AGP and PCI

Accelerated Graphics Port (AGP) and Peripheral Component Interface (PCI) are two types of slots found on just about every current or recent motherboard. The differences lie in their capabilities. AGP was designed strictly for video cards. It gives equipped systems faster access to a video card's graphics capabilities and a speedy pipe to the system memory to score extra textures. The PCI port, however, is built with general use in mind. Although video cards are still made to work with PCI, you'll generally find sound cards, SCSI cards, and even modems connected to a PCI slot. Among the two, AGP is far better for graphics. If you're in the market for a new video card and your motherboard supports AGP in any respect, your best bet is an AGP video card. The slightly higher cost is offset by the greatly increased speed.

The various flavors of AGP include 1x, 2x, 4x, and the upcoming 8x; the number is an indication of how quickly texture data can be transferred from the system bus to the motherboard. Most 4x implementations include sidebands, which allow requests for data to be sent at the same time as previous requests are being fulfilled. Most current hardware supports 4x.

AGP is of primary importance to gamers whose video cards have less than 32MB of memory. Games run best when all or most texture data is stored in local memory--that is, memory right on the video card. The more memory a video card has, the more likely it is that this is going to be possible. Video cards with smaller amounts of memory will make more judicious use of the AGP bus.

Hardware T&L

Hardware transform and lighting is found on the latest-generation video cards and supported by only a few games at this point--though that will almost certainly change. Hardware T&L, as it is called, is a great step towards helping developers put more detail into objects without bogging down CPUs. To understand hardware T&L, you have to know a bit about the process of rendering 3D graphics.

The moving images you see in a game are actually made up of rapidly displayed still frames. The more still frames your computer is able to display in a given length of time (the most commonly referenced unit of time is one second), the smoother the

scene appears to move. That's why a high frame rate, which is the number of frames drawn in one second, is so desirable.

It takes a series of steps for your computer to lay out and draw (or render) each still frame. In most cases, the steps are transform, lighting, triangle setup, and rendering. Obviously, T&L represents the first two steps.

A 3D application, such as a game, keeps tabs on everything that's going on in a game, including camera movements, the relative motion of other objects, changes in level of detail, physics engine calculations, and other factors. This data is sent through the API and on to the graphics pipeline, where transform, lighting, triangle setup, and rendering take place.

The transform step takes all of that viewpoint data and determines exactly what objects will be rendered in a single frame. Usually, every object--including those obscured from the final rendered scene by closer objects--is transformed. Lighting effects, based on the 3D engine's lighting capabilities, is then applied to the transformed scene. Then the triangles, which are the polygons that make up the 3D objects of the scene, are set up by a floating point engine, and the subsequent data is used in the final step in the process, the rendering of the scene. The rendering engine decides the best color for each pixel that makes up the scene (based on myriad factors including the base color of each textured or multitextured pixel, lighting data, transparency and translucency, fog, and so on.

Traditionally, the transform and lighting are taken care of by the main system processor, and only the final steps are offloaded to the video card's processor. Nvidia's GeForce 256 chipset was the first major graphics chipset to contain its own transform and lighting engine, which is why Nvidia dubbed it a GPU (graphics processing unit, a term which other companies have accepted and are even using to describe their own 3D processors). Hardware T&L, therefore, is the ability of a graphics processor to do transform and lighting calculations, thus offloading the task from the system processor and leaving it free to take care of other processes.

Hardware T&L is still a new, developing technology. Currently, a few games (Soldier of Fortune and MDK2, for example) use T&L, but in many cases it's still faster to let the system processor do it. This is likely to change as hardware T&L engines become more sophisticated and as game developers program their titles to take hardware T&L into account, thus getting the most out of the technology.

Ant aliasing

Ant aliasing, often called FSAA (full-scene ant aliasing), is a technique used by video cards and some software to reduce the jagged look of low and medium resolution graphics. If you look closely at a diagonal line in a game such as Quake II, you'll notice that it isn't entirely straight--it actually seems to resemble stair steps. Ant aliasing blends the edges of these lines, the end result being a smoother, straighter look. Most of the new video cards, including the 3dfx Voodoo5 series, ATI's Radeon cards, and Nvidia's GeForce2 series, offer FSAA. Note, though, that to use it, you have to enable it through the cards' drivers, not through the game's interface.