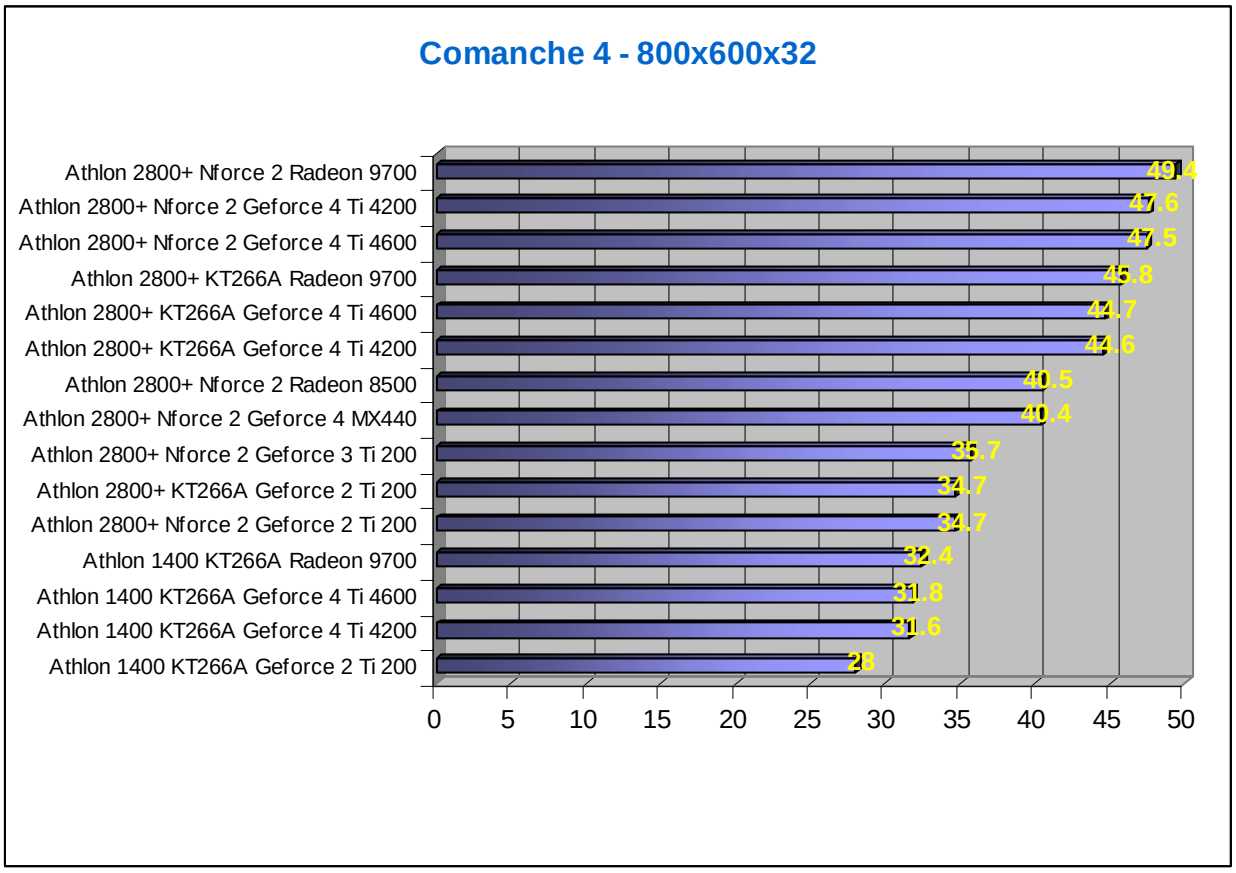


An Athlon 1400 is clearly too slow to show much difference between the Nforce 2 and KT266A. The extra bandwidth of the Nforce 2 goes to waste, as the Athlon 1400 works with a 266 MHz (2.1 GB/s) FSB.

So far we can conclude that the CPU is most important component for Comanche, but if you pair it with a Geforce Ti 4200, you'll see an impressive performance boost. This may not be a big surprise for the hardware veterans out there, as we know that the Comanche graphics engines uses some of the more advanced features of DirectX 8. Comanche uses the pixel shader effects for the water surface perturbation caused by for example the chopper's rotors. On graphics cards without pixel shaders, the engine will simulates the water effect using multipass rendering.

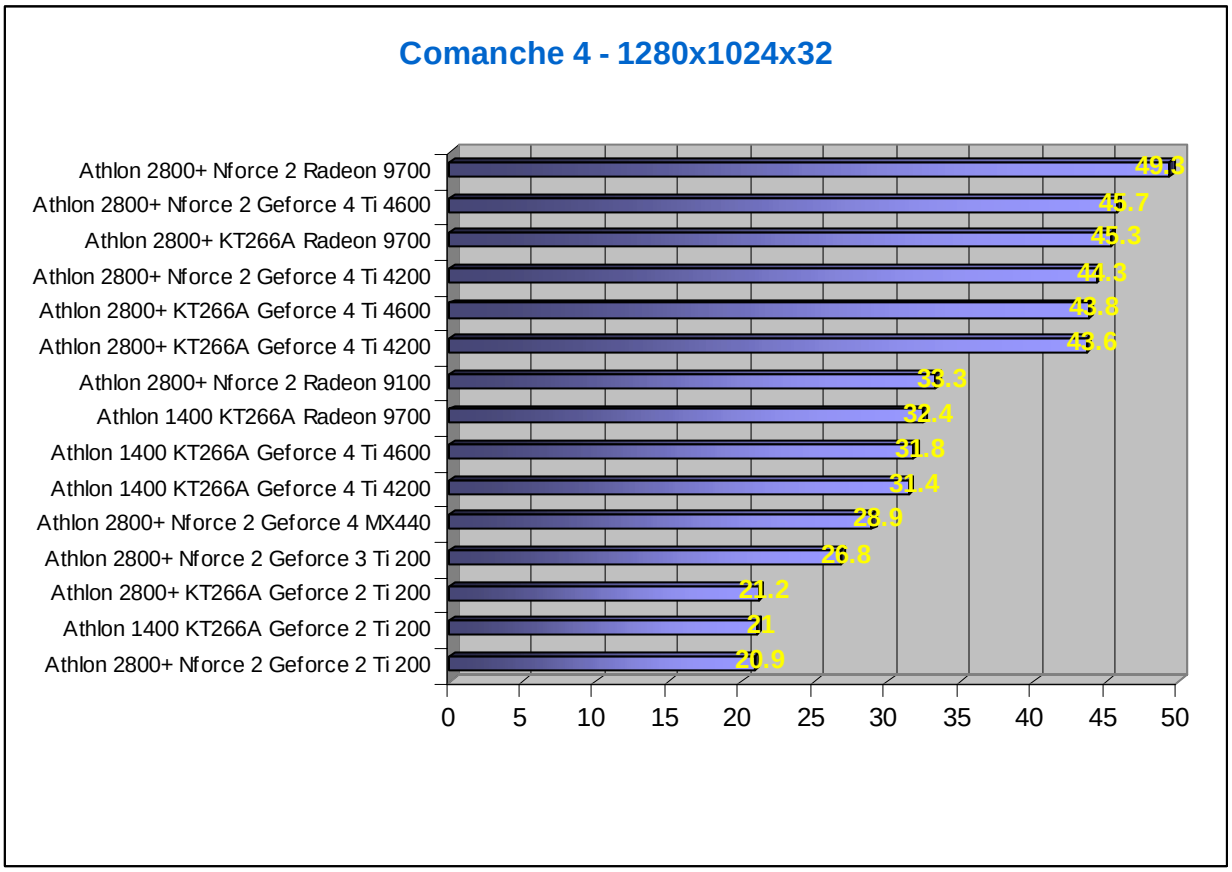
This does not only mean that you get a slightly less realistic effect, but that non - pixel shader card need more video RAM bandwidth and texel fillrate to accomplish the same thing as the pixel shader cards. That is one of the reasons why we see that an Athlon 2800+ maxes out at about 35 fps with the Geforce 2 Ti 200.

To help you with your upgrade decision, we decided to test with the Radeon 8500, Geforce 2 Ti 200 and Geforce 4 MX440 too on the Nforce 2 platform. These 3 video cards have been very popular as they offer(ed) a very good price/performance ratio.



If you upgrade your motherboard, video card and CPU to the best you can find today, you can upgrade performance by 76%. However, it is clear that the Ti4200 + Athlon XP 2800 is by far the most affordable, effective (+59%) and trouble free upgrade for KT266A owners.

800x600 is of course a rather a mediocre resolution for 2003. What happens if we test at 1280x1024?



The importance of the video card increases even more of course. If you do not mind playing at 20 to 35 fps (average 31.4), simply upgrading the GeForce 2 to a Geforce 4 Ti 4200 can offer you good performance.

Notice how bad the Geforce 4 MX440 performs, even with an Athlon 2800. Remarkable also is the dissapointing performance of the Geforce 3 Ti 200. Polygon power might be the problem as the Geforce 3 Ti 200 runs at only 175 Mhz and has only one Vertex shader.

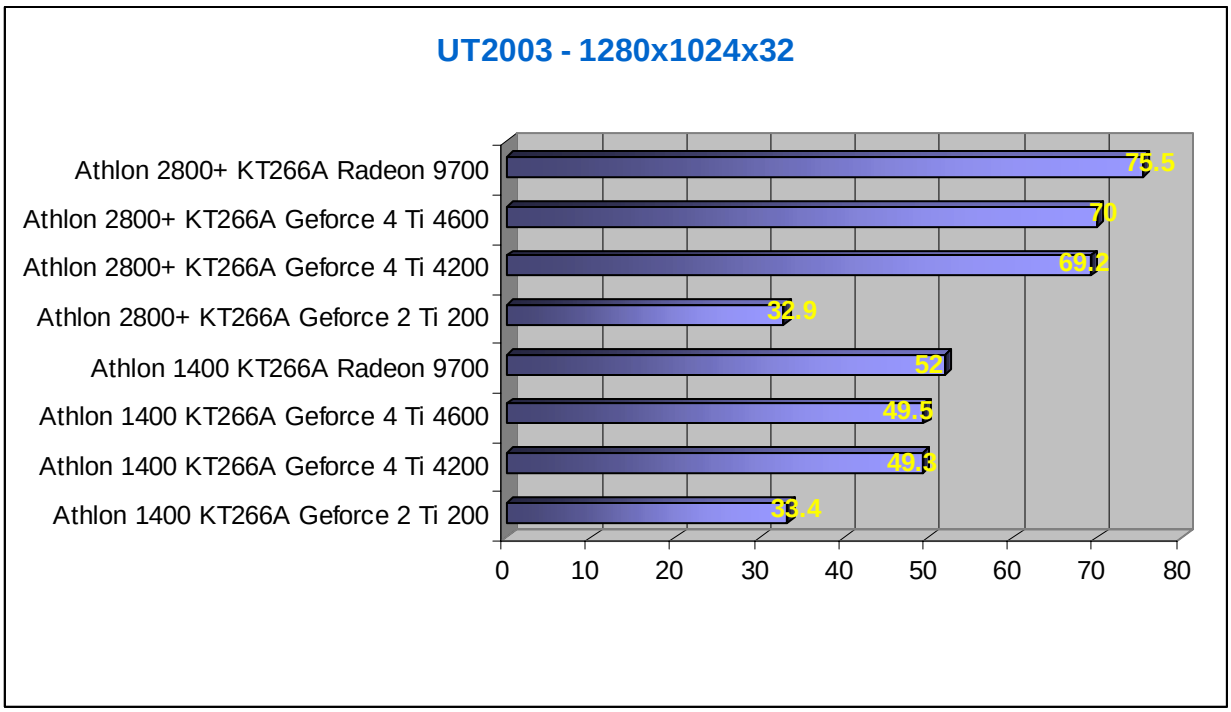
It is interesting to note that with the introduction of pixel and vertex shading in games, (flight) simulators are no longer limited by the CPU only, but need a relatively fast video card too.

First Person Shooters: Unreal Tournament 2003

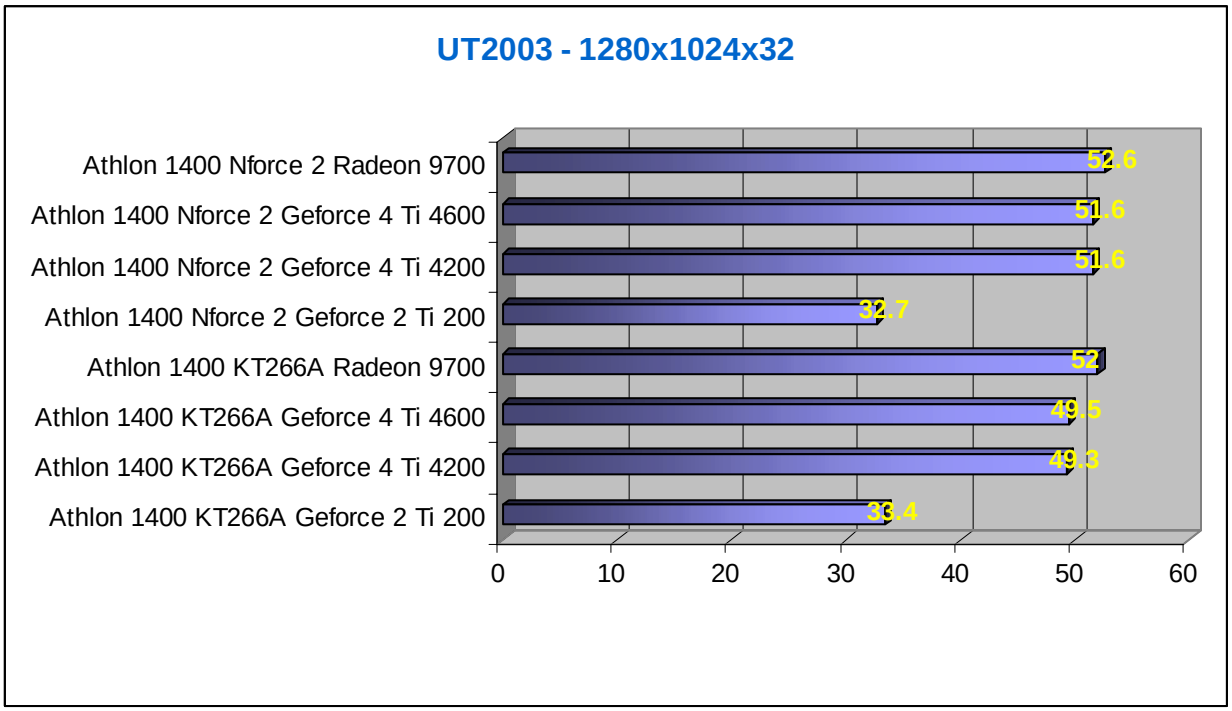
While Unreal Tournament 2003 certainly looks fantastic, the new Unreal graphics engine is primarily a DirectX7 based engine. With a DirectX8 compliant card, you get a modest speedup thanks to pixel shaders, which will be used to take multiple terrain passes. Bigger texture sizes, cube mapping and a huge number of polygons make Unreal Tournament look much better than most DirectX 7 games.

Based on the same engine as UT2003, Unreal 2 shows that the engine rivals the best efforts of modern day plastic surgeons.

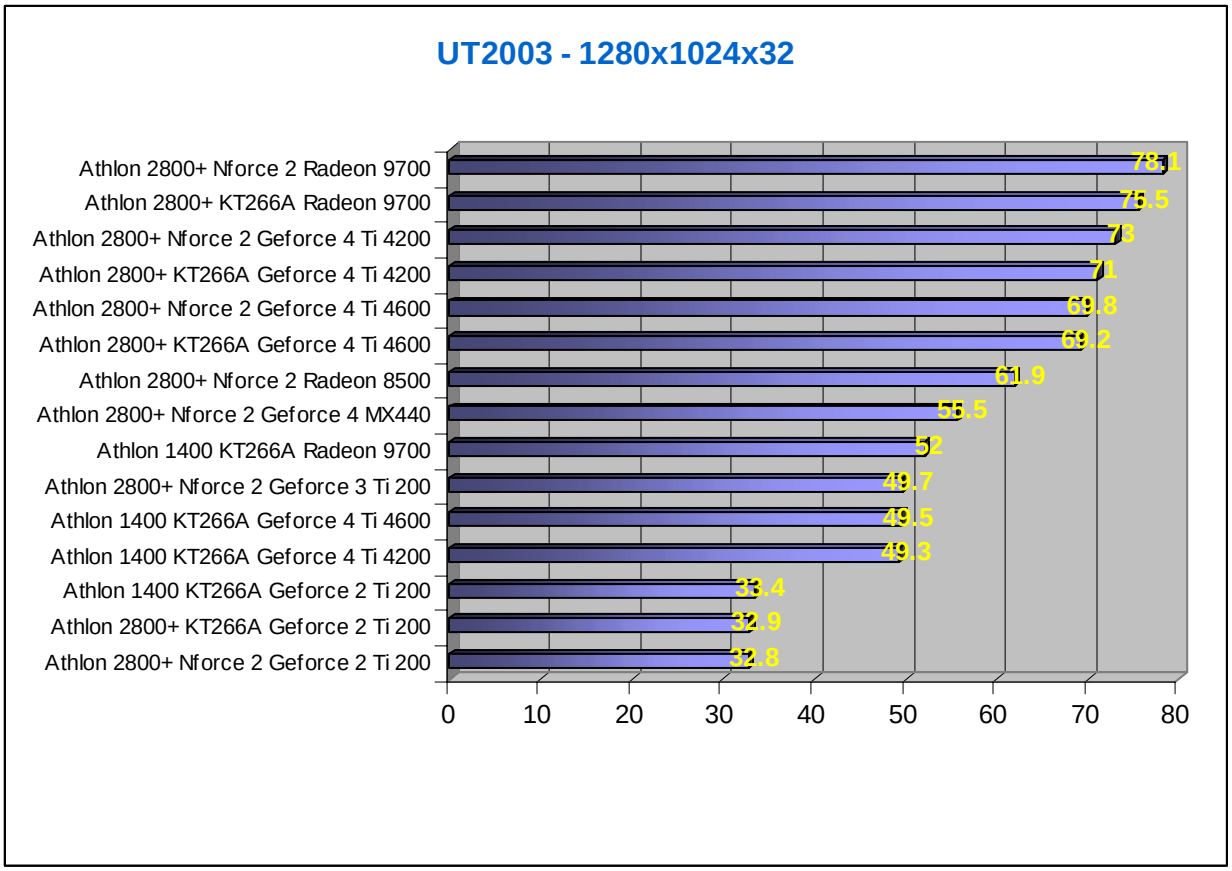
Let us see what happens if we upgrade our KT266A system with a faster CPU.



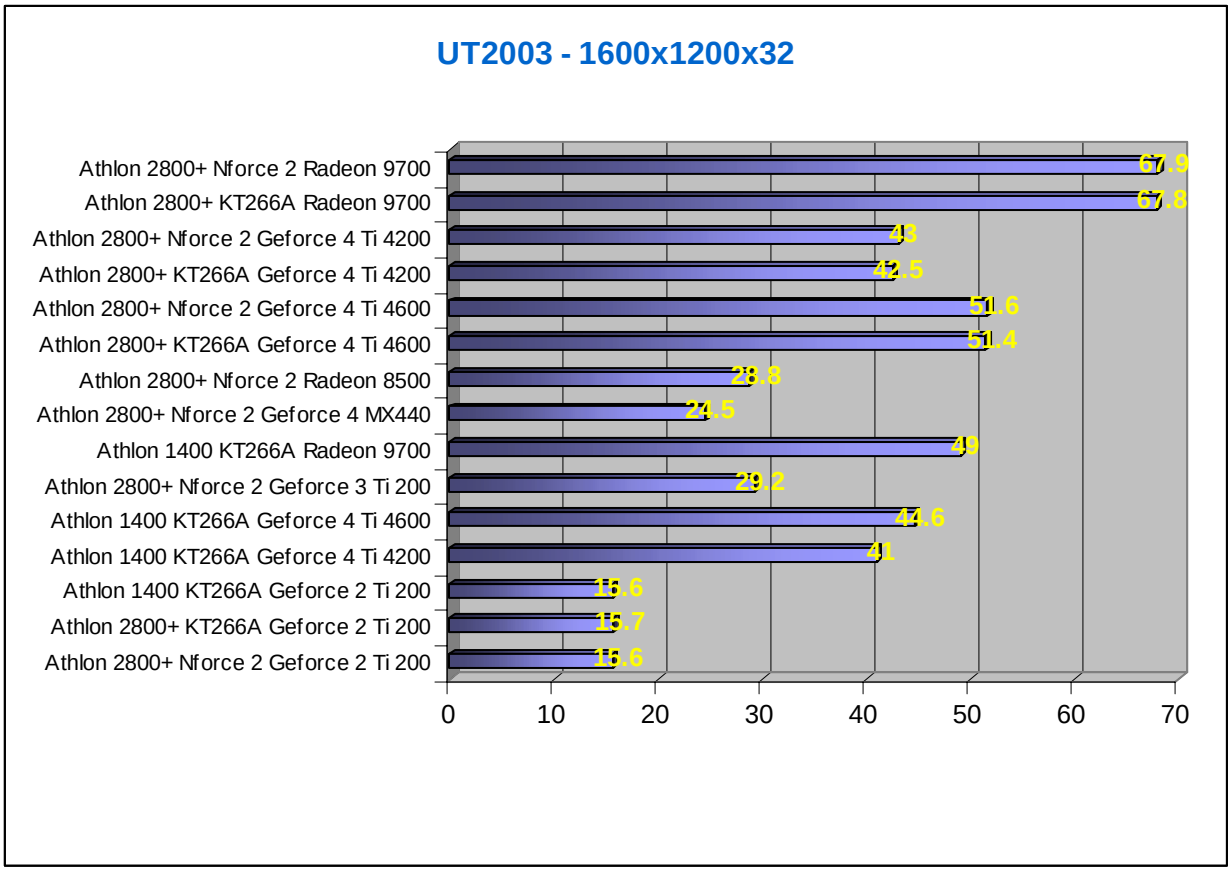
Simply upgrading to a Ti4200 offers a good performance boost to our "old" Athlon 1400 KT266A system. First person shooters do no longer behave radically different than flight simulators. Not so long ago, developers of first person shooters neglected the physics engine somewhat. The raging CPU war between Intel and AMD has made CPU power so cheap that first person shooters are now equipped with complex physics engines and AI. Unreal Tournament 2003 does feature a very complex physics engine, "Karma".



Simply upgrading the motherboard does not help of course, as the Nforce 2 is only slightly faster than the KT266A with a 266 MHz FSB. The step from AGP 4x to AGP8x does not help either. Now let's see the full picture.



UT2003 likes more CPU power slightly more than video chip power. An Athlon 2800+ with a Geforce 3 Ti 200 comes very close to the Athlon 1400 with a super video card like the Radeon 9700 Pro. Let us pump the resolution to 1600x1200.



For those who where a bit dissapointed in the Radeon 9700 Pro performance so far, this is where such a video card really pays off. If you plan on playing on 1600x1200, a card like the Tyan Tachyon is what you need. Simply upgrading your GeForce 2 (or even Geforce 3 TI 200) video card to this Radeon 9700 Pro delivers 3 times better performance in UT2003.

More Game Benchmarks...

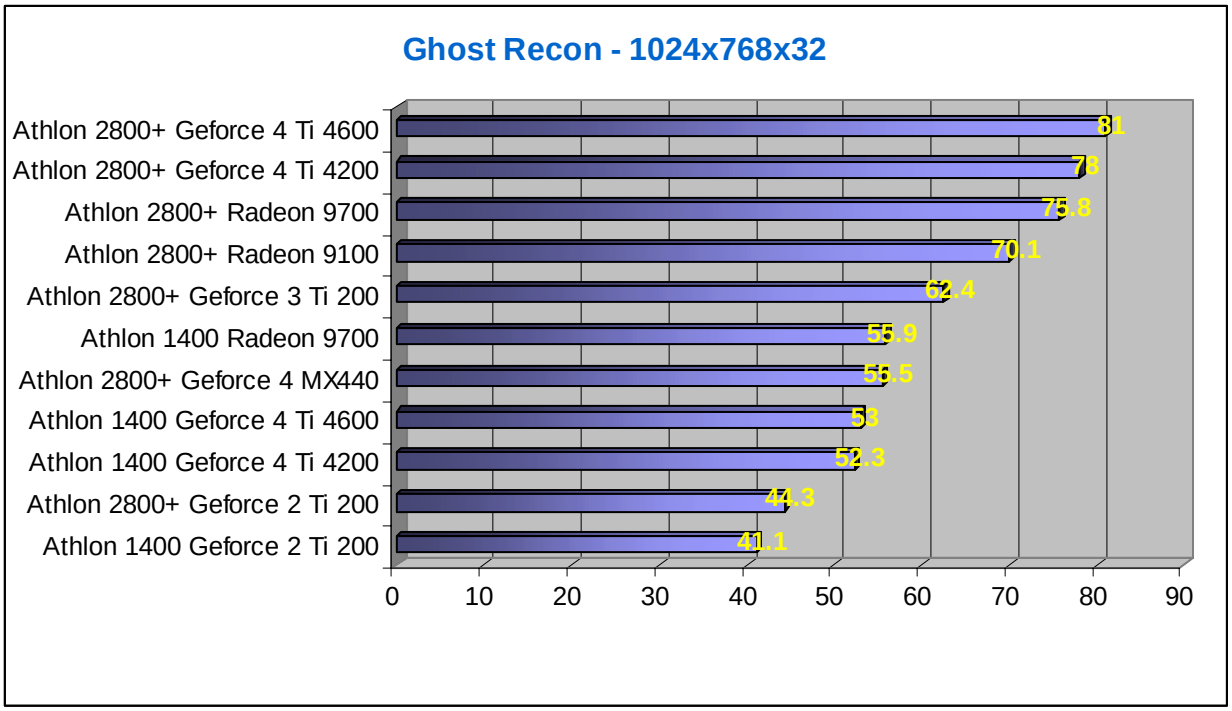
As we saw that the differences between the Athlon 1400 running on Nforce 2 (266 MHz FSB) or KT266A were very small, we decided to make our tables a bit easier to read and show only the results on the Nforce 2. If there were significant differences between the two platforms, we will tell you about it of course.

Ghost Recon: Desert Siege

Personally I like a first person shooter to be a bit more realistic than what you experience in a typical Unreal or Quake 3 game. In that kind of games you can survive bazooka grenade in your stomach, you can take a few rounds of - in the real world - armour piercing bullets before you die. It is fun, but when you are looking for a real adrenaline kick, you need something more like Ghost Recon.

In Ghost Recon you are part of an elite military unit, which are sent in all secrecy to troubled areas in the world. One well-aimed shot can kill you or one of your crewmembers, so you can forget attacking terrorists Rambo style. Real world weaponry, the importance of stealth and accuracy attacks make Ghost Recon a thrilling experience. This kind of "as- realistic-as- possible" first person shooters demands of course a different game engine which taxes your gaming system in a different way. Ghost Recon excels in detailed shadows for example, which is very processor intensive. Well-detailed shadows and especially enemy AI can make or break such a game.

The engine does take advantage of hardware T&L (Transform & Lighting) but does not support vertex or pixel shaders. We'll see that this will have a significant impact on the benchmarks. All effects and settings were set to the maximum.



The video card does play a role, but a minor one. As enemies and team members are very detailed and rather intelligent, the game needs CPU power above all. The Geforce 2 Ti 200 might still be a bit too slow, but an Athlon 2800+ with Geforce 3 Ti 200 easily beats the Athlon 1400 with the Radeon 9700.

It is important to note that especially minimm framerates were affected by the CPU. Even with the Athlon 2800+, we managed to see framerates as low as 13 fps, no matter what video card we used! (The Athlon 1400 was able to run this scene at 8 fps)

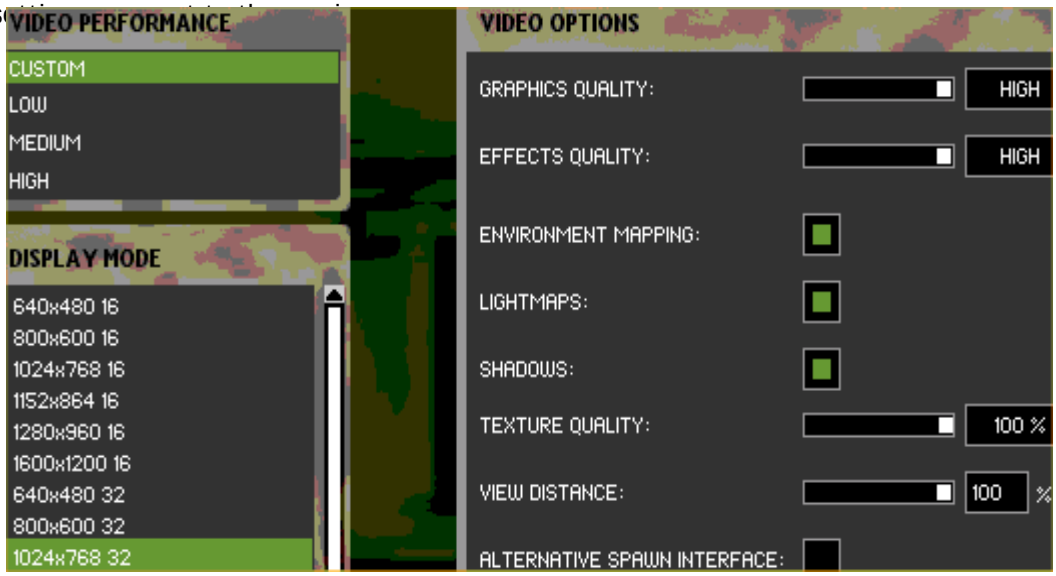
Luckily, it does not happen that much that you come very close to your enemies. Nevertheless, when you are ransacking the terrorist hideout, a sturdy CPU may make the difference between being a bit faster than the onrushing bad guy or being dead as a doornail.

Battlefield 1942

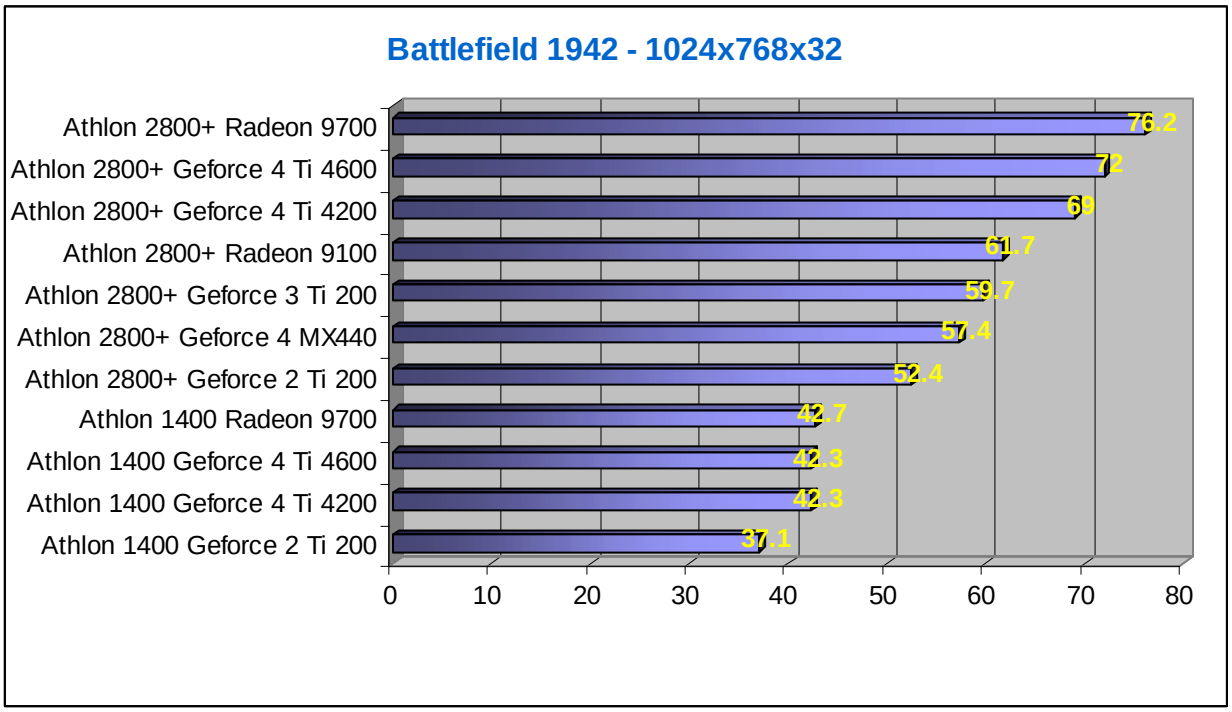
Battlefield 1942 has some similarities with Ghost Recon. This first person, team-based action game places you in the midst of one of the WWII battles and you can drive tanks and jeeps and fly Spitfires and Stuka's. Again, you can not run around as Rambo and get your BFG-9000 to kill a tank, and you need to depend on teammates. While it is not as realistic as Ghost Recon, enemy and ally AI is very important. In fact by default, the AI takes up 20% of the CPU power, and you can manually raise this to a maximum of 25%.

The "Refractor 2" 3D rendering is able to render gigantic 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 hardware skinning on animated meshes, what makes the soldiers look more life like.

All effects and s



Let us see what kind of upgrade will give you the best performance in B1942.



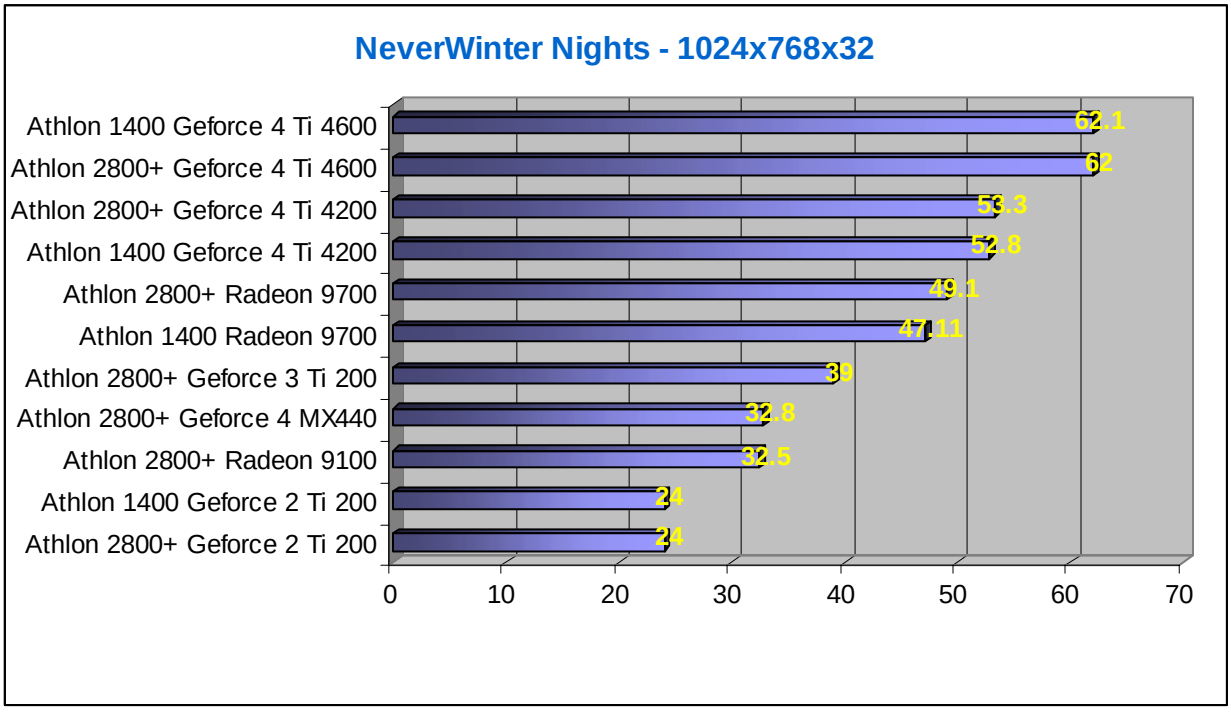
The relatively intelligent AI and the complex physics engine make this game very CPU intensive. A CPU upgrade is always more effective than a video card upgrade.

RPG: NeverWinter Nights

Reading the comments on our message board and elsewhere, NeverWinter Nights is a very popular RPG for the PC and one that also offers quite a bit of expandability. Real time shadows, relatively smooth animations and nice spell effects make the game visually attractive.

Enemy AI is pretty good in NeverWinter Nights, especially if you consider that most RPG monsters would perform worse in an IQ test than the monsters in DOOM. But still, as the adventure element is much more important, it is clear that not so much time has been spent on AI than for example in Battlefield 1942.

NWN is based on the BioWare's 3D engine Aurora that features a powerful particle system, superb dynamic lighting, and key frame interpolation.

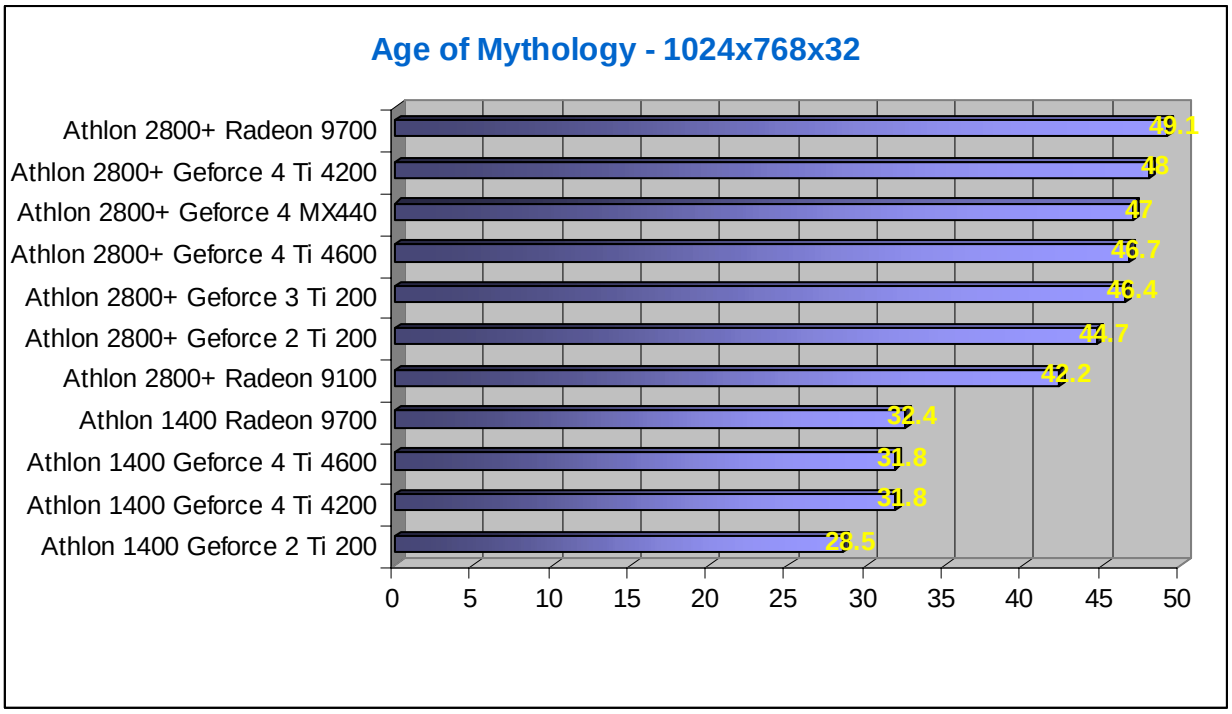


For NWN, an Athlon 1400 will do fine. The only thing the Aurora engine really cares about is the video card. These findings are in sharp contrast to Bioware's previous RPG engines, the isometric 2D engine from the Baldur's Gate and Diablo II, which depended heavily on CPU power, and not the video card.

RTS: Age Of Mythology

Age of Mythology is the third incarnation of Microsoft's and Ensemble studio's very popular Age of Empires series. But the 2D genie engine of Age of Empires has been replaced with a new 3D engine. It is a slick and graphically beautiful game, especially the oceans, that is extremely user friendly. In real time strategy games, the AI is of course of the utmost importance.

However, this kind of game is not really for those who want to be challenged intellectually. Battles tend to get completely cluttered and strategy is much less important than a hand that can produce many clicks per minute. Most battles are won by the player who is able to build the largest army the quickest.



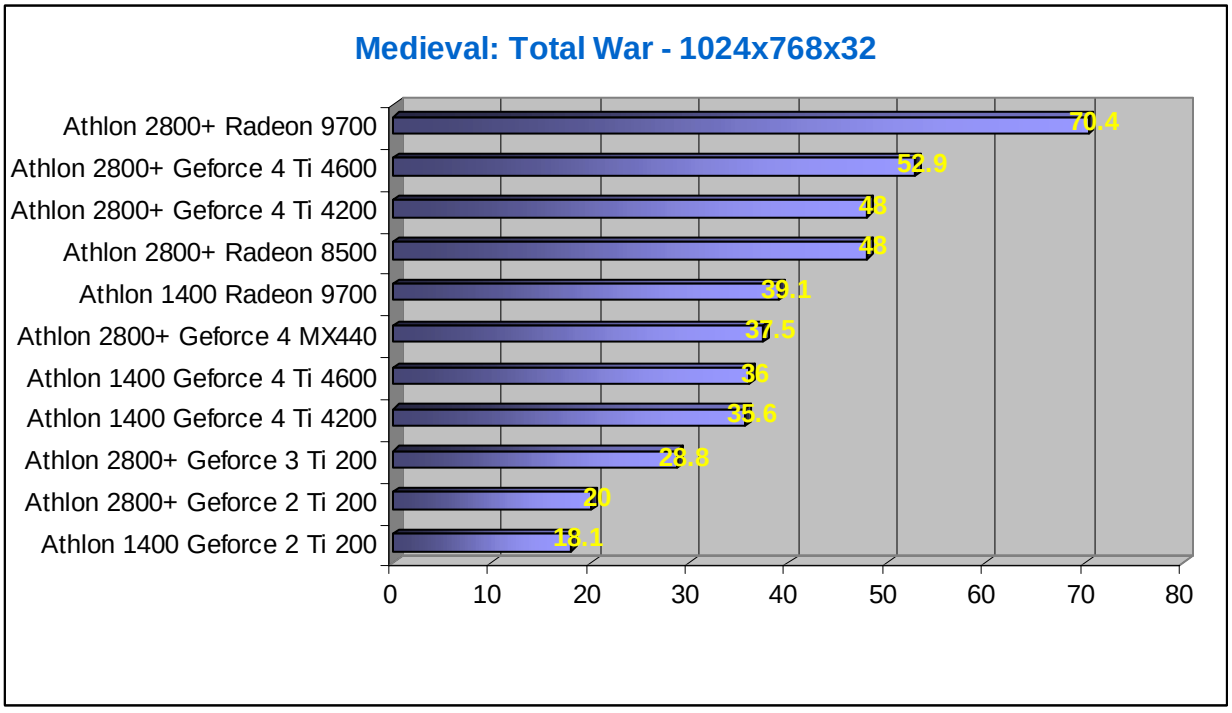
Despite many 3D graphical enhancements, Age of Mythology remains a mostly CPU limited game. A CPU swap delivers 50% better framerates and more, a video card upgrade is hardly worth the trouble.

RTS: Medieval: Total War

If you like an intellectual challenge and are a true megalomaniac, then Medieval War should be your thing. It is a masterly mix of strategy, politics and battlefield tactics. The strategy part will not really challenge your system of course, as it is more like a boardgame. The battlefield part is however quite stunning. A few thousands of spearman, knights, archers, arbalests and siege weapons march by in enormous landscapes, such as the Sahara Desert, British forests, Russian plains and the Alps mountain range.

The computer oponent is cunning and quick-witted, as it will try to lure your onrushing cavalry towards it's best pikeman. It will also try to let it's cavalry charge on your archers and arbalests, if they are only a little bit exposed and open in the field. The morale, the hardiness and experience of your solders, the reputation and capabilities of your general, the position of your troops, it all determines the outcome of the battles. In other words, this is a very demanding game, which should hog the power of both your video card and CPU.

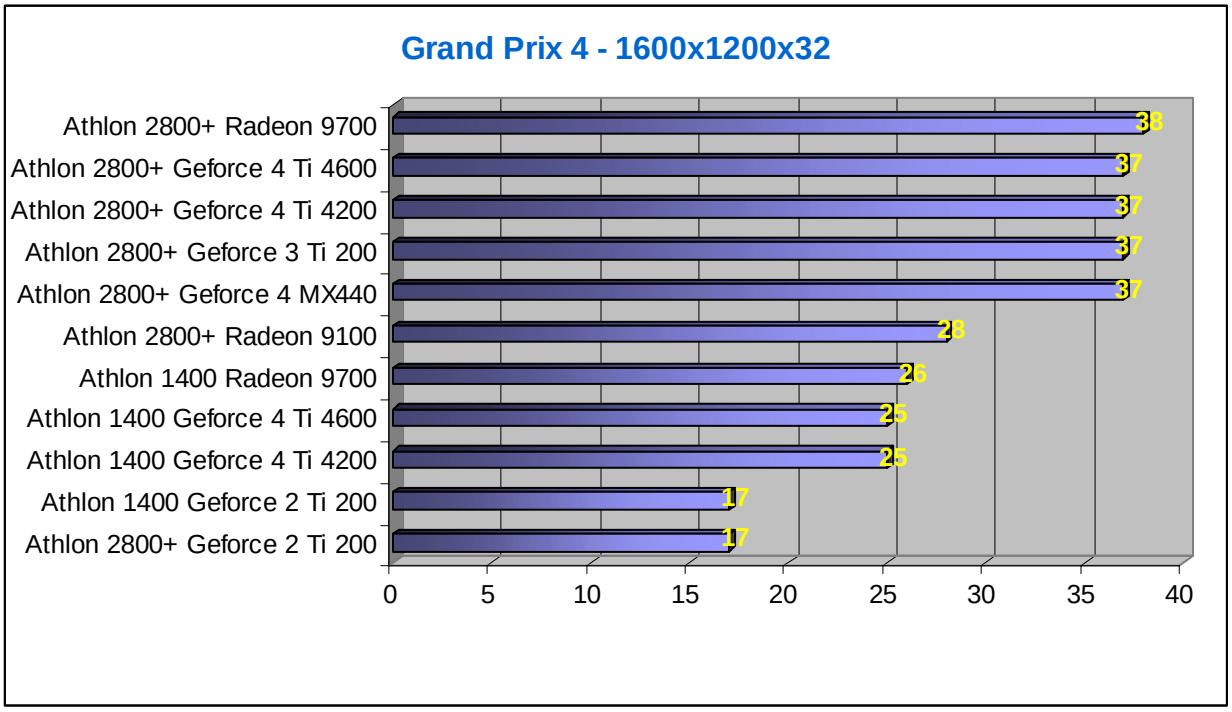
Medieval: Total War is based on the an improved version of the game engine that powered "Shogun: Total War."



While a RTS game almost naturally needs a lot of CPU power to create a decent computer opponent and to calculate the enormous amount of parameters and variables, the enormous open landscapes and huge amount of animated solders take it's toll on the video card. The engine seems to use the T&L capabilities to somewhat offload the CPU very well, as a CPU upgrade helps little but replacing the Ti200 by a Geforce 4 almost doubles your framerate. And believe me, you need a decent framerate if you want to be able to give new orders quickly to your troops.

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 mapped (cars, reflections in wet surfaces) and bump mapping (heat haze from engine heat).



Only at 1600x1200, the video card starts to play. And even with a humble Geforce 4 MX440, the game maxes out at 37 fps. Clearly a CPU limited game.

Conclusion

We can come to two important conclusions. Firstly, it is clear that what we told you a year ago, is no longer entirely valid. In the past, RPG, RTS and simulators were mostly CPU limited, and a fast video card could not boost these games to much higher framerates. As games are using more and more of the new possibilities of pixel and vertex shaders, and are leveraging the power of the T&L unit, the importance of the video card grows. Specifically, many games now feature several levels of detail, enabling those with faster video cards to enable extra shadowing, higher levels of geometry, higher resolution textures, and so forth.

In the more strategy-oriented first person shooters -- namely Ghost Recon and Battlefield 1942 -- we see the opposite trend. In these games, the NPC and enemy AI can make or break the game. The amount of time spent in AI routines has percentage wise grown enormously. Back in 1999, AI demanded about 1-4% of the CPU's power. Today, CPUs are spending up to 25% of their time crunching through AI algorithms. CPU power is thus getting more important for many such games.

The best approach to upgrading is to consider what types of games you play most, and then upgrade the component that will provide the most benefit to that genre. In the case of Battlefield 1942 and Ghost Recon, a new CPU may be in order, while other games may warrant the purchase of a new video card. Hopefully this guide will give you a good idea of where your system's weak point lies, so you can upgrade it. Until next time...