TECH SHOP

By Christopher Lindquist

Inside MPEG

If you've been following multimedia for a while, you've probably run into the term MPEG more than once. You may have also noticed that the hype surrounding this video-compression technology is frenzied, in spite of sluggish sales of both the hardware necessary to display MPEG video and of the games and multimedia titles that use it.

The MPEG compression standard was established by the International Standards Organization's Motion Pictures Expert Group. It defines a way to compress video and synchronized audio up to 200 times—small enough for a CD-ROM drive to play it back full screen and at a full 24 frames per second. As much as 74 minutes of near–Super VHS–quality MPEG-compressed video can be packed onto a single disc that will play on a single-speed CD-ROM drive.

Despite a number of competing video-compression formats designed for computers, such as Intel's Indeo and Radius's Cinepak, MPEG enjoys the support of such companies as Panasonic, GoldStar, and Philips in 3DO and CD-i CD-ROM–based game consoles. Sigma Designs' ReelMagic cards for the PC use MPEG, as do new products from Creative Labs, RasterOps, and Jazz Multimedia. Even Apple is working on MPEG for its new 630-series Macintoshes.

This onslaught of MPEG products has helped reduce prices, too. Consumer VideoCD players that also play audio CDs are hitting the market for less than $300, and MPEG cards for PCs have dropped from more than $400 to around $200.

This consumer push has attracted the attention of content developers that are looking for a more mass-market buyer pool. As a result, there are currently dozens of MPEG-compressed VideoCD movies, and software companies such as ReadySoft and Infocom have released MPEG versions of their popular games Dragon's Lair and Return to Zork.

To understand what's going on behind the scenes when you see an MPEG image on your screen, read on.

How Big Is Video?

Uncompressed TV-quality video transmits at about 27 megabytes per second. That's 180 times the maximum speed of a single-speed CD-ROM drive. At that rate, 600MB CD-ROMs could hold only a measly 20 seconds' worth of images. Clearly, something had to be done to reduce the amount of video data.

PHOTOGRAPH BY CHRIS CALLIS/EARTHWATER STOCK

Activision's MPEG Return to Zork

Cutting Corners

The first step in shrinking the video data is to lower the quality of the image. Decreasing resolution by a factor of four—from broadcast quality to close to Super VHS quality—helps a little, but it's still necessary to compress the video another 45 times. That's where MPEG comes in.

Back to the Future

MPEG derives its images from a limited number of complete frames—or intraframes—that dictate how the rest of the video will look. These *intraframes* occur only every dozen or so frames. The other 11 frames consist of *predicted frames*, which get their information from the images that precede them, and *bidirectionally predicted frames*, which are derived from either past or future frames. Predicted frames work for objects that are already on the screen, such as a ball moving from left to right. Bidirectionally predicted frames handle objects that are about to appear, such as a ball suddenly thrown across the screen.

Life on the Edge

MPEG is far from perfect. Because it works with 16-by-16 blocks of pixels, object edges can often appear blurry, blocky, or jagged unless the image is hand tuned. Cartoons, in particular, often reveal this shortcoming. The best way for software developers to produce great-looking MPEG titles is to take the time to tweak every frame, which takes considerable effort but results in a superior product.

ReadySoft's MPEG Dragon's Lair

Asymmetry for You and Me

One of the biggest advantages—and one of the biggest drawbacks—to MPEG is that it is an asymmetrical compression technique. That means it takes much more effort to compress MPEG video than to decompress it. That helps keep MPEG decompression hardware fairly inexpensive, but it also lifts MPEG compression out of reach for consumers who want to record their own MPEG movies.

Directionally Challenged

Current MPEG technology delivers maximum crunching power on video that contains consistent, predictable movement. Scenes with lots of objects moving in many directions at once, such as a school of sharks, often suffer from "artifacts" such as blurry, blocky spots in the image. MPEG also prefers that objects move in a straight line; thus rotating objects, such as Ferris wheels or windmills, can be troublesome. Future improvements in the compression technology will no doubt further reduce these artifacts.

How Does MPEG Work?

To store video efficiently, MPEG doesn't compress every single frame. Instead, it transmits only the differences between one frame and the next. For example, in a clip of a man giving a speech, only the area around his mouth and hands changes from frame to frame. The background and much of the rest of his body stay fairly constant, so MPEG doesn't store that extra information on the disc. MPEG also predicts where moving objects will go next based on their direction and speed. So instead of recompressing the whole picture of a baseball flying over the left-field fence, MPEG predicts where the ball will be in the next frame and saves only those pixels.

Crystal Dynamics' MPEG The Horde

Up the Sample

Most MPEG video is compressed at only 352-by-240-pixel resolution, which produces an image about half the size of a standard VGA screen. To get full-screen video, the decompression chip employs a technique called *upsampling*. This process doubles the number of pixels and looks at the pixels on either side of the newly produced pixel to decide what it should look like.

High-Tech Models

MPEG also uses a number of other techniques. Because the eye is more sensitive to brightness than color, MPEG deletes some subtle color information—without noticeably affecting picture quality. Similarly, it removes a small amount of detail that won't be noticeable to a viewer.

Time Warner's MPEG Flash Traffic