Eyefinity

We are going to start with AMD's approach to building multiple-display configurations. The marketing department at AMD has been working really hard for the last five years or so. ATI acquisition and brand merger that followed obviously required a lot of effort from the marketing department to convince the public that all changes are for the best not only for the company, but also for the end-users.

Taking into account the user feedback, growing demand and previous technological achievements AMD came up with [AMD Eyefinity Technology](http://www.amd.com/us/products/technologies/amd-eyefinity-technology/Pages/eyefinity.aspx). This technology allows putting together three, four, five or even six displays for a truly unique gaming experience. It was supposed to be a technological masterpiece and a dream setup for all major hardcore gamers out there.

But not everything is as rosy as it seems. There are a few problems to overcome on this way to perfection. First of all you need six displays, each of which is going to cost you at least $250. Secondly, you need enough space to build this permanent setup. Wall mounting is going to set you back another few hundred dollars. The power bills are the next big thing. Let’s assume you agree to all of the above mentioned expenses, but unfortunately, this is not all yet.

You see, natively AMD Radeon HD graphics cards support only two displays, no matter what connection protocol is used. But if you want to connect a third, fourth, fifth or sixth monitor you need an adapter supporting DisplayPort for each monitor after the first two. On the positive note I have to say that the whole system is quite user friendly and its broad compatibility allows you to tie together different display models.

AMD has recently updated its [online setup guide](http://www.amd.com/us/products/technologies/amd-eyefinity-technology/how-to/Pages/how-to.aspx) so it became even easier go get your multi-display system started. As you can also see from the screenshots above, Catalyst Control Center offers very simple and intuitive setup options and you should hardly have any difficulty configuring your multi-monitor system with AMD Eyefinity.

3d vision

Unlike their competitors from AMD, the marketing department at Nvidia had plenty of time to practice. The management of this Santa Clara Company realized long time ago that emotions help the sales. This is exactly where products with Nvidia logo excel. Somehow they manage to give you an additional feeling of involvement and supremacy.

The current Nvidia's Holy Grail of marketing and product placement opportunities are largely based on their three main technologies. PhysX provides an advanced physics model for game developers. SLI brings more performance for a single system thanks to dual-card support. And [3D Vision Surround Technology](http://www.nvidia.com/object/3d-vision-surround-technology.html) implemented via 3D stereoscopic glasses brings true 3D experience to the gaming community.

As part of the 3D Vision Surround Technology package, one may choose to install only the Surround Vision, without the additional expensive 3D. For the latter you need a slightly different breed of monitors with a different price tag and, in fact, this could be a topic for a separate review.

Just like AMD’s Eyefinity Technology, Nvidia allows tying together three monitors for a better gaming experience. Unlike their competitors, Nvidia offers a different approach. They do not expect the users to invest extra money in adapters with DisplayPort. On the other hand, Nvidia expects you to have three identical displays. This isn't necessarily a huge disadvantage for someone building a new gaming rig from the ground up. But if you happen to have a slightly outdated display you'll most likely have to get rid of it. Chances are that you won’t find the same exact model anymore.

Another little issue or what some may even consider a disadvantage of the Nvidia’s Surround gaming setup originates from the graphics chip architecture. If you are interested in building an Nvidia-powered gaming rig, there are only two options – expensive and very expensive. In order to create a three-display set-up ForceWare graphics driver needs to address two physical GPUs in a single system. Currently only GeForce GTX 590 is capable of enabling 3D Vision Surround Technology on a single graphics card. Alternately you may choose to run an SLI setup with two graphics cards, but this means investing in the second adapter as well as into an SLI-ready mainboard and possibly a more powerful PSU.

Configuring a monster system like that is no trickier than the AMD one, and just like its counterpart Nvidia posted an in-depth [online guide](http://nvidia.custhelp.com/app/answers/detail/a_id/2667) describing every step in detail. No matter which approach you find more appealing, in the end the only thing that matters is performance and more realistic gaming experience. So, performance is going to be the next thing we will discuss.

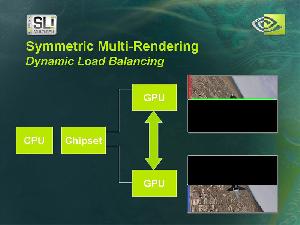
SLI

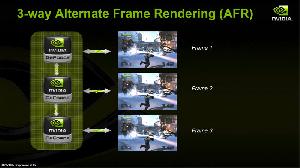
With the recent release of CrossFireX by AMD/ATI and 3-way SLI by NVIDIA we think it is a good time to make a technical comparison between all incarnations of these two technologies, which have the same goal: to allow video cards to be connected in parallel in order to increase gaming performance.

Let’s start first talking about SLI, since it was the first of the two technologies to be released. SLI was originally introduced by 3dfx in 1998 with their Voodoo 2 card. At that time SLI meant Scan Line Interleaving and worked by making each GPU to process one group of lines (one GPU processing odd lines and the other processing even lines). NVIDIA bought 3dfx on April 19th 2001 and introduced a similar but updated concept for their video cards in June 2004, renaming SLI to Scalable Link Interface.

SLI can work under the following modes:

* SFR (Split Frame Rendering), where each frame is divided in two and each half is sent to a different GPU to be processed. This is the mode used by SLI configurations using two video cards. See Figure 1.
* AFR (Alternate Frame Rendering), where each GPU processes an entire frame, but while one GPU is processing the current frame, the other GPU is already rendering the next frame, so when the first frame is delivered, the second frame is already rendered (ideally) or almost rendering. This is the mode used by three-way SLI. See Figure 2.
* AFR of SFR, which is used on Quad SLI system. Here two GPUs process the first frame under SFR mode while the other two GPUs are processing the next frame also under SFR mode.
* SLI AA (Anti-Aliasing). This mode isn’t intended to improve gaming performance but increasing image quality. In fact under this mode the game usually runs slower but with a better image quality. While with a single video card you can typically only obtain up to 4x or 8x anti-aliasing modes, with SLI this number is elevated to 8x, 16x or 32x, depending on the SLI mode. So far this mode does not work under Windows Vista.







Crossfire

Of course NVIDIA’s rival ATI couldn’t stay behind and released an equivalent technology to work with video cards based on ATI chips. The main advantage of CrossFire over SLI is that on CrossFire the video cards don’t need to be based on the same graphics chip (GPU) – but there are some limitations to what cards can be used together, as will explain in details (basically the cards can be different but must be from the same family).

CrossFire can use the following modes to render images:

* Scissors: This mode is similar to the SFR (Split Frame Rendering) from SLI, but since you can hook two different video cards under CrossFire, the half of the screen rendered by the fastest video card would be done first and the card would have to wait for the slower can to finish its job to go ahead to the next frame. This would make the faster video card work at the same speed of the slower one. To solve this problem, Crossfire enables dynamic load balancing, i.e., if a fast card is connected together with a slower one, the system won’t divide the screen as two equal parts, it will put the faster card to render a bigger portion of the screen than the slower one, thus making them to finish the rendering at the same time.
* SuperTiling: Under this mode the screen is divided into several small squared portions (or “tiles”), each one measuring 32x32 pixels, and each video card is in charge of handling part of the available tiles. Load balancing is also used here, so the fastest card will get more tiles to render than the slowest card if you use two different video cards.
* Alternate Frame Rendering (AFR): this mode is identical to the SLI mode with the same name, where while one video card is rendering the current frame, the other card is rendering the next frame.
* Super AA: Equivalent to SLI AA, this mode allows increase image quality instead of performance. You can increase AA (anti-aliasing) up to x14 under this mode.

Just like SLI, CrossFire is available only to PCI Express cards and you need to have a motherboard with two (or four, in the case of CrossFireX) x16 PCI Express slots and the motherboard must be based on an AMD/ATI or Intel chipset. Keep in mind that depending on the chipset the x16 PCI Express slots can run at x8 speed when CrossFire mode is enabled (more on this later).

Also when CrossFire mode is enabled only one video output is available, so you can’t have a multiple monitor configuration under CrossFire, just a single display.

So far there are three CrossFire generations: CrossFire, Native CrossFire and CrossFireX.

The first generation of CrossFire had two main problems. First they required a “master” card, called “CrossFire Edition,” which was different from the regular model sold around – it had an additional chip called “compositing engine.” For example, there was Radeon X850 CrossFire Edition and the regular Radeon X850 XT video card. You couldn’t use two Radeon X850 XT cards, one of them needed to be the special CrossFire edition.

The second major problem was that you needed an external cable to connect the video cards, as you can see in Figure 7. This cable connects the DVI output from the “slave” card to a connector called DMS-59 (or DMS for short), which has the same physical size of DVI but with more pins, or to a connector called VHDCI (Very High Density Cable Interconnect), which is a connector originally used by some SCSI devices, on the “master” card.

This version of CrossFire can increase the maximum resolution of your video card up to 2560x1600, the same limit of SLI.

Hybrid CrossFireX is the equivalent of NVIDIA’s GeForce Boost technology.

Metaphorically speaking ati has a good engine compared to nvidia. But nvidia has a better car

AMD GCN

Available on select, high-performance AMD Radeon™ HD 7000 Series graphics products, the **Graphics Core Next (GCN) Architecture**is a radically new approach to the design of a consumer GPU.

Most importantly, it is the world's first 28nm GPU architecture, which enables AMD to fit up to 4.3 billion transistors-the most basic building blocks of a GPU-into approximately the same space once needed to fit 2.6 billion. Increasing transistor density by greater than 60% is more than just a feat of engineering-it's responsible for the world's most powerful and advanced GPU.1

Designed to push not only the boundaries of DirectX® 11 gaming, the GCN Architecture is also AMD's first design specifically engineered for general computing. Equipped with up to 32 compute units (2048 stream processors), each containing a scalar coprocessor, AMD's 28nm GPUs are more than capable of handling workloads-and programming languages-traditionally exclusive to the processor. Coupled with the dramatic rise of GPU-aware programming languages like [C++ AMP and OpenCL™](http://blogs.amd.com/developer/2011/07/07/opencl%E2%84%A2-and-microsoft-c-amp/), the GCN Architecture is truly the right architecture for the right time.

## Performance

In simple terms, increasing the number of transistors in a GPU has a big impact on the potential performance of a graphics card-but transistors alone are not enough. It takes a truly great design, like the GCN Architecture, to effectively utilize that potential for real-world performance.

Below you will find just a few examples of how this truly next-generation architecture delivers on one very simple design goal: enable the world's most powerful graphics cards.1

Starting with GPU utilization, AMD has taken great strides to ensure that the GCN Architecture is capable of efficiently using its hardware resources. This seems like such a simple idea, but designing a GPU to frequently approach its peak theoretical performance is a challenge the GCN Architecture tackles with ease.

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The GCN Architecture is designed for improved utilization, which ensures that the GPU is making optimal use of its resources for maximum performance.

DirectX® 11 tessellation has also seen incredible improvement from previous AMD Radeon™ products. On the left in the image below, a chart plots the AMD Radeon™ HD 7970's performance across 32 levels of tessellation, and the results are stunning: a 350% boost at the highest factors.2 And on the right, the GCN Architecture's ability to effectively utilize its potential again shines through: highly-tessellated games are decisively faster by an average of 79%!

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| [Click to enlarge](http://www.amd.com/PublishingImages/Public/Graphic_Illustrations/HighResolutionJPEG/tessellation_benches_960W.jpg) |

The GCN Architecture also benefits from dramatically improved tessellation performance. Games featuring this DirectX® 11 technology are considerably faster than they were on the previous generation of AMD Radeon™ products.

Every gamer knows that the GPU's clockspeed also has a big impact on the performance of a graphics card, and the GCN Architecture keeps that in mind.

But what many don't know is that every graphics card is designed to draw only a certain amount of power from your PC's power supply. This is called the Thermal Design Profile, or TDP, and it's critical that the GPU architecture is capable of making the most of every watt. The GCN Architecture can do that thanks to a technology called AMD PowerTune technology.

AMD PowerTune is an intelligent system that performs real-time analysis of the games and applications that utilize a GPU. Examples of such software might include Battlefield 3 or Furmark. In the event that an application is not making the most of the power available to the GPU, AMD PowerTune can improve that application's performance by raising the GPU's clockspeed by up to 30%! Best of all, this technology is completely automatic and is designed specifically to improve gaming performance.

Available on all 28nm AMD Radeon™ products, AMD PowerTune is designed to enable significantly higher clockspeeds in your favorite games-automatically!

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## Image Quality

But performance is not enough for today's demanding gamers. Image quality, or the clarity and accuracy of textures and effects, is equally important. The GCN Architecture is equipped with three key technologies that dramatically raise the bar in this regard.

### Partially Resident Textures (PRT)

Even in the latest titles, gamers may have noticed that games often re-use or repeat textures, particularly on the ground or in background scenery such as mountains or trees. This is because increasing the physical size or number of textures in a game can have a negative impact on the performance of a GPU. PRT is a radical new technology that hopes to break this cycle.

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PRT can utilize absolutely enormous texture files, up to 32 terabytes large, with minimal performance impact. PRT accomplishes this by streaming small bits of these massive textures into the GPU as needed, giving compatible games a virtually endless supply of unique texture data it can apply to the game world. The GCN Architecture in 28nm AMD Radeon™ products is the first GPU design to feature a hardware implementation of this technology.

Partially Resident Textures (PRT) enables future games to utilize ultra-high resolution textures with the same performance as today's small and often repetitive textures.

### Improved Anisotropic Filtering (AF)

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Available on every modern GPU, anisotropic filtering is a technique that assists the GPU in making sure textures in your favorite games remain razor sharp, even at a distance. Most games now offer the ability to enable this feature, and the AMD Catalyst™ driver suite has long provided players with the option to force enable anisotropic filtering for all of their games.

Where every GPU design differs, however, is in the way the anisotropic filtering is actually executed. The GCN Architecture has been specifically optimized to produce superior results when AF is enabled.

Improved anisotropic filtering in products like the AMD Radeon™ HD 7900 Series ensure gamers get sharper, better textures when this technology is enabled.

### Improved DirectX® 11 Tessellation

As DirectX® 11 titles become more mature, game developers are naturally pushing the envelope of realism by utilizing a greater degree of special rendering effects. One such effect is tessellation, which can dynamically generate additional detail in a scene on the fly.

A wireframe scene of a rally car in DiRT 3 driving through water. On the left, notice there are no ripples. On the right, after tessellation, there is new and dynamic detail in the game.

As with anisotropic filtering, tessellation is not new to GPUs, but the manner in which tessellation is executed can have a large impact on the gaming experience. Because of this, the GCN Architecture has again been optimized to deliver up to 4x the performance of the AMD Radeon™ HD 6000 Series in heavily-tessellated games.

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## Efficiency

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| [Click to enlarge](http://www.amd.com/PublishingImages/Public/Graphic_Illustrations/HighResolutionJPEG/amd_zcp1_960W.jpg) |

Finally, it's important that great performance and great image quality doesn't come at the expense of a high power bill. Compared to the AMD Radeon™ HD 6000 Series, products with the GCN Architecture feature reduced power consumption in the "idle state," better known as the time when you're doing desktop work. But there's more, too.

### AMD ZeroCore Power Technology

AMD ZeroCore Power Technology leverages AMD's leadership in notebook power efficiency to grant our desktop GPUs the ability to power down when your monitor is off, also known as the "long idle state."3

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| [Click to enlarge](http://www.amd.com/PublishingImages/Public/Graphic_Illustrations/HighResolutionJPEG/amd_zcp2_960W.jpg) |

This is great for those times when you've stepped away from your PC to take a call, watch TV, or pop down to the store. Furthermore, AMD ZeroCore Power allows additional GPUs in an AMD CrossFire™ technology configuration to shut off when they're not in use-even the fan stops spinning!

An AMD-exclusive technology, AMD ZeroCore Power ensures that unused or idle GPUs are as efficient as possible.

Even the most hardcore gamer with an AMD CrossFire™ multi-gpu configuration benefits from AMD ZeroCore Power. Unused or idle GPUs are shut down until needed to conserve power.

CUDA

CUDA™ is a parallel computing platform and programming model invented by NVIDIA. It enables dramatic increases in computing performance by harnessing the power of the graphics processing unit (GPU).

With millions of CUDA-enabled GPUs sold to date, software developers, scientists and researchers are finding broad-ranging uses for GPU computing with CUDA. Here are a few examples:

Identify hidden plaque in arteries: Heart attacks are the leading cause of death worldwide. Harvard Engineering, Harvard Medical School and Brigham & Women's Hospital have teamed up to use GPUs to simulate blood flow and identify hidden arterial plaque without invasive imaging techniques or exploratory surgery.

Analyze air traffic flow: The National Airspace System manages the nationwide coordination of air traffic flow. Computer models help identify new ways to alleviate congestion and keep airplane traffic moving efficiently. Using the computational power of GPUs, a team at NASA obtained a large performance gain, reducing analysis time from ten minutes to three seconds.

Visualize molecules: A molecular simulation called NAMD (nanoscale molecular dynamics) gets a large performance boost with GPUs. The speed-up is a result of the parallel architecture of GPUs, which enables NAMD developers to port compute-intensive portions of the application to the GPU using the CUDA Toolkit.

BACKGROUND

## GPU Computing: The Revolution

You're faced with imperatives: Improve performance. Solve a problem more quickly. Parallel processing would be faster, but the learning curve is steep – isn't it?

Not anymore. With CUDA, you can send C, C++ and Fortran code straight to GPU, no assembly language required.

Developers at companies such as Adobe, ANSYS, Autodesk, MathWorks and Wolfram Research are waking that sleeping giant – the GPU -- to do general-purpose scientific and engineering computing across a range of platforms.

Using high-level languages, GPU-accelerated applications run the sequential part of their workload on the CPU – which is optimized for single-threaded performance – while accelerating parallel processing on the GPU. This is called "GPU computing."

GPU computing is possible because today's GPU does much more than render graphics: It sizzles with a teraflop of floating point performance and crunches application tasks designed for anything from finance to medicine.

CUDA is widely deployed through thousands of applications and published research papers and supported by an installed base of over 375 million CUDA-enabled GPUs in notebooks, workstations, compute clusters and supercomputers.

Visit [CUDA Zone](http://developer.nvidia.com/category/zone/cuda-zone) for examples of applications in diverse vertical markets… and awaken your GPU giant.

## History of GPU Computing

The first GPUs were designed as graphics accelerators, supporting only specific fixed-function pipelines. Starting in the late 1990s, the hardware became increasingly programmable, culminating in NVIDIA's first GPU in 1999. Less than a year after NVIDIA coined the term GPU, artists and game developers weren't the only ones doing ground-breaking work with the technology: Researchers were tapping its excellent floating point performance. The General Purpose GPU (GPGPU) movement had dawned.

But GPGPU was far from easy back then, even for those who knew graphics programming languages such as OpenGL. Developers had to map scientific calculations onto problems that could be represented by triangles and polygons. GPGPU was practically off-limits to those who hadn't memorized the latest graphics APIs until a group of Stanford University researchers set out to reimagine the GPU as a "streaming processor."

In 2003, a team of researchers led by Ian Buck unveiled Brook, the first widely adopted programming model to extend C with data-parallel constructs. Using concepts such as streams, kernels and reduction operators, the Brook compiler and runtime system exposed the GPU as a general-purpose processor in a high-level language. Most importantly, Brook programs were not only easier to write than hand-tuned GPU code, they were seven times faster than similar existing code.

NVIDIA knew that blazingly fast hardware had to be coupled with intuitive software and hardware tools, and invited Ian Buck to join the company and start evolving a solution to seamlessly run C on the GPU. Putting the software and hardware together, NVIDIA unveiled CUDA in 2006, the world's first solution for general-computing on GPUs.

ECOSYSTEM

## Tools and Training

Today, the CUDA ecosystem is growing rapidly as more and more companies provide world-class tools, services and solutions.

If you want to write your own code, the easiest way to harness the performance of GPUs is with the [CUDA Toolkit](http://developer.nvidia.com/cuda-toolkit), which provides a comprehensive development environment for C and C++ developers.

The CUDA Toolkit includes a compiler, math libraries and tools for debugging and optimizing the performance of your applications. You'll also find code samples, programming guides, user manuals, API references and other documentation to help you get started.

NVIDIA provides all of this free of charge, including NVIDIA Parallel Nsight for Visual Studio, the industry's first development environment for massively parallel applications that use both GPUs and CPUs.

Learning to use CUDA is convenient, with comprehensive [online training](http://developer.nvidia.com/cuda-education-training)available as well as other resources, such as [webinars](http://developer.nvidia.com/gpu-computing-webinars) and [books](http://developer.nvidia.com/cuda-books). Over 400 universities and colleges teach CUDA programming, including dozens of CUDA[Centers of Excellence](http://research.nvidia.com/content/cuda-centers-excellence) and CUDA Research and Training Centers.

# PhysX

From Wikipedia, the free encyclopedia

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| PhysX | |
| [Nvidia physx official logo.png](http://en.wikipedia.org/wiki/File:Nvidia_physx_official_logo.png) | |
| [Developer(s)](http://en.wikipedia.org/wiki/Software_developer) | [NVIDIA Corporation](http://en.wikipedia.org/wiki/Nvidia) |
| [Stable release](http://en.wikipedia.org/wiki/Software_release_life_cycle) | 9.12.1031, 306.97 nvidia drivers / November 26, 2012; 3 months ago |
| [Operating system](http://en.wikipedia.org/wiki/Operating_system) | [Windows 7](http://en.wikipedia.org/wiki/Windows_7), [Windows Vista](http://en.wikipedia.org/wiki/Windows_Vista), [Windows XP](http://en.wikipedia.org/wiki/Windows_XP), [Mac OS X](http://en.wikipedia.org/wiki/Mac_OS_X), [Linux](http://en.wikipedia.org/wiki/Linux) (not GPU accelerated), [Wii](http://en.wikipedia.org/wiki/Wii),[PlayStation 3](http://en.wikipedia.org/wiki/PlayStation_3), [Xbox 360](http://en.wikipedia.org/wiki/Xbox_360) |
| [Type](http://en.wikipedia.org/wiki/List_of_software_categories) | [Physics simulation](http://en.wikipedia.org/wiki/Physics_simulation) |
| [License](http://en.wikipedia.org/wiki/Software_license) | [Proprietary](http://en.wikipedia.org/wiki/Proprietary_software), Commercial |
| Website | [Nvidia PhysX developer site](http://developer.nvidia.com/physx) |

PhysX is a [proprietary](http://en.wikipedia.org/wiki/Proprietary_software) [realtime](http://en.wikipedia.org/wiki/Real-time_computer_graphics) [physics engine](http://en.wikipedia.org/wiki/Physics_engine) [middleware](http://en.wikipedia.org/wiki/Middleware) [SDK](http://en.wikipedia.org/wiki/Software_development_kit). It was developed by [Ageia](http://en.wikipedia.org/wiki/Ageia) with the purchase of [ETH Zurich](http://en.wikipedia.org/wiki/ETH_Zurich) spin-off NovodeX in 2004. Ageia was acquired by [Nvidia](http://en.wikipedia.org/wiki/Nvidia) in February 2008.[[1]](http://en.wikipedia.org/wiki/PhysX#cite_note-1)

The term PhysX can also refer to the [PPU](http://en.wikipedia.org/wiki/Physics_processing_unit) [expansion card](http://en.wikipedia.org/wiki/Expansion_card) designed by Ageia to accelerate PhysX-enabled [video games](http://en.wikipedia.org/wiki/Video_game).

Video games supporting [hardware acceleration](http://en.wikipedia.org/wiki/Hardware_acceleration) by PhysX can be accelerated by either a PhysX PPU or a [CUDA](http://en.wikipedia.org/wiki/CUDA)-enabled [GeForce](http://en.wikipedia.org/wiki/GeForce) [GPU](http://en.wikipedia.org/wiki/Graphics_processing_unit) (if it has at least 256MB of dedicated VRAM), thus offloading physics calculations from the [CPU](http://en.wikipedia.org/wiki/Central_processing_unit), allowing it to perform other tasks instead. This typically results in a smoother gaming experience[*[citation needed](http://en.wikipedia.org/wiki/Wikipedia:Citation_needed" \o "Wikipedia:Citation needed)*] and additional visual effects.

Middleware physics engines allow [game developers](http://en.wikipedia.org/wiki/Game_development) to avoid writing their own code to handle the complex [physics](http://en.wikipedia.org/wiki/Physics) interactions possible in modern games. PhysX is one of the handful of physics engines used in all of today's games.[[2]](http://en.wikipedia.org/wiki/PhysX#cite_note-sdk3-2)

The PhysX engine and [SDK](http://en.wikipedia.org/wiki/Software_development_kit) are available for [Microsoft Windows](http://en.wikipedia.org/wiki/Microsoft_Windows), [Mac OS X](http://en.wikipedia.org/wiki/Mac_OS_X), [Linux](http://en.wikipedia.org/wiki/Linux), [PlayStation 3](http://en.wikipedia.org/wiki/PlayStation_3),[[3]](http://en.wikipedia.org/wiki/PhysX#cite_note-ps3-physx-license-3)[[4]](http://en.wikipedia.org/wiki/PhysX#cite_note-4) [Xbox 360](http://en.wikipedia.org/wiki/Xbox_360)[[5]](http://en.wikipedia.org/wiki/PhysX#cite_note-PhysX_website-5) and the [Wii](http://en.wikipedia.org/wiki/Wii).[[6]](http://en.wikipedia.org/wiki/PhysX#cite_note-Gamasutra_News-6) The PhysX SDK is provided to developers for free for both commercial and non-commercial use on Windows. For Linux, OSX and Android platforms the PhysX SDK is free for educational and non-commercial use.[[7]](http://en.wikipedia.org/wiki/PhysX#cite_note-7)

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## [[edit](http://en.wikipedia.org/w/index.php?title=PhysX&action=edit&section=1)]History

What is known today as PhysX originated as a physics simulation engine called NovodeX. The multi-threaded engine was developed by Swiss company NovodeX AG. In 2004, [Ageia](http://en.wikipedia.org/wiki/Ageia) acquired NovodeX AG and began developing a hardware technology that could accelerate physics calculations, aiding the CPU. Ageia called the technology PhysX PPU (physics processing unit), and the SDK was renamed from NovodeX to PhysX.[[8]](http://en.wikipedia.org/wiki/PhysX#cite_note-8)

In 2008, Ageia was itself acquired by graphics technology manufacturer [Nvidia](http://en.wikipedia.org/wiki/Nvidia). Nvidia started enabling PhysX hardware acceleration on its line of GeForce graphics cards[[9]](http://en.wikipedia.org/wiki/PhysX" \l "cite_note-9) and eventually dropped support for Ageia PPUs.[[10]](http://en.wikipedia.org/wiki/PhysX#cite_note-NoSupport-10)

## [[edit](http://en.wikipedia.org/w/index.php?title=PhysX&action=edit&section=2)]Features

PhysX is a multi-threaded physics simulation [SDK](http://en.wikipedia.org/wiki/Software_development_kit) available for [Microsoft Windows](http://en.wikipedia.org/wiki/Microsoft_Windows), [Mac OS X](http://en.wikipedia.org/wiki/Mac_OS_X), [Linux](http://en.wikipedia.org/wiki/Linux), [PlayStation 3](http://en.wikipedia.org/wiki/PlayStation_3), [Xbox 360](http://en.wikipedia.org/wiki/Xbox_360) and [Wii](http://en.wikipedia.org/wiki/Wii). It supports rigid body dynamics, soft body dynamics, [ragdolls](http://en.wikipedia.org/wiki/Ragdoll_physics) and character controllers, vehicle dynamics, volumetric fluid simulation and cloth simulation including tearing and pressurized cloth.

### [[edit](http://en.wikipedia.org/w/index.php?title=PhysX&action=edit&section=3)]APEX PhysX

[Nvidia](http://en.wikipedia.org/wiki/Nvidia) APEX technology is a multi-platform scalable dynamics framework first introduced in [*Mafia II*](http://en.wikipedia.org/wiki/Mafia_II) in August 2010.[[11]](http://en.wikipedia.org/wiki/PhysX#cite_note-APEX-11) Nvidia's APEX engine comprises the following features: APEX Destruction, APEX Clothing, APEX Particles, APEX Vegetation, and APEX Turbulence.[[12]](http://en.wikipedia.org/wiki/PhysX#cite_note-12)

## [[edit](http://en.wikipedia.org/w/index.php?title=PhysX&action=edit&section=4)]Hardware acceleration

[](http://en.wikipedia.org/wiki/File:Mafia_physx.jpg)

[http://bits.wikimedia.org/static-1.21wmf11/skins/common/images/magnify-clip.png](http://en.wikipedia.org/wiki/File:Mafia_physx.jpg)

The top screenshot shows how debris is simulated in [Mafia II](http://en.wikipedia.org/wiki/Mafia_II) when PhysX is turned to the highest level in the game settings. The bottom screenshot shows a similar scene with PhysX turned to the lowest level.

### [[edit](http://en.wikipedia.org/w/index.php?title=PhysX&action=edit&section=5)]PPU

A [physics processing unit](http://en.wikipedia.org/wiki/Physics_processing_unit) (PPU) is a processor specially designed to alleviate the calculation burden on the CPU, specifically calculations involving physics. PPU cards with PhysX support were available from the manufacturers [ASUS](http://en.wikipedia.org/wiki/ASUS), [BFG Technologies](http://en.wikipedia.org/wiki/BFG_Technologies)[[13]](http://en.wikipedia.org/wiki/PhysX#cite_note-13) and [ELSA Technology](http://en.wikipedia.org/wiki/ELSA_Technology). Beginning with version 2.8.3 of the PhysX SDK, support for PPU cards was dropped, and PPU cards are no longer manufactured.[[10]](http://en.wikipedia.org/wiki/PhysX#cite_note-NoSupport-10)

### [[edit](http://en.wikipedia.org/w/index.php?title=PhysX&action=edit&section=6)]GPU

After [Nvidia](http://en.wikipedia.org/wiki/Nvidia)'s acquisition of [Ageia](http://en.wikipedia.org/wiki/Ageia), PhysX development turned away from PPU extension cards and focused instead on the [GPGPU](http://en.wikipedia.org/wiki/GPGPU) capabilities of modern [GPUs](http://en.wikipedia.org/wiki/Graphics_processing_unit). A graphics processing unit or GPU (also occasionally called visual processing unit or VPU) is a dedicated graphics rendering device for a personal computer, workstation or game console. Modern GPUs are very efficient at manipulating and displaying computer graphics, and their highly parallel structure makes them more effective than general-purpose CPUs for a range of complex algorithms, such as accelerating physical simulations using PhysX. A GPU can sit on top of a video card, or it can be integrated directly into the motherboard. More than 90% of new desktop and notebook computers have integrated GPUs.

Any [CUDA](http://en.wikipedia.org/wiki/CUDA)-ready GeForce graphics card (series 8 and newer, with a minimum of 256MB of video memory[[14]](http://en.wikipedia.org/wiki/PhysX" \l "cite_note-nvidia.com-14)) can take advantage of PhysX without the need to install a dedicated PhysX card.

Versions 186 and newer of the ForceWare drivers disable PhysX hardware acceleration if a GPU from a different manufacturer, such as [AMD](http://en.wikipedia.org/wiki/Advanced_Micro_Devices), is present in the system.[[14]](http://en.wikipedia.org/wiki/PhysX#cite_note-nvidia.com-14) Representatives at Nvidia stated to customers that the decision was made due to development expenses, and for quality assurance and business reasons.[[15]](http://en.wikipedia.org/wiki/PhysX#cite_note-15) This decision has caused a backlash from the community that led to the creation of a community patch for Windows 7, circumventing the GPU check in Nvidia's updated drivers. To counter this patch, Nvidia implemented a time bomb in driver versions 196 and 197 that slowed down hardware accelerated PhysX and reversed the gravity,[[16]](http://en.wikipedia.org/wiki/PhysX#cite_note-16) but an updated version of the patch removed all unwanted effects.[[17]](http://en.wikipedia.org/wiki/PhysX#cite_note-17)

## [[edit](http://en.wikipedia.org/w/index.php?title=PhysX&action=edit&section=7)]Real World Technologies analysis

On 5 July 2010, Real World Technologies published an analysis[[18]](http://en.wikipedia.org/wiki/PhysX" \l "cite_note-18) of the PhysX architecture. According to this analysis, most of the code used in PhysX applications at the time was based on [x87](http://en.wikipedia.org/wiki/X87)instructions without any multi-threading optimization. This could cause significant performance drops when running PhysX code on the CPU. The article suggested that a PhysX rewrite using [SSE](http://en.wikipedia.org/wiki/Streaming_SIMD_Extensions) instructions may substantially lessen the performance discrepancy between CPU PhysX and GPU PhysX.

In response to the Real World Technologies analysis, Mike Skolones, product manager of PhysX, said[[19]](http://en.wikipedia.org/wiki/PhysX" \l "cite_note-19) that SSE support had been left behind because most games are developed for [consoles](http://en.wikipedia.org/wiki/Video_game_console) first and then ported to the PC. As a result, modern computers run these games faster and better than the consoles even with little or no optimization. Senior PR manager of Nvidia, Bryan Del Rizzo, explained that multi-threading had already been available with CPU PhysX 2.x and that it had been up to the developer to make use of it. He also stated that automatic multithreading and SSE would be introduced with version 3 of the PhysX SDK.[[20]](http://en.wikipedia.org/wiki/PhysX#cite_note-20)

PhysX SDK 3.0 was released in May 2011 and represented a significant rewrite of the SDK, bringing improvements such as more efficient multithreading and a unified code base for all supported platforms.[[2]](http://en.wikipedia.org/wiki/PhysX#cite_note-sdk3-2)

## [[edit](http://en.wikipedia.org/w/index.php?title=PhysX&action=edit&section=8)]Use

### [[edit](http://en.wikipedia.org/w/index.php?title=PhysX&action=edit&section=9)]PhysX in video games

*See also:*[*List of games with hardware-accelerated PhysX support*](http://en.wikipedia.org/wiki/List_of_games_with_hardware-accelerated_PhysX_support)

PhysX technology is used by [game engines](http://en.wikipedia.org/wiki/Game_engine) such as [Unreal Engine](http://en.wikipedia.org/wiki/Unreal_Engine) (version 3 onwards), [Unity 3D](http://en.wikipedia.org/wiki/Unity_(game_engine)), [Gamebryo](http://en.wikipedia.org/wiki/Gamebryo), [Vision](http://en.wikipedia.org/wiki/Vision_Engine) (version 6 onwards), Instinct Engine,[[21]](http://en.wikipedia.org/wiki/PhysX#cite_note-21) [Panda3D](http://en.wikipedia.org/wiki/Panda3D), [Diesel](http://en.wikipedia.org/wiki/Diesel_(game_engine)), [Torque](http://en.wikipedia.org/wiki/Torque_(game_engine)), [HeroEngine](http://en.wikipedia.org/wiki/HeroEngine) and[BigWorld](http://en.wikipedia.org/wiki/BigWorld).[[22]](http://en.wikipedia.org/wiki/PhysX#cite_note-22)

As one of the handful of major physics engines, it is used in many games, such as [*Bulletstorm*](http://en.wikipedia.org/wiki/Bulletstorm), [*Need for Speed: Shift*](http://en.wikipedia.org/wiki/Need_for_Speed:_Shift), [*Castlevania: Lords of Shadow*](http://en.wikipedia.org/wiki/Castlevania:_Lords_of_Shadow), [*Mafia II*](http://en.wikipedia.org/wiki/Mafia_II), [*Alice: Madness Returns*](http://en.wikipedia.org/wiki/Alice:_Madness_Returns), [*Batman: Arkham City*](http://en.wikipedia.org/wiki/Batman:_Arkham_City)etc. Most of these games use the CPU to process the physics simulations.

Video games with optional support for hardware-accelerated PhysX often include additional effects such as tearable cloth, dynamic smoke or simulated particle debris.[[23]](http://en.wikipedia.org/wiki/PhysX#cite_note-23)[[24]](http://en.wikipedia.org/wiki/PhysX#cite_note-24)[[25]](http://en.wikipedia.org/wiki/PhysX#cite_note-25)

### [[edit](http://en.wikipedia.org/w/index.php?title=PhysX&action=edit&section=10)]PhysX in other software

Other software with PhysX support includes:

* [Active Worlds](http://en.wikipedia.org/wiki/Active_Worlds) (AW), a 3D virtual reality platform with its client running on Windows
* [Autodesk 3ds Max](http://en.wikipedia.org/wiki/Autodesk_3ds_Max), [Autodesk Maya](http://en.wikipedia.org/wiki/Autodesk_Maya) and [Autodesk Softimage](http://en.wikipedia.org/wiki/Autodesk_Softimage), [computer animation](http://en.wikipedia.org/wiki/Computer_animation) suites[[26]](http://en.wikipedia.org/wiki/PhysX#cite_note-26)[[27]](http://en.wikipedia.org/wiki/PhysX#cite_note-27)[[28]](http://en.wikipedia.org/wiki/PhysX#cite_note-28)
* [DarkBASIC Professional](http://en.wikipedia.org/wiki/DarkBASIC_Professional) (with DarkPHYSICS upgrade), a [programming language](http://en.wikipedia.org/wiki/Programming_language) targeted at game development[[29]](http://en.wikipedia.org/wiki/PhysX#cite_note-darkbasic-pro-physx-29)
* [DX Studio](http://en.wikipedia.org/wiki/DX_Studio), an integrated development environment for creating interactive 3D graphics[[30]](http://en.wikipedia.org/wiki/PhysX#cite_note-30)
* [Futuremark](http://en.wikipedia.org/wiki/Futuremark)'s [3DMark06](http://en.wikipedia.org/wiki/3DMark#Versions) and [Vantage](http://en.wikipedia.org/wiki/3DMark#3DMark_Vantage) [benchmarking tools](http://en.wikipedia.org/wiki/Benchmark_(computing))[[31]](http://en.wikipedia.org/wiki/PhysX#cite_note-31)
* [Microsoft Robotics Studio](http://en.wikipedia.org/wiki/Microsoft_Robotics_Studio), an environment for robot control and simulation[[32]](http://en.wikipedia.org/wiki/PhysX#cite_note-32)
* [Nvidia](http://en.wikipedia.org/wiki/Nvidia) [SuperSonic Sled](http://en.wikipedia.org/wiki/Nvidia_demos#SuperSonic_Sled) and [Raging Rapids Ride](http://en.wikipedia.org/wiki/Nvidia_demos#Raging_Rapids_Ride), technology demos
* [OGRE](http://en.wikipedia.org/wiki/OGRE) (via the NxOgre wrapper), an [open source](http://en.wikipedia.org/wiki/Open_source_software) [rendering engine](http://en.wikipedia.org/wiki/Rendering_(computer_graphics))
* The [Physics Abstraction Layer](http://en.wikipedia.org/wiki/PAL_(software)), a physical simulation [API](http://en.wikipedia.org/wiki/Application_programming_interface) abstraction system (it provides [COLLADA](http://en.wikipedia.org/wiki/COLLADA) and [Scythe Physics Editor](http://en.wikipedia.org/wiki/Scythe_Physics_Editor) support for PhysX)[[33]](http://en.wikipedia.org/wiki/PhysX#cite_note-33)
* Rayfire, a plug-in for [Autodesk 3ds Max](http://en.wikipedia.org/wiki/Autodesk_3ds_Max) that allows fracturing and other physics simulations

TressFX

##### As promised, AMD has unveiled its TressFX technology today and as we suspected, this new tech will be used in Crystal Dynamics’ upcoming Tomb Raider game. AMD’s TressFX is a hair technology and the company has released some before/after screenshots from Tomb Raider to show off what can be achieved with it.

##### According to AMD, TressFX Hair revolutionizes a characters’ looks by using the DirectCompute programming language to unlock the massively-parallel processing capabilities of the Graphics Core Next architecture, enabling image quality previously restricted to pre-rendered images. Building on AMD’s previous work on Order Independent Transparency (OIT), this method makes use of Per-Pixel Linked-List (PPLL) data structures to manage rendering complexity and memory usage.

##### As AMD noted:

##### “DirectCompute is additionally utilized to perform the real-time physics simulations for TressFX Hair. This physics system treats each strand of hair as a chain with dozens of links, permitting for forces like gravity, wind and movement of the head to move and curl Lara’s hair in a realistic fashion. Further, collision detection is performed to ensure that strands do not pass through one another, or other solid surfaces such as Lara’s head, clothing and body. Finally, hair styles are simulated by gradually pulling the strands back towards their original shape after they have moved in response to an external force. Graphics cards featuring the Graphics Core Next architecture, like select AMD Radeon HD 7000 Series, are particularly well-equipped to handle these types of tasks, with their combination of fast on-chip shared memory and massive processing throughput on the order of trillions of operations per second.”

##### Got the catch here? Graphics cards featuring Graphics Core Next architecture. Yeap, this will be an AMD exclusive feature, so it will be interesting to see how Nvidia will react to this one.