Introduction

to

Digital Video

and

The Web

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DV Terminology

Everyone starting out in digital video finds themselves faced with a bewildering array of new buzzwords, acronyms, and terminology. This glossary aims to help you through the confusion by explaining many of the commonly used terms. Rather than just a glossary of words in alphabetical order, the terms are introduced in the order you would encounter them when working though a typical video project. For quick reference there is also an alphabetical index.

Linear editing is the process of copying video between multiple VCR machines, possibly including special effects processors, etc. It can be manually or computer controlled. It is fast but requires expensive equipment for good results.

Non-linear editing (NLE) is the process of manipulating video stored as digital computer files. Special video editor software is used. This allows video to be visually constructed in a manner similar to cutting and sticking cine film. This tutorial focuses on NLE.

Video computer files in the PC world are usually either AVI or MPEG types. The process of getting video into a computer from an external device such as a camcorder is called capturing.

There are two main methods of capturing, either analog or digital (see Video media & formats. You can use analog capture with almost any device; you can only use digital capture with digital devices that have a Firewire output. Both methods require appropriate hardware installed in the computer.

Analog capture normally requires a capture card, but MPEG capture can be done using an external device on a USB or parallel port.

Digital camcorders use the Digital Video (DV) standard. This defines not only the size of the tape, but also the format of the digital data. All DV camcorders produce digital data in the same format. DV and Mini-DV are the same except for the physical size of the cartridge and hence the running time. Digital-8 cameras also use the same data format, but use a tape that is physically the same as Video-8.

Firewire (or IEEE1394) is a high-speed serial data connection, used by almost all DV camcorders. It needs a Firewire port on the computer (often as a plug-in card), but there is now a trend in high-end computers for Firewire to be built-in. DV captured by Firewire is stored in AVI files (when using Microsoft Windows). There are two types, Type-1 and Type-2.

> An AVI file can contain multiple streams, usually one video and one audio. DV is a data stream that itself contains video and audio. In a Type-1 AVI, the whole DV stream is stored unmodified as one AVI stream. In a Type-2 AVI the DV stream is split into separate video and audio data, which are stored as two streams in the AVI.

The advantage of Type-1 is that the DV data does not need to be processed, and is stored in its exact original format. The advantage of Type-2 is that it is compatible with video software that is not specially written to recognize and process Type-1 files.

There are several limits that affect the maximum size of an AVI file.

The original specification for AVI files limits their size to 4GB, but for software reasons the maximum workable size is 2GB. This corresponds to about 9.5 minutes of DV format video.

OpenDML is a standard that extends the AVI specification to effectively remove the file-size limit. If video software and drivers support OpenDML then the size of AVI files is only limited by the operating system and size of disks.

File sizes are also limited by the disk format used by the operating system. FAT32, supported by Windows 95 onwards, does not allow any single file larger than 4GB. NTFS, supported by Windows NT & Windows 2000, allows effectively unlimited files and partitions.

Once video has been captured to disk files, it can be edited. This is done using a special video editor program, and the majority of non-linear editors, such as MediaStudio Pro, are based on the idea of a timeline. This presents a visual workspace on the screen, representing time from left to right. The finished video is composed in the way a cine film might be composed by laying out film clips on a bench. In the NLE process the clips are disk files containing captured video.

Different editors have different capabilities, but most will include transitions allowing various effects when going clip to clip, filters allowing the look of the video to be altered, and overlays allowing multiple clips to be combined in various ways.
When everything has been laid out as required in the timeline, the editor program renders a new video file that contains the result. The original files are not altered; the computer combines information from the files, transitions, effects, and overlays and computes a new file. Depending on complexity, this can require large amounts of computing power resulting in a long rendering time (sometimes more than 10 times running time). The faster the CPU the faster this process runs.

If the result is intended for recording to tape (e.g. DV), the rendered file must be played on the computer, and an output taken to a VCR or recording camcorder. In the case of DV, the output is again the Firewire connection, allowing the pure digital data to be recorded onto tape. If a camcorder is to be used as the external recorder, its Firewire connection must be able to record input as well as replay output. Such a capability is called DV-in and not every camcorder supports it, especially if it is made in Europe.

Both the capture and output-recording processes are simpler and more accurate if the computer can control the tape functions of the camcorder/VCR. OHCI is a standard for sending controlling commands over the Firewire link. If supported by the digital camcorder/VCR and by the computer software, then no manual control is required and the external device effectively becomes a computer peripheral.

There are many more technical terms used in connection with video on computers, but we hope this has helped to explain many of the frequently encountered terms.

Video Formats and the Web

Just a few years ago, video was a form of creative expression intended only for tape, film, and television. However, now that 56K connections are commonplace, and broadband connections such as cable and DSL are rising in popularity, we're seeing a dramatic increase in the use of video on Web sites and as attachments to E-mail.

The rising popularity of video brings with it a familiar challenge: Balancing the need for smaller file sizes with the desire for the best possible quality. Video compression isn't quite as straightforward as static image compression, where we can follow basic rules such as using GIF for computer images and JPG for photos. Video has many commonly used file formats, and those file formats each come with a unique and sometimes complicated set of options. In this article, we'll look at two of the most common file formats, AVI and MPG, and look at how to select compression options when using these formats.

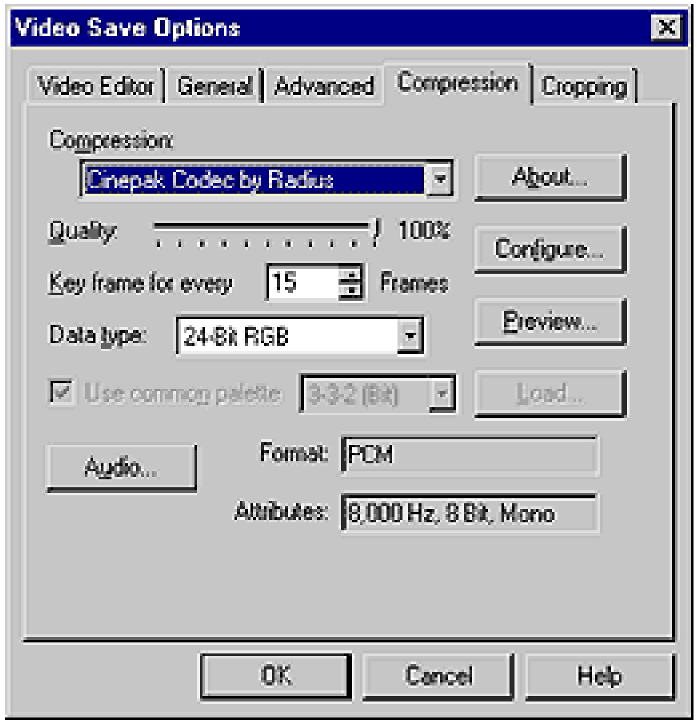
AVI

AVI stands for Audio Video Interleave. Created by Microsoft, AVI is one of the most commonly used video formats. In addition to being able to save live action video and audio in the AVI format, you can export animations from Ulead products such as GIF animator and Cool 3D as AVI files. The advantage to exporting animation in the AVI format (versus the GIF format) is that AVI can handle 16.7 million colors, and has more advanced transparency support as well. A variation of the AVI format, called DV AVI, is used to create Digital Video that can be transferred losslessly (without loss of quality) between computers and camcorders.

The AVI format is dependent upon "codecs" (an acronym for compressor / decompressor). Codecs serve two purposes: They tell your computer how to encode (or compress) a video file when you save the file, and they tell your computer how to decode (or play) the file when you open the file. Since the same codec is needed to both compress the file and play the file, the choice of which codec to use is extremely important. If the codec you use to compress your file is not installed on your user's computer, your user will not be able to play the video.

Note: Many AVI players, including Microsoft's "Windows Media Player" will attempt to download and install an appropriate codec if one is not already installed. However, you should not count on this feature, since downloads can be time consuming, and an appropriate codec cannot always be located.

We'll take a look now at some commonly used compression schemes for AVI video. The screen shots for these sections are from Ulead's Media Studio Pro 6, but you'll also be able to apply these same concepts to other programs.



The Video Save Options dialog box is shown above. The Video Editor tab allows you to select options that are specific to Media Studio Pro 6, such as whether you would like to preview the video immediately after saving it. The General tab is used to set the size and playback speed of your video. The Advanced tab is used when you want to control video quality and file size based on the speed of the hardware that will play your video. The Compression tab enables the selection of video codecs and allows you to set how much compression you would like applied by the codec. The Cropping tab is used to crop your video as it's being saved. For the purpose of this article, we'll focus on compression options, the remaining options may be left at their default settings.

Compression

The Compression drop down list box is used to select a codec. For distributing video from a Web site or via e-mail, it's generally best to stick with one of the following codecs, due to the fact that they're installed on just about every PC (and many Macs as well):

Cinepak Codec by Radius: Cinepak is perhaps the safest choice of codecs for general usage. Cinepak's main advantages are that the codec is already installed on most machines, and that it can play video reliably even on older machines such as Intel 486 computers. Its disadvantage is that, when compared to other codecs, it tends to produce lower quality and larger file sizes.

Indeo Video: Indeo Video was created by Intel and has shipped with Windows since 1994 and with Apple's QuickTime since 1998, making it another of the most widely available codecs. The 3.2 and 5.06 versions are the most widely distributed. Indeo's advantages, particularly in version 5.06, include strong compression and preservation of video quality. It's also more demanding on processors than Cinepak, so it's not the ideal format to use if you expect your viewers to be using 486 processors.

Quality

The quality option allows you to balance file size and video quality, similar to the way in which you can set quality options for JPG images. It's best to start with a quality setting of about 80 to 90, and take advantage of the preview button to make certain that your video is not losing too much quality. While in preview mode you can check the "preview with specified frame size" for a full size preview window.

Key Frame For Every _____ Frames

Most video compression schemes use a delicate balance of key frames and delta frames to create a video file. Key frames contain all of the information required to display the frame, while delta frames require data from previously viewed key frames in order to be displayed. You can think of delta frames as being similar to frames in a GIF animation in which redundant pixels have been removed: Although the frames will display correctly when the animation is played, if you were to look at the animation in an editor such as GIF Animator, you would see that blocks of pixels have been removed to improve compression.

All videos contain at least one key frame in the first frame of the file. The remaining number of key frames will serve to improve the quality of the video, but will also increase file size. As a general rule, you should try using 1 key frame for every 1 second of video. Using this formula, a video that plays 15 frames per second ("frames per second" is set in the "General" tab) will have a key frame every 15 frames. You can improve quality by increasing the number of key frames. Keep in mind that this is accomplished by lowering the "Key Frame For Every _____ Frames" setting. You can improve compression by decreasing the number of key frames per second, which is done by raising the "Key Frame For Every_____ Frames" setting.

Data Type

For the codecs described above, the data type will always be 24-bit RGB, the standard data type for modern computer monitors. Note that if you're creating a low color video, such as text moving across a solid color background, you can choose the "Microsoft RLE" codec, a widely distributed codec that conserves file space by using 8-bit color.

Palette

Palette options are only available with the 8-bit data type, since higher color counts do not require a predefined palette. This option is very similar to the palette option used when creating a GIF file. An optimized palette provides the best color reproduction, while the "6-6-6 (levels)" option provides a video equivalent of the "web-safe" palette.

Audio

Using audio in a video file always increases file size, sometimes dramatically. This makes selecting audio options an important factor in keeping file size to a minimum. If your video file will be delivered via a Web page or e-mail, try the default audio selection of "8,000 Hz, 8-bit, Mono". Any increase in the frequency (the "8,000 Hz" in this example) or the bit count (the "8-bit" in this example), may result in both an improvement in quality and an increase in file size.

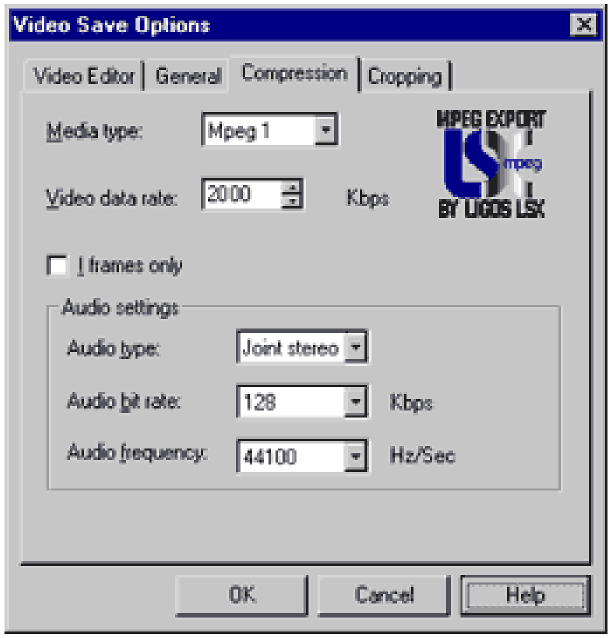
Changing from mono to stereo essentially doubles the amount of space needed to store your file's audio, so stereo should only be used if absolutely necessary. For improved voice quality, instead of switching to stereo, try raising the frequency to 16,000 Hz. For improved music quality, MP3 quality audio is available by clicking the format drop-down list box, and selecting "MPEG Layer 3".

MPG

MPG (or MPEG as it is sometimes called) stands for Moving Picture Experts Group, an independent committee of audio and video experts that created the MPG file format. The MPG format frequently offers better compression than the AVI format, and better image and sound quality as well. MPG export is not supported as widely as AVI export, but most video editors (including Ulead's Video Studio and Media Studio Pro), can convert AVI files to MPG files.

Compressing MPGs

The MPG Video Save Options dialog box in Media Studio Pro is similar in design to AVI Video Save Options dialog box. There are four tabs in the MPG version of the dialog box. In keeping with the scope of this article, we'll look at the intricacies of using the compression tab; default values may be accepted for the remaining tabs.



Media Type

There are four options to choose from: MPEG-1, MPEG-2, NTSC VCD, and PAL VCD: Decoding and playing an MPG file is generally harder on system resources than decoding and playing an AVI file, a factor that makes choosing the correct media type very important.

MPEG-1: MPEG-1 is the best MPEG Media Type for use on the Web and for use in videos that will be distributed via e-mail

This is due to the fact that MPEG-1 files are generally easier on system resources and smaller in file size than other MPEG Media Types. An issue that must be considered when selecting an MPEG Media Type is the CPU speed of the system that will play your videos. For example, even slightly older Pentium systems (such as those with CPU speeds under 350 - 450 MHz) cannot reliably decode and play the MPEG-2 media type. However, MPEG-1 can be decoded and played on just about any Pentium (or generic Pentium) computer. Playing MPEGs on 486 machines is possible, but special software, and at times special hardware (depending on the system setup) is required.

MPEG-2: MPEG-2 is a newer, more flexible, and more powerful MPEG Media Type.

The quality of MPEG-2 can be so good that it's the file format used in DVD and digital satellite television. The most significant downside of MPEG-2 in terms of use on the Internet is system resources: MPEG-2 requires at least a Pentium 350 - 450 (or generic Pentium 350 - 450) CPU for reliable decoding and playback.

NTSC VCD and PAL VCD: These are both variations on the MPEG 1 format that are used to create Video Compact Disks which can be played back on televisions (by using a DVD player). The NTSC standard is used in North America, while the PAL standard is used in Europe. When using either VCD option, the remaining compression options will be fixed to what is called the "White Book Standard", a set of compression guidelines that must be followed when creating VCD files. Note that simply copying an MPG VCD file to a CD will not enable the file to be played back on a television, your CD writing software must be capable of converting the file to a pure VCD file as it's written to the CD.

Video Data Rate

The Video Data Rate determines how much information is stored for each second of video playback. As you may suspect, higher Video Data Rate values produce both better quality and larger file sizes. This value is fixed at 1500 when using either the NTSC VCD or PAL VCD Media Types. When using MPEG-1, you can use a value between 391 and 2000. A value of 1000 is a good starting point, you can then increase the value if more quality is needed, or decrease it if smaller file size is needed. When using MPEG-2, you can use a value between 391 and 14,648. A value of 6,000 is usually a good starting point.

I-Frames Only

I-Frames are a frame type that increases quality and often dramatically increases file size. Except in cases in which the absolute highest quality is needed, and in which file size is not an issue, it's best to leave this option unchecked.

Audio Type

Mono is the best choice for keeping file size to a minimum. Two stereo options are available: Stereo and Joint Stereo. If you require stereo sound, Joint Stereo is almost always the best choice. The Joint Stereo option enables better audio compression by essentially combining redundant audio information in both stereo channels to a single data stream. Differences in the two audio channels that are detectable to human hearing are not combined, so stereo sound is maintained, but in a smaller file size than traditional stereo would require.

Audio Bit Rate

In general, you'll want to use the lowest possible Audio Bit Rate that produces acceptable sound quality. In many cases, background noise (such as traffic in a street scene or ocean waves in a beach scene) can be reproduced effectively with a Bit Rate of 32 (the lowest available setting for Mono sound) or 64 (the lowest available setting for Stereo and Joint Stereo sound). Human voice will generally require a setting of 64, while music will often require a setting of 128.

Audio Frequency

This selection is limited to two settings: 44,100 Hz and 48,000 Hz. Since 44,100 Hz is considered CD Quality sound, there will seldom be a need to use the higher 48,000 Hz setting. I hope you've found this introduction to video and the Web useful and informative. In future articles, we'll look at the Real Movie, QuickTime, and Microsoft ASF video formats.

DV Vs Analog

DV Vs Analog

With analog video, light and sound are captured and recorded as electrical signals, transmitted as waves that can be represented by the up and down movement of a line. These signals look like mountain peaks and valleys, with variations in the height of the mountain and the depths of the valley, and variations in the distances between peaks and between valleys. With light, those variations are the differences between dark and very bright, as well as colors; and with audio, the differences are between no audible sound and very loud sound.

Another way of looking at these waves is to imagine them as waves on the ocean --infinitely variable - going from dead calm to large waves. There is just as much variation in the electrical signals captured on analog. The problem with analog recording is that it is hurt by interference, which can reduce the quality of the electrical signal and make the recorded picture quality far worse than what was captured by the camera or VCR. Going back to our mountain analogy, the interference can change the height of the mountaintops and the depths of the valleys -- make them seem higher or lower -- changing the actual recording so that it no longer accurately represents the true image. Analog video is also affected by timing errors, so what should be a straight vertical line, such as a telephone pole, will play back wavy instead. Digital recordings don't have to deal with the wide variations found in analog recording.

Digital recording is binary, with its electrical signals consisting of just two values, "on" or "off" ('1' or '0') -- there's a signal there or there isn't. Should there be interference, while it may alter the strength of the "on" of "off" signal, the circuitry of the digital equipment can still tell whether the signal is "on" or "off" -- that's all it has to do. In a language of 1s and 0s, a message can be translated clearly. This makes digital recording almost immune to signal problems, and results in the highest quality picture and audio. This is a major advantage over analog. Digital is the language of computers. Computers easily store and transfer binary signals, from machine to machine, disk to disk, hard drive to floppy disk -- without distortion. It is exactly the same with digital video.

The DV Advantage

Let's compare digital video to analog video. The image from a digital video product is a significantly better picture than that available from an analog video product. Digital video has approximately twice the horizontal resolution that can be produced by a standard VHS videocassette recorder.

The resolution of a DV standard image is about 25% better than that from an S-VHS or Hi-8 camcorder or deck. While resolution is dependent on a products components and circuitry, standard VHS and 8 mm video are capable of delivering about 250 lines of horizontal resolution, with S-VHS and Hi-8 at about 400-420 lines. The DV format is capable of delivering over 500 lines on horizontal resolution (of course, actual performance will depend on the individual camcorder model). Another way to look at digital video's image superiority is to note that an NTSC digital video signal contains three times the data of its analog counterpart, a PAL digital video signal contains six times the data of its analog counterpart.

Digital video will deliver the absolute best consumer video quality. Interestingly, DVC has almost the same resolution as analog Betacam, a very popular professional video format -- an amazing quality jump for consumer equipment.

Color Rendition Advantage

Horizontal resolution is not all that goes into making a superior image; color resolution (or rendition) is also very important. Color rendition refers to the ability to accurately reproduce colors, without smear or blur. Analog can have trouble with color blur and color noise, but digital video does not. In a video image, color smear or blur is when, for example, the red of a woman's lipstick seems to smear beyond her lips, while color noise is indicated by random sparkles in the picture.

Because there is neither color blur nor noise, digital video delivers a far more life-like video image on the screen. This will be especially evident in images shot on a camcorder, and with images played on large screen TVs. What you will see is much sharper subject edges and clearer color reproduction.

Video Media and Formats

When home video taping first became available there were two formats - VHS & Betamax, and VHS won. Now, ever since the arrival of camcorders and then digital video, there seems to be an ever-increasing array of formats. Which should you use? This tutorial attempts to guide you through the maze.

Digital

Digital video formats are always a trade-off between size and quality. Maximum quality is only achieved by sampling at a high rate and not compressing the data. Doing this with broadcast-quality video requires about 20 MB/sec of digital data (or 1.2 GB/min). For most purposes this is an impractical amount of data, so various compression schemes are used to reduce the amount of data without noticeably reducing quality.

DV

The DV format now universally adopted in consumer camcorders compresses the data to a fixed rate of about 3.5 MB/sec. This preserves visible quality very close to broadcast, and better than any consumer analog tapes formats. The fact that the video data is recorded on the tape digitally means that it can be copied by Firewire to a computer disk and back to tape, without any of the loss of quality associated with analog copying.

DV and Mini-DV are the same thing; Mini-DV just uses a physically smaller tape cartridge with shorter running times.

M-JPEG

This format is almost exclusively used to capture analog video for digital editing. It's usually implemented by the hardware of a capture/replay card, and different manufacturers tend to implement it slightly differently. Hence, M-JPEG files captured by one card may not be playable on another. The compression, and thus resulting data-rate, is normally adjustable. To retain the quality of Hi8 or SHVS, a data rate of about 3 MB/sec or higher is required. 1 MB/sec is roughly equivalent to VHS quality.

DVD

DVDs are recorded using MPEG-2 compression. The MPEG compression schemes achieve much lower data rates than DV or M-JPEG for the same visual quality, but are more difficult to edit than DV or M-JPEG.

VCD

The VCD format uses MPEG-1 compression, at a data-rate identical to that of an audio CD. The quality is low, slightly lower than VHS, although a good player can sometimes make it appear slightly better. The compression parameters for an MPEG-1 file that can be used to make a VCD are very precisely defined. The current (2.0) standard for VCD also allows still images to be included, enabling such things as a CD photo-album to be created.

SVCD

This is a rather loose standard that allows MPEG-2 format data to be used on a CD medium. Many current DVD players will also play SVCD-format CDs. It's a useful interim format for putting reasonable quality video on recordable CD, until recordable DVD is available at consumer prices. There is much more flexibility in the compression parameters of MPEG files written to SVCD, unlike VCD in which there is none.

MPEG

The MPEG formats are not limited to CD and DVD use. Digital broadcast TV uses virtually the same MPEG-2 format as DVD. Both MPEG-1 and MPEG-2 formats can be used at a variety of frame-sizes, frame-rates, and data-rates. MPEG-1 files can be small enough to be sent over the Internet, especially if a small frame-size is used.

The main differences between MPEG-1 and MPEG-2 are that MPEG-1's maximum frame size is 1/4-frame and that MPEG-1 only allows one field/frame. MPEG-2 supports up to full-frame and two fields/frame, corresponding to TV. MPEG-2 also allows higher quality audio (the popular MP3 format for audio compression is in fact "borrowed" from the MPEG standard).

Other

There are several other compression formats that can be used on a PC, including for example Intel's Indeo and Apple's QuickTime. These can be an appropriate choice for video that is targeted exclusively for viewing on a computer. Microsoft have also recently introduced their Windows Media Format, which is a deliberately low quality, low data-rate format designed specifically for Internet use.

However, none of these are usually relevant to work that involves any sort of external medium (tape, CD, DVD). The two formats that are becoming increasingly predominant in these areas to the exclusion of others are DV and MPEG.

Editing

There is a fundamental difference between the DV and MPEG styles of compression, which affects the editing process. DV (and M-JPEG) stores each frame as a complete image - it's the digital equivalent of a cine film. MPEG only stores some complete frames -- the remainder is stored as differences between adjacent frames. This enables MPEG to achieve its much more efficient compression, but means the editing process is more complex for a computer to handle.

The consequence is that simply making cut-edits on an MPEG file can result in quality loss, since frames have to be re-computed, and the more edits are made the greater the loss. It can also make the editor software sluggish to respond because of the amount of intense computing required. DV & M-JPEG, on the other hand, do not suffer from this problem because frames do not depend on each other. Images only have to be re-computed where transitions, special effects, etc. are used. Where an MPEG result is required, the best quality is usually achieved by editing in DV or M-JPEG format, then rendering or converting the result to MPEG. Even better is to also save a DV copy as an archive in case subsequent changes are needed.

Devices are available that will capture directly to MPEG. They are appropriate if little or no editing is required. The main advantage is that they save the time required to generate the resulting MPEG file, which can be a slow process even on the latest fast processors.

Frames & Fields

One aspect of video editing that takes some time for some people to understand is Fields. This includes getting it wrong in the first video, resulting in a few jerky sequences and transitions. Although most know what fields are, many don't realize all the implications when it comes to editing.

For the benefit of anyone else who has trouble or is confused with this, here is an explanation of fields as they affect video editing, as well as some tips on how to get best results.

What are fields?

Each TV frame is produced by scanning the screen twice, arranged so that the lines of the second scan fill in the gaps left by the first. Each of these scans is a field. So a 25 frame/sec TV picture is actually 50 fields/sec (30 & 60 respectively for NTSC - I'm English so I think PAL).

So to get one frame with maximum detail, you need to combine the information in both fields. Easy so far, but what happens when motion is introduced? Because the two fields are scanned sequentially in the camera, anything in the image that is moving is in a different place in the second field than it is in the first. This helps make for smooth motion in a TV picture, but is also the reason why fields can cause trouble when it comes to editing.

Computers and TVs

When a computer plays video on its monitor it only displays a sequence of complete frames; it doesn't use the TV trick of interlacing fields. So video formats designed for computer displays don't use fields and nor does MPEG-1. Some video editing software intended only for use with such formats is unable to handle fields properly, which makes it unsuitable for getting good results with video targeted for TV use. It's important to use an editor that can process fields if the target medium is intended for TV replay.

Video Capture

Capture card drivers often offer the option of capturing one field per frame (sometimes you can choose the first or second), or capturing both fields. In addition, when capturing both fields there is a question of what order the fields are packed into the frames of the file on disk. Most drivers pack them in the order they are scanned; field-A first, but some pack them field-B first. Your capture card's documentation should tell you which field order it uses, but if you can't find it try order A and do a field-dependent trial edit. If the result plays badly, try order B. DV Type-1 is always order A.

If you capture one field then the resulting video file is frame-based. In other words, it has one image per frame. If you capture both fields the file is field-based - each frame consists of two distinct field images, separated by 1/50 (1/60) second.

For best quality you will want to capture both fields, so knowing about field mode is important.

Video Editing

Most of an AVI file compiled by a video editor program consists of frames that are simply copied from an input file to the output file (assuming you're not changing the compression scheme). For this material it doesn't matter whether the files are frame or field based, the frame data is just copied verbatim - the output is the same as the input. But when you start adding effects, transitions, speed changes, etc. the difference becomes very important.

If the editor doesn't know that the input frames contain pairs of fields, it may do completely wrong things with the images. In addition, by creating the output in field mode, synthesized motion produced by transitions, titles, etc. is considerably smoother.

AVI files contain a lot of information identifying the format of their contents, but the ability to mark a file as containing dual-field frames was not put into the AVI specification. As a result you have to know what field layout your files contain, and set the editor options correctly yourself. Exactly how you do this depends on the video editor you are using: check your documentation.

As a general rule, if you capture your clips using both fields, set the appropriate field order as the default for imported clips, and use the same setting for creating the edited result. If you import clips in field mode but create video in frame mode, then video creation will be extremely slow, as every frame will be re-rendered. If, on the other hand, you have a particular reason to convert a field-mode video to frame mode, then the following is the way to do it.

Speed and Direction Changes

This is where it is very important that field mode files are correctly identified. If you reduce the speed of a clip, the effect is achieved by repeating frames. If the editor treats the clip as frame mode, then it repeats a whole frame. If this frame consists of two fields A & B, the resulting field sequence is A-B-A-B. This will jitter visibly when replayed. If it treats the clip as field mode, it creates the sequence A-A-B-B. In other words, each field becomes one frame. This can actually be quite useful for other purposes, as we can see later.

A similar effect occurs if you reverse a clip. If the clip is treated as frame mode, the frames are played in reverse, but each pair of fields within the frame are still played forwards. The result looks horrible! Identifying the clip as field mode ensures that the editor reverses the order of the fields within the frames as well.

Capturing Stills

If you want to capture a still image of a single frame from a video file, then the multiple fields can be a serious problem. If you use a video capture program to grab a single frame, the resulting image will probably contain both fields. This gives you the best detail if the scene is static, but if there is any significant motion present the difference between the fields shows up as a blurring. Let's assume you don't want this!

One solution is to re-capture the sequence using single-field mode in the capture driver. However, this may lower the resolution too far, or you just may not be able to re-run the original. Much simpler is usually to use your video editor to create the image, as it will look after the field problem at the same time.

Editors will normally let you select a single frame and save it to disk as an image file (MediaStudio lets you save a block of frames as an Image Sequence, for a single frame you just create a sequence of one). By setting the clip's field properties correctly, the editor should use just one field when creating the image, thus avoiding the field-blur problem. In MediaStudio you simply have to mark the clip as field-mode. In other editors you may need to specify de-interlace.

Another way to break a clip down into individual frames in an editor is to define the speed of the clip as 50% (half-speed). As described above, this has the effect of turning each input field into one output frame. If you expand the editor's timeline so you can see each frame, each frame of the expanded clip is actually one field of the original. You can now save whichever frame you want as a clean image.

Summary

If you capture clips using both fields, then set the default import mode in your editor to the correct field-order for your capture hardware. Also set the same field-order for creating result-files and previews. You shouldn't get any peculiar effects caused by the existence of two fields per frame.

If you're doing anything more subtle, especially working with still images, then understanding what fields are all about will help you get the best results.

Shooting Techniques for Editing

When most people use a video camera for the first time, they shoot what they think they will look cool on video. And, it hardly ever looks the way they expect. Those with a critical eye will correct the ubiquitous mistakes of overlong shots, camera waving, and trampoline zoom, but even they will still concentrate on trying to shoot a sequence that can't be viewed straight off the camera.

However, if you know you are going to edit your results before letting them loose on the world (or at least your friends!), you can use a few techniques that will simplify the subsequent editing process. Specific techniques vary depending on the type of material, whether scripted, an event (e.g. wedding), documentary, or ad-hoc (e.g. holiday, kids). If you are doing a scripted project you should have built a storyboard of the shots you want. This way you will already have subsequent editing in mind. The tips here are more applicable to non-scripted work where you will largely film on-the-fly, with little chance to set up or repeat shots.

Straight shooting

We usually want the audience to feel part of the action, as if they are in the scene. The sequence of shots displayed should be what they would be looking at if they were there. The classic beginner's mistake is to try to do this by setting the camera running and pointing it where he/she is looking, thus waving the camera around while looking around.

In reality we don't look around us like this. It is physiologically impossible for us to pan our eyes over a scene. Our gaze flicks from point to point, so what we actually see is a sequence of short static scenes. Most of a professionally made movie is almost always constructed as a sequence of surprisingly short edited shots. This emulates the way we actually view the world much more better than long waving shots and is, hence, much more compelling to watch.

The sound track on the other hand should be much more continuous. We hear the world as a continuous stream of sound, even when our eyes are darting about. So there should not be cuts in the sound track with every cut in the video. In fact, a sudden change of sound usually implies a change of scene.

All this doesn't mean you shouldn't include things like pan shots for example -- they can also be very good for scene setting. The key thing is to appreciate how the pictures and sound you record are likely to be perceived by a viewing audience, not necessarily the way you perceive the scene when using the camera.

Storyline

A video should always tell some sort of story. Unlike looking at a photo album, a video imposes pace on the audience as well as content. It needs some structure, even if it's only pictures of last summer's holiday. It needs a beginning, middle, and end. Often the first and last are what's missing if you have no plan of what you are going to shoot. Always try to include some scene-setting material -- shots that in themselves are pretty boring but can serve as a video "frame" for the interesting bits. Like a picture frame they aren't much use on their own, but serve to enhance what's put inside them.

Also remember that because you are going to edit, you don't have to shoot scenes in the same order as they will be shown. You might take some interesting shots, then realize you don't have anything to serve as an introduction for the topic. No matter, look for a suitable shot and record it afterwards.

Video

Always try to use good lighting, the best you can get for the situation. Low light results in increased noise level ("snow") in the images and causes a disproportionate degradation in the compressed video. "Night" scenes in movies are often shot in daylight, and darkened during post-processing. You may want to experiment with this yourself.

Start shots early and finish late. You can trim when editing, and the extra sound can be a useful overlap. It's much better than discovering you've missed a vital second at the beginning or end of a shot.

Keep shots steady, avoid camera waving. If tracking a moving subject try to keep it central.

When panning do it slowly, keep it steady and don't reverse direction in the middle. Include a few seconds of steady shot at each end. The same applies to zooming.

A sequence of fixed shots is frequently better than a long waving one.

When practical, do re-takes and record more rather than less (tape is cheap).
If a second camera is available, record the same scene from different angles. You can then edit the results together. If your cameras have color balance adjustments make sure to set them up. If they don't, record several seconds of the same static reference scene on both cameras under identical lighting conditions (e.g. at the same time). If possible, use a color calibration card. If it's not available, a scene with several distinct bright colors will do. You can later make calibration adjustments during capture or editing to compensate for any color differences.

Make notes of what you are shooting. If you can't make written notes, make voice notes on the tape. Record your notes between real shots, unless you know you won't need the sound in which case you can talk while shooting. Written notes should reference the time counter (make sure you know where it was zeroed!).

Sound

Sound is very important for continuity. It gives the audience a strong sense of location. If the sound is continuous, the video can cut fast and furious, but the sense is of one time and place. A sudden change in sound suggests a complete change of scene.

The loudest component of the sound should correspond to the subject of the shot. If someone is talking, the voice should be predominant. A good external directional microphone is always far better than the built-in microphones on nearly all camcorders. The built-in ones pick up far too much ambient noise close to the camera -- the sources of which are usually out of shot. Mono sound is best on the camcorder; a good spatial stereo sound image is difficult to record because you don't get it for free at the same time as filming.

Although a sequence of fixed shots is better than a long waving one, the way you do this depends very much on what you want to do with the background sound. Although you plan to edit the result from shot to shot, you may also want the sound as a continuous track. The best thing, of course, is to use a separate sound recordist but in a lot of cases this isn't practical. A solution is to keep the camera running between each shot, instead of stopping the tape with the pause button. When you edit the video later you can cut out the junk bits, or replace them with infill shots, but you will have a continuous soundtrack to work with.

And finally ...

These tips are by no means complete, and every videographer you ask would find something different to add. But if you're new to video and especially to the world of editing, we hope they prove a useful starting point.

Shooting Video for the Web (Formats)

Overview

These are some general tips aimed at producing good web video. Most of these tips are focused on creating video that will compress well - by carefully shooting video for web use; you can substantially improve how well the final video will compress. Better compression results in higher-quality and/or smaller movies. The overall goal is to produce a video signal with the least amount of noise, camera movement and fine detail possible so that the final movie will compress effectively and look good at a small screen size.

It is critical that you shoot tests of your material and run it through your entire production process before you film the whole project. It's important to view the final results on the desktop, as they will appear in the final project because your image may look great when filmed and edited, but look less than optimal after resizing and compression. Early and thorough testing will help spare time-consuming reshoots. Finally, if you are new to video production, having proper lighting when you shoot your video is a very good idea. Adequate lighting is the best way to get off to a good-looking movie.

Use a High-Quality Camera

The higher the quality of the original video signal, the better the final movie will look and compress. A common misconception is that because the final movie will end up small on the screen, a cheap camera won't make a difference. This is absolutely wrong. Video noise substantially degrades compression, so a "clean" video signal produced by a high-quality camera will compress much better than a "noisy" signal produced by an entry-level model. In addition to lower noise, better cameras generally produce a sharper image with better colors given their superior optics and multi-chip design. Anything that improves the quality of the original video will help you deliver better web-movies.

Common Formats

Below is an overview of some common classes of cameras used for desktop video:

DV (miniDV, DVCPro, DVCam) DV is a high-quality digital format that integrates well with desktop systems. There are currently three DV formats: miniDV, DVCPro, and DVCam. MiniDV is the most common and generally is the format used by consumer cameras. DVCPro and DVCam are professional formats, which are not as widely available as miniDV. The DV format is far superior to Hi8, S-VHS and other consumer formats. DV is digital, so it does not suffer from generation loss - a copy of a DV tape is identical to the original. Most miniDV cameras can be connected to your computer via Firewire (IEEE 1394). Some DV cameras offer a "progressive scan" feature. This records each frame as a single non-interlaced image, instead of two separate interlaced fields. Progressive scan source material often doesn't play as smoothly on television as interlaced material but is vastly superior for desktop delivery because it contains no interlacing artifacts. You should look for this feature when buying a DV camera and plan to use it when filming for web delivery.

Consumer Formats (Hi8, S-VHS and VHS)

These consumer formats produce substantially noisier signals with lower resolution than the professional and DV formats. Hi8 and S-VHS are superior to VHS. These are analog formats and a capture card is required to get these formats into your computer.

Computer-Based Cameras (video conferencing cameras, etc.)

Generally, these cameras produce very noisy and low-resolution images. They generally hook up directly to your computer, so a capture card isn't needed. We strongly recommend using a better camera if you are trying to deliver high-quality movies.

Shooting Techniques for Web Video

Use a Tripod and Reduce Movement

The use of a tripod often makes a dramatic impact in the quality of the final movie. This is because keeping the camera steady reduces subtle differences between frames and therefore improves the temporal compression of the video. Be sure to use a sufficiently heavy tripod for your camera. If you plan to pan the camera during filming, use a high quality fluid head and keep the pan smooth and slow. Irregular or "jerky" camera motion is hard to compress.

Avoid hand-held shooting if possible. If you need to film a hand-held shot, a motion stabilizer (Steadi-Cam[a], gyro, etc.) will improve your results. If your camera has an image-stabilization option (either optical or electronic), you should generally use this feature to reduce subtle changes between frames from camera motion.

Keep Detail to a Minimum

Keeping the detail within the scene to a minimum will help the video compress better spatially. It will also make the video easier to see when the movie is reduced in size for desktop delivery. If you are shooting an interview, keep the background simple. Painted or plain backdrops are often a good choice.

If you have the experience and equipment, blue or green screen can work very well for interviews. It is fairly common to film people in front of windows. If there is much detail or movement outside, you can throw the background significantly out of focus to simplify the image. Trees are often used as backdrops for interviews filmed outside. The excessive detail of the leaves poses a challenge for compression and should be avoided if possible. If you must film against a tree, using a shallow depth of field to defocus the leaves will often improve the final movie. Beware of trees moving in a breeze - the high detail and subtle changes between frames make compression difficult.

Ask your subjects to wear clothes that don't have high contrast patterns or lots of details. Plain colors are best - bold stripes or checked patterns can do very odd things when resized and compressed.

Producing Good Audio

Audio production values are often overlooked when creating multimedia, but are critical to professional results. As with video, your goal is to produce as high-quality and noise-free an audio signal as possible. You should use high-quality audio equipment and remote microphones whenever possible to reduce camera noise. You should try to minimize any unnecessary noise in the audio signal such as wind or street sounds (cars, construction, etc.). Shotgun microphones may be useful for minimizing background noise and lavaliere microphones often work well for interviews.

If you are recording voice-overs in a studio, you should use professional equipment. The microphones that come with computers (both Mac and PCs) don't usually produce the audio quality of a real, professional microphone. If you are recording directly into a computer, beware of hard drive noise - this is often hard to hear when recording, but will decrease the quality of the final audio signal. Many computers' built-in sound cards introduce line noise, so it is usually better to record directly through your capture card.

Lighting Video for Web Delivery

Generally speaking, video that is well lit will compress better than under- or over-exposed material. Most compressors work best with moderate contrast material, and many don't work as well with dark scenes. For example, Cinepak normally produces better compression with lighter images. Adequate lighting is critical to producing superior movies because low-light conditions produce excessively noisy video signals lacking details in the shadows.

Overexposure is less frequently a problem but should also be avoided. You should not shoot video that you know is incorrectly exposed and plan to fix it in post-processing - detail that is missing and excessive noise can never be fully corrected after the fact. Lighting your video properly is the only way to ensure the highest-quality results.

Shooting Techniques for Web Video – Part II

Techniques

A. **Composing your shot**

Start with a long shot to establish your subject, and then use the 16x zoom to move in closer for medium shots or close-ups.

B. **Keep it steady**

You don't need a Steadicam® for jiggle-free tracking shots or pans; the XL1S (16x lens only) automatically eliminates camera shake, even when you shoot without a tripod. Just turn at the waist to track a moving subject, or pan across that awe-inspiring vista, and let the camera do the rest. Remember to use moving shots sparingly, or your audience might get motion sickness!

C. **Watch the sun**

Try to keep the sun behind you as you shoot. This keeps the light on your subject, and glare out of your lens. If you can't avoid shooting into strong sunlight, consider using a neutral density filter (available from Canon) to keep the sun from washing out the colors of your video and to maintain focus over a greater depth of field.

D. **Achieving good audio**

The XL1S' on-board stereo microphone provides great sound quality for most situations. For those times when ambient sound might distract from your subject--for instance, when recording dialogue--consider plugging a directional microphone into your camcorder's microphone terminal.

16 Bit Audio Mode will provide you with the highest sound quality, since audio is sampled at 48kHz (Equivalent to DAT). However, in 16 Bit Mode, you are only able to record 2 channels of audio. It is not possible to add any additional audio to the tape.

12 Bit Audio Mode records sound at 32 kHz (Near CD Quality). Although the sound quality is lower than 16 Bit Mode, it provides added flexibility, since two additional channels of sound may be added.

Editing Tools with Web Publishing in Mind

Editing Tools

A variety of low-cost editing tools exist today that enable easy integration of DV camera technology and common home computers. These DV editing solutions typically combine easy to use software with the necessary IEEE-1394 hardware components to make your computer a video editing system. The tools available range from simple edit-only software to full-featured professional editing suites.

Some of the latest computers include an IEEE-1394 port, and all you need is compatible software. Editing software such as FreeDV is designed to operate with Windows computers and your DV camera. Basic editing capabilities are included, along with the ability to prepare and publish the movie to the web.

As you climb the ladder of available editing software tools, more control of the process and additional capabilities are added. These additional functions might include extensive titling and transition tools, audio functions to add extra soundtracks or more precisely control channel balance and tonal equalization, and the ability to do special multi-layer visual effects.

Editing for Web Delivery

As with all the other steps in video production, how you edit and add effects to your video can affect the final quality of the movie. Below are some general tips on optimizing your editing for web delivery.

Transitions & Effects

To improve the compression of your material, you should avoid elaborate transitions. Hard cuts and simple wipes are usually the easiest transitions to compress. Fades are difficult for codecs, but are often unavoidable. Complex transitions, such as page curls, pinwheel wipes and paint spatters are very difficult and will often become pixelated in the final compressed movie. Frequent cuts between scenes make temporal compression difficult, which is why many music videos don't compress well. If possible, try to keep the number of cuts in your piece to a minimum. Effects that add lots of minute and/or random detail to an image, such as film noise and explosions, are especially difficult to compress both spatially and temporally.

Work at Full Resolution

If you are able to capture your video at full resolution, be sure to do your editing and effects at this size. Do not resize your video with your editing or effects package. Also, be sure to render any effects with the highest quality possible. For example, After Effects offers different rendering qualities -- it's fine to use lower quality for quick previews, but be sure to render the final piece at the best quality possible.

Editing Video

Editing Overview

The digital video standard specifies certain system requirements that make editing digital video much easier than editing analog video. For example, digital video recording equipment must record specific data on the tape, including a time code, an index of the start and stop points of each recording, the date and time, and photo print information. And, of course, DV's greatest advantage in editing is that the DV copies of DV originals are exact copies with no loss.

Transferring Video to the Computer

DV cameras already store their video in a digital format, so you don't need to digitize DV source. However, you do need to import the DV files into your computer via Firewire (IEEE 1394). Perhaps the most intriguing aspect of digital video is the ability to transfer the signal to computer.

Transferring an analog video signal to computer requires the translation of that signal into a digital form so the computer can read it. Depending on the quality of the equipment used, this leads to varying degrees of quality loss. When the digital data on the computer is sent back to the analog VCR for recording, it must be converted back into an analog signal, causing further signal loss and a further reduction in quality.

The final analog tape contains a video signal that is significantly poorer in quality than the original analog video. This problem doesn't exist with digital video. Signal quality does not deteriorate regardless of how many times it is moved between tape and computer, even if the video is edited or manipulated (for example: special effects).

Getting the digital video signal into the computer requires the use of the proper computer equipment and cables, designed specifically to handle digital video (IEEE 1394). If you transfer the digital video on your computer to digital video tape, there will be no quality loss, but if the transfer is to an analog VCR, there will be losses, simply because the analog tape cannot handle the large quantities of data held in the digital signal.

Capture Video at Full Screen

To get the highest-quality results, you should capture your video at full-screen resolution (640x480 or 720x486). Even if you intend to deliver smaller final movies, a full-screen capture will generally give you better results for a number of reasons. A major reason to capture at full screen and scale down is that doing so tends to improve the final image.

When you scale down an image, several of the original pixels are averaged to make each final pixel -- this averaging tends to reduce video noise and result in a "smoother" looking image which compresses better. Full-screen capture allows more deinterlacing options, such as blending the fields to preserve the "motion blur" effect of interlacing. If the original source was shot on film and transferred to video tape, capturing at full-screen resolution and full frame rate allows you to remove the 3:2 pulldown and return your material to its original 24 fps, which will compress better.

Most captured video has black edges around the perimeter (this is often called "overscan" or "edge blanking"). To deliver professional results, you must remove these black edges. Starting from a larger image allows you to crop and then scale the image down. If you capture at the final size that you wish to deliver your video, removing edge noise requires you to crop and then scale the video up, which degrades image quality. Finally, if you capture and edit your material at full-screen resolution and archive the source, you can later repurpose your content to larger delivery sizes without having to re-capture and re-edit your project.

Audio Capture Settings

As with the video, you should capture the audio at the original quality. This is generally 44-kHz, 16-bit, stereo. We strongly recommend that you capture in 16-bit audio depth if at all possible -- having 16-bit source material generally gives you more options and higher final quality, even if your final movie will be delivered with 8-bit audio.

Dropped Frames

All web video formats drop frames. In the world of television broadcast, a dropped frame is unacceptable, and would signal the end of clip capture for any serious editor. Ideally, no dropped frames will give the best possible video quality to base your web movie on. Be sure to configure your capture system to warn you of dropped frames and stop capturing if you get errors. To stop dropping frames, you may need to de-fragment your hard drive, remove unneeded Extensions from your system, or buy a faster hard drive.

System Requirements

Video editing and processing software requires a reasonably fast, current computer system to operate properly and efficiently. The following systems should be considered the minimum requirements:

Macintosh system:

Power Macintosh or Mac
OS compatible computer with PowerPC processor Mac
OS 8 or later QuickTime 3.0 or later

64MB of RAM
Color monitor capable of displaying at least 800x600 pixels in millions of colors (24-bit)
CD-ROM drive (at least 2x)
Hard disk capable of sustaining at least 5MB/sec

Windows system:

200MHz Pentium class processor or faster
Windows 95/98/NT4
QuickTime 3.0 for Windows or later
64MB of RAM
Color monitor capable of displaying at least 800x600 pixels in millions of colors (24-bit)
CD-ROM drive (at least 2x)
Hard disk capable of sustaining at least 5MB/sec

Still Images

You can grab still images from video, as mentioned in the Frames & Fields article, but this page is about the opposite: incorporating existing still photos into a video.

There are various reasons you might want to do this: either out of necessity because you only have still photos available or simply for visual impact.

Capturing Images

The first thing to do is get the photos you want to work with onto the computer. If your source is a digital camera there is little problem. If starting with actual photos then there are two routes.

Scan

You can scan prints using a flatbed scanner. Nearly all modern scanners produce very good quality and are easy to use. Some scanners offer transparency adapters as optional extras for scanning slides and negatives. If you have one of these you probably don't need us to tell you how to use it.

CD

If you know you want to use your photos on the computer when you get them developed, you can have them put onto Kodak PhotoCD or the newer, cheaper Picture CD. These give extremely high-quality images and are a very convenient medium for using with a computer.

Image Size and Quality

The resolution of a video picture is much lower than a still image, so achieving the finest possible resolution in your image files is not necessarily important (but see Moving over the image below). However, a clean image with good contrast and well-defined color (unless monochrome) will help produce a good end-result.

For overall quality, 35mm film processed to CD is almost always best. Few, if any, digital cameras are as good.
Scanned prints give surprisingly good quality, surpassing a lot of the cheaper digital cameras.

Using Images

There are many ways you can incorporate still photos into a video. The obvious is to display a still instead of a video clip. But you can do many other things such as pan and/or zoom over the image giving an impression of motion, use a picture-in-picture effect of a small still inserted into a video, create a moving montage of several stills, or many other things limited only by your imagination!

You may be limited by what your editor software can do; everything described here is possible using Ulead MediaStudio Pro.

Fitting the Image to the Video

It is very unlikely that you will want to display the contents of an image file directly as a video frame. To start with the dimensions will probably be unwise. Video frames have an aspect ratio of 4:3 (ignoring wide-screen), but your images may be different, the exception being the majority of digital cameras, which also use 4:3.

However, most photos benefit from some cropping, so you need to use the feature of your video editor that allows you to control which part of your image is displayed in the video frame. In MediaStudio Pro this is the Moving Path feature (even if you don't want the image to move). If your editor doesn't give you this sort of control you may need to use a separate image editor and save an image file cropped to 4:3, which you can import into the video.

Image Distortion

Images are always displayed on a PC screen using square pixels. All image file formats also use square pixels. This means that if an image is for example 640 x 480 pixels, it will display at an aspect ratio of 4:3.

The same is not always true of video frames. For example the DV format is 720 x 480 for NTSC and 720 x 576 for PAL, but in both cases the final image when rendered on a TV is 4:3. When these frames are displayed on a computer (e.g. in a preview window while editing) they are usually slightly distorted - NTSC is horizontally stretched, and PAL is horizontally squashed.
When a still image with square pixels is incorporated the different pixel shape must be allowed for, otherwise the image will be distorted the opposite way when shown on a TV. Some editors are smart enough to compensate automatically; others require you to do it manually. One way of doing the latter is to save copies of all your images "pre-distorted" to the equivalent of your video format. Use an image editor to stretch or squash the images horizontally, and use these copies to import into the video. Stretch by a ratio of 720/640 if working in NTSC, or squash by 720/768 if using PAL.

Moving Over the Image

A still photo can almost come to life if you make the video pan across or zoom in or out on it. Panning can work well on a wide-angle shot of landscape; a zoom is effective on shots like "Me standing in front of the Taj Mahal." Start zoomed in on the figure, then pull back to reveal the whole context.

For these effects, a high-resolution image is important because only a small part is used to fill the frame. The exact technique again depends on your editor. In MediaStudio Pro you use the same Moving Path feature that you use to crop an image, so it's a simple step from stationary to moving images.

Picture-in-Picture

This is almost the opposite of the idea above. A small frame containing the image or part of it appears over the main video. Superimposing multiple images this way gives a montage effect, where you may want to dispense with the background altogether. In both cases the images can be static or moving.

Again, the exact technique in MediaStudio Pro is just another application of the Moving Path feature. Working with multiple images will normally require use of a separate overlay track for each one.

With this technique the final images will be a lot smaller than the video frame, so you can afford to start with lower resolution image files. Avoiding the use of files with unnecessarily high resolutions not only saves disk space, but also saves the editor program from needing as much memory. It also will generally speed up the rendering process.

Summary

Incorporating still photos into a video can enhance both the video and the photos, and there are endless possibilities to explore. This article has concentrated on suggestions for photographs, but other sorts of images, such as clip-art or graphic designs can be given similar treatment.

Preparing Your Web Movie

Making it Small: Why You Need to Compress

Video, in its raw form, takes up huge amounts of space. For example, uncompressed NTSC video is about 27 Megabytes per second! At this size, you could fit only about 24 seconds of video on a CD-ROM, and no CD-ROM drive could transfer such a file fast enough to play it smoothly.

On the audio side, compression is also important, especially for Web use. For example, uncompressed CD audio is 150 kilobytes per second, which would completely saturate a T1 connection and leave no room for video.

In order to make desktop movies feasible, compression algorithms (Codecs) were created. Compression is the process by which large movie files are reduced in size by the removal of redundant audio and video data. For more dramatic size reduction, less important data may also be removed, resulting in image and/or sound degradation.

The codec is the algorithm that handles the compression of your video or audio, as well as the decompression when it is played. QuickTime has several codecs available within it for free, and there are professional versions of certain codecs, which may be purchased for superior quality and additional options.

A More Advanced Discussion About codecs

Most codecs compress video different compression techniques to remove redundant data. Understanding the basics of how a codec compresses video can help you create and process your material to make the codec's job easier, which in turn will produce superior final QuickTime movies.

One method of compressing movies is to remove the redundant data within any given image. For example, in a given movie there may be areas of flat color with many identical pixels. Instead of specifying each pixel and its color, a codec can generalize by specifying the coordinates of the area and the area's color; it doesn't have to note all the little details. This manner of reducing the size of an image is called "spatial compression."

The less detail there is in the image, the better the codec is able to generalize the image and compress it. Removing fine details in preprocessing can improve the spatial compression of an image. Video noise often looks like fine detail to a codec and should be removed to improve spatial compression. Creating video with simple backgrounds will also improve how well the final movie compresses.

Another way to make a frame smaller is to look for changes between consecutive frames and only store the differences instead of the entire image. The original reference frame on which these differences are based is called a keyframe.

Keyframes contain the entire image, and look just like a normal picture. The frames based on the changes between frames are called delta frames, or difference frames. They contain only information for the areas that are different from the last frame and are usually much smaller than the keyframes. For example, the first frame of any movie is always a keyframe and contains the entire image.

After this initial keyframe, there normally follows a series of delta frames. These delta frames show only the differences between the previous frame and the current frame. The delta frame wouldn't contain information on a truly static background, because it wouldn't be changing. Every second or so a new keyframe is added to correct for slight cumulative errors in the delta frames. This kind of compression tracks changes over a period of time and is therefore called "temporal compression."

Video content that changes very little from frame to frame is best suited for temporal compression. Whenever possible, you should use a tripod when filming video for desktop playback and attempt to reduce camera and subject movement. You should also avoid complex transitions and fast edits to minimize the differences between frames and improve the final compression.

Real Video

Shooting the Video

Jeff Rule, April 19, 1999

Creating RealVideo is as much an art as a science. If you have the resources and are creating video specifically for the web then there are a number of tricks you can use to get your video to compress better. Let's start with the source video.

The better the video source the better the final result. You should always record to the best medium available. The best mediums in order of descending quality are:

1. Beta or Betacam SP. This is the most common format for professional production.
2. DV or Digital Video. This newly emerging standard captures the video in digital format so there is no tape degradation as it is encoded from analog to digital.
3. S-VHS or HI-8mm. These two formats are common for home recording devices.
4. VHS. The same as in your VCR. These tapes can have a lot of noise both in the audio and video tracks that cause problems with encoding.

If you have control over how the video is shot you can also film it in such a way that compression is easier. Lots of fast cuts, motion, and music are hard to encode to RealVideo. Talking head shots of people are the easiest to encode. To help the final quality, avoid camera pans and wipe transitions between shots. Having lots of stationary objects in the background helps also. Always use a mounted camera instead of a hand held one. Hand held ones produce movement that causes objects to move around, making it more bandwidth intensive to encode. If you use rapid movement make sure that the important information doesn't occur until a few seconds after the movement. This will give the new object time to "resolve" before it becomes central to the scene. The lighting should also be kept constant and uniform colors should be used. Complex patterns in the background are hard to encode.

Digitizing the Video

Once you've recorded the video to tape it needs to be digitized to your hard drive. The video doesn't need to be captured at full screen and 30fps because the final result is probably going to be 15 fps at best for RealVideo. Capturing the video at 15 fps and 320x240 size is a good compromise. This will be a good quality capture without taking up all the room on your hard drive. Always be sure to capture the video at 24 bit or full color. Lower color resolutions produce poor video quality with noticeably blotchy color.

Video capture should always be done on a fast machine with a fast hard drive. SCSI drives are preferable to IDE hard drives, but the newer IDE drives are up to the task. Compressing video is a very CPU intensive task and having a machine with lots of memory and a fast CPU is important. I'd recommend a Pentium II though a fast Pentium or Pentium Pro should work.

There are many capture cards on the market that will capture at 320x240 and 15 fps. The Intel Smart Video Recorder III is a good low cost choice. It should be around $199.

There are also a number of programs that can capture video that enters through the video-encoding card. The best desktop solution is still Adobe Premiere. It works well with the Intel Smart Recorder III. In Premiere you will be able to select the format to save the video. I've always had a preference for QuickTime, which is now in Version 3 on both Windows and Macintosh. QuickTime has had a history of better synchronization between video and audio. On Windows you might also wish to record to AVI. Make sure to encode the video as uncompressed so that you have the best possible digital source file to encode to RealVideo. If you would like to output RealVideo directly from Premiere there are plug-ins available that allow you to do this. However, I usually take the digital uncompressed file from Premiere and import it into RealProducer for encoding.

Real Video

Encoding to RealVideo

Jeff Rule, April 19, 1999

OK, now we have an uncompressed digital video file stored as AVI or QuickTime. It's encoded at 15frames per second, its size is 320x240 and colors are set to 24 bit. The file is probably huge, depending on the length it is probably 10 MB or greater. When this source file is encoded to RealVideo it will drop in size to less than one tenth its current size. It will compress even more if there is very little movement or if the speaker is a talking head.

I will be doing the encoding in RealProducer. Most development shops use one of RealProducer's products for encoding. The low end of these, RealProducer, is free from Real. This program contains everything a low volume environment needs to produce RealVideo.

- It allows you to do live broadcasts, provided you have access to a Real Server. You'll encoding in near real time.
- Creates scaleable SureStream files for various modem speeds. The program encodes at various bit rates for different modems and then adjusts to the user's modem speed and bandwidth. Only two bandwidths can be encoded at once.
- Creates backwards compatible files for RealPlayer 5.0 users
- Control of data rates and Codec selections
- Creates audio and video content that can be streamed serverless from a personal page
- Creates pages with embedded content instead of using the G2 Player window

With all these features in the low end RealProducer you might wonder why you would need to upgrade to RealProducer Plus or RealProducer Pro. These two packages do have some other features that make them worthwhile. They include:

- Batch conversion - The most important feature for large volume production environments. In Real Producer Pro there are more features added which help in SMIL production and creating template driven sites.
- Drag and Drop batch processing
- SMIL Template integration
- Timeline interface for creating time-based presentations

I'll be discussing the base line RealProducer that can be downloaded here for free. Once RealProducer is installed you're ready to start encoding. When you first launch RealProducer you will have a choice of file types to encode. You can encode from a file, you can encode from a stream coming in from the video-encoding card or you can encode a live stream.

RealProducer

Let's start by encoding a file. Once you select "Record From File" Producer will ask you to pick the file. Not all video file formats are supported. QuickTime is only supported in uncompressed format. This is why it is always best to work with an uncompressed file.

- Audio (.au)
- Waveform audio (.wav)
- Video for Windows (.avi)
- QuickTime for Windows (.mov); requires DirectX 6.0

Once you choose the file you can add name, author and copyright info to the file. Your next choice is to encode it for a single stream rate or to encode to SureStream format, which is only supported on the new G2 Servers. We'll get back to the SureStream format later, so for now let's encode a single stream. The next step is choosing the bandwidth for playback. This means understanding your target audience. If you're encoding for average Internet users there is a big trade off between 28.8 video which is virtually unviewable and 56K video which is more watchable, but results in lots of buffering time for end users. For high action video I would always choose 56K; you might get away with 28.8 video for a talking head presentation.

Once this decision has been made, RealProducer asks you what type of audio you are working with. Is it voice, music or a mix of the two? Similar questions are asked about the type of video. Is it mixed video with some high movement pieces and some still shots, in which case Normal Motion video should be selected? Is it mostly talking heads, in which case Smoothest Motion should be selected? Or does it have lots of motion, in which case Sharpest Image Video should be selected? The final selection, Slide Show, produces a number of very clear sharp pictures from the video, however they don't really appear as video. This option is good for a video slide show.

Finally, you name your video file and save it with an RM file extension. Once all the selections are made check the final configuration, return to the main interface and hit Start. The speed of encoding is determined by the speed of your computer.

Streaming Media

So you say that you want to stream video on the Internet, OK. Let me show you how to do it and with some time and effort on your part, you will be streaming.

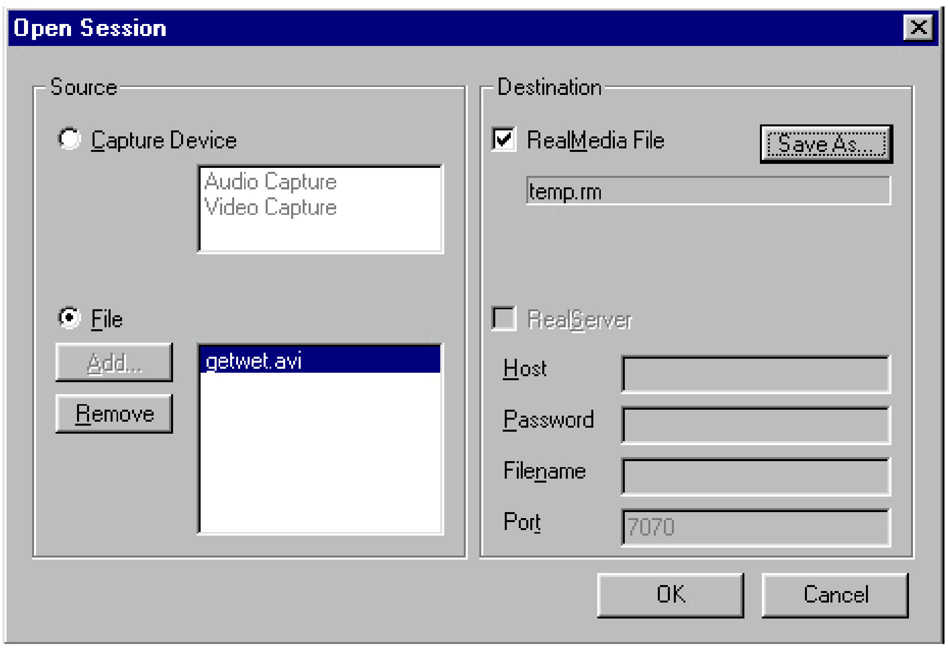
Lets start with the basic video package. First you will need a video capture card and the software to go with it. This does not need to be a very high dollar item! The one that I used to capture all the video is a Creative Labs RT300. While you can go hog wild on the cards and spend upwards of one thousand dollars, it is really not necessary to do so.

Your second item on the list, streaming software. I have tried three different ones and by far the Real Audio people have the best in my opinion. I like the way it is configured to run the within Windows 95 platform and you should have no problems setting it up. You can get their free software here, as well as info on commercial tools here.

The other major item and probably right next to the most expensive would be something like Adobe Premiere to edit your creations. I won't go into the details of how this program works, that is a whole other story. For now lets just say you have an edited .avi or .mov file that you want to stream and work from that point.

Ready, now we have the HARDWARE and SOFTWARE items and are ready to roll. I am going to recommend a setting of 240x180or smaller. Why you ask? Because it streams the fastest and looks the sharpest in fast action video. The most you are going to achieve with the Real Media streaming software it 15 frames per second. That means you should capture the original as close to 30 frames a second as possible and let the Real Media software compress it from there. The audio setting should be at the lowest setting possible so that the frame rate stays hi and clear.

Lets back up for a moment on that point. Believe it or not most Internet users still use a 28.8 modem. In theory that means you should not go above the 26,000 kilobits per second bandwidth. Well let me share a secret with you, that is not true. I usually format my videos to somewhere in the 30,000 kbps range. But Mike, you just said that everyone still uses 28.8 modems, how it possible for them to watch? BUFFERING. The Real Audio Player buffers the signal to provide smooth playback to some degree. While I do not have an exact number for it is appears to be about 20 kbps better than what you are watching it on. Put in simple terms, if I want to watch a 33,600 or even a 56 kbps stream it will run well, it just takes extra time to buffer before it starts to play on a 28 kbps modem.
The other very important thing is the audio stream. Make sure that you don't use any more than necessary. I use the 6.5kbps option with most of my stuff. You can certainly tell that the audio is a poor quality when compared to CD but it does get through OK. If you are more concerned with picture quality and sharpness but don't need a high frame rate, then dedicate less for Video section and use it for improved audio. Once again the ultimate balancing act with the limited bandwidth.



Now look over at the Destination side of the form. The Real Media file box should be checked, if not, do so now. The reason for this is that we will not be broadcasting live video streams. Then select the SAVE AS button and save your creation in the temporary file directory you made and that name will appear in the box.

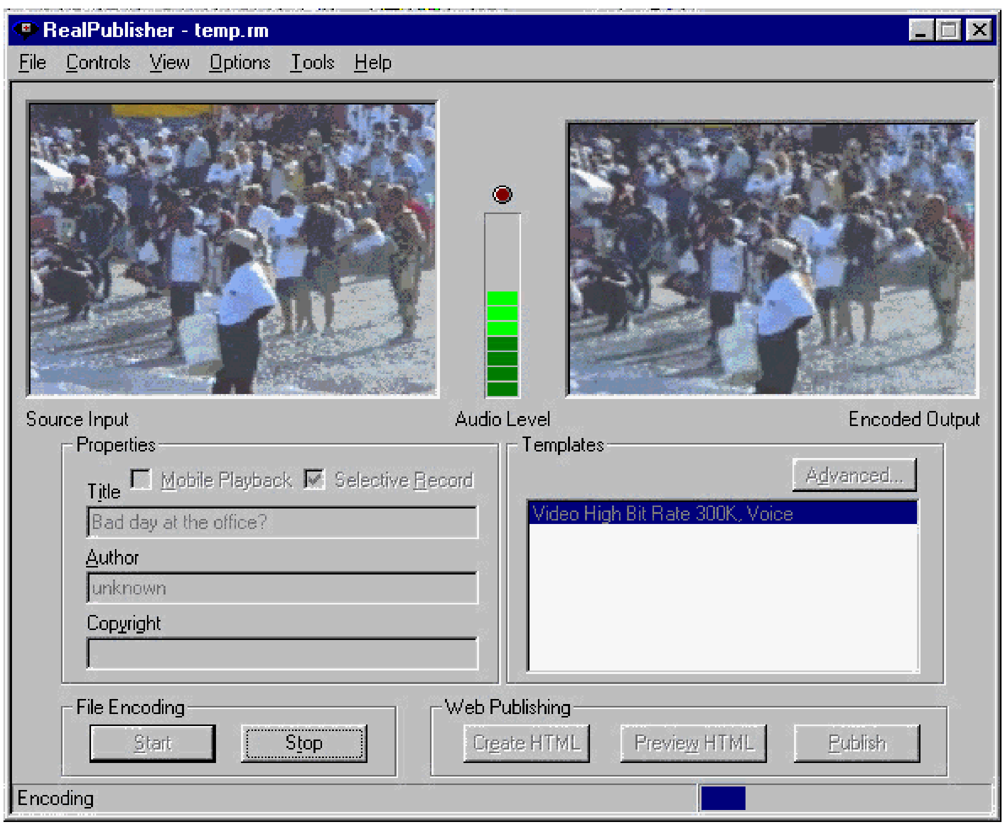
Almost ready, and your file will show up on the left side of the window, that screen will disappear when you click OK. Now is for compression. Choose the Advanced button on the right side of the Real Publisher window. There are many options to choose from that are already set up in the Template. Find the one that best fits what the general public has to view the video that you wish them to. Remember that is a total of about 33 kbps total.

Once those settings are in place check SAVE. You will now go to the next screen that will look something like this. Hit the START button and watch as the Real Encoder takes control of your PC.

When the encoder is done you will have a new file in your temporary directory that you set up. At that time you can double click on it and review it. If it is to your liking you are now ready to publish it on the Internet.

Let's cover that quickly. In order for you to publish it on an Internet site without the use of a Real Media Player on the server side a trick must be made so that it will play correctly. Quite simply you must make another file that refers to the clip. Why, because if you don't the entire clip will have to download before it would play and that would not be a good thing for real-time streaming. So then, go to Note Pad or Editor in windows and make up the following file. http://www.(your domain).com/(your user name)/video/(and the name of the clip you just made).rm. Save that file as a .ram for an extension and upload it to your root directory on your internet site. This file will also be your reference file when you hyperlink it. The entire purpose of this file is to redirect the media file to the clip and then play it in real time. This little trick is called Pseudo Streaming and work quite well. Remember the reference file you just made has an extension of .ram the file that is your video clip is .rm.

That is it. You are now set up to stream video and or audio on the Internet. If you have any questions give me a jingle and I will see about getting back to you.



Real Video

SureStreaming

Jeff Rule, April 19, 1999

We encoded for a single bandwidth of 56K. What if you could encode a single file that would switch between different bandwidths as the Internet changed? You might start off watching 56K video, however when your connection slows it switches to 28.8 video. This is what SureStream does and it greatly reduces how often you'll need to wait for video to rebuffer.

SureStream files are created in a manner similar to single bandwidth encoding. However, with SureStream you select several bandwidths instead of just one. RealProducer is limited to two bandwidths and you'll need to upgrade to RealProducer Plus to encode multiple bandwidths. Both bandwidths are encoded into one file that can then be uploaded to a G2 Server. This technology does not work on older Real servers. If a user with an older version of the real Player receives the broadcast they will default to the 28.8 broadcast, which is actually at 20kbps.

Live Broadcasts

Live broadcasting of audio and video content is the closest that most people are likely to get to owning their own TV station in the near future. The setup process has gotten much easier with the release of RealProducer G2. The setup is very similar to encoding from a file. You still need to set the video types and audio types; however, at the end you need to point to a Real Server.

Streaming in real time requires a serious encoding machine. Doing encoding in real time will max out even the latest computers and better encoding means better quality. If you are trying to encode SureStream video I wouldn't go with anything less than a decked out Pentium II system at 400MHz with 64 MB of RAM.

RealVideo

Waiting on Broadband

Jeff Rule, April 19, 1999

RealVideo is the dominant streaming technology on the web today and will play an increasing role in broadband web delivery in the near future. In this article we'll see how to create video optimized for the web, how to encode it and how to incorporate it with SMIL.

Delivering video over the web is the Holy Grail of web development. It's the magic bullet that will allow the web to compete with TV as a viable entertainment medium. However streaming video across the Internet still requires some serious bandwidth. Let's admit it, video at 28.8 is an experiment. It's a promise of things to come; it is not a viable technology. The Real compression codecs keep getting better every year. Some of the new G2 codecs make 56kbp/sec video look pretty good. I can remember trying to get video to playback off a 1X CD-ROM back in 1993. It was usually QuickTime compressed with Cinepak and it was playing back at about 15 frames per second (fps) at 160x120 pixels and it was always locking up. A 1X CD-ROM gives you 800kbps or 100K/sec! I just had ADSL installed and my Internet connection is 640kbps. Only now six years later do I have the Internet bandwidth that I had running from CD-ROM back in 1993. When I stream video over the Internet at these rates it is 24-30fps and usually 320x240. The difference is better compression codecs and faster computers to decompress the video. When RealVideo is combined with other media types such as graphics, audio, and text it can make for a powerful multimedia presentation. This is the environment that the G2 Real Player and SMIL provide.

Broadband access to web is the key ingredient for true streaming video. Currently there are about 1.25 million home users with cable or ADSL service (1 million cables and 250K ADSL). In addition to this there are 10 million users who access the web either through a fractional T1 line or over ISDN. Unfortunately most of these 10 million users are viewing the web at work where entertainment viewing is discouraged. That doesn't leave all that great a market penetration for broadband RealVideo. However, there is a lot of lip service being paid to broadband development. The recent merger of Yahoo and Broadcast.com should help speed the delivery of a true broadband portal. In the mean time several sites are already aggregating broadband video and other content. OnBroadband.com is a site dedicated to aggregating broadband content including RealVideo. Another site, BroadbandZone.com, is dedicated to Broadband content as well as discussions of development tools, books, and tutorials. Other sites focusing on RealVideo and its incorporation into SMIL are Streaming Media World and JustSmil.

Including RealVideo in an SMIL presentation can be quite a challenge if you are planning on delivering at anything below 56kbps. The lowest setting for RealVideo is delivery over a 28.8 modem. This is going to produce video running at about .25 fps or one frame every four seconds. If you use the full bandwidth of a 56kbps modem you might get 10 fps. However, you'll want to be able to stream other SMIL media types so the video will probably be encoded at 28.8kbps. If you're doing graphics this means you can download a new graphic that is 10K every 5 seconds to give a slide show along with the video. RealText could also be added to the presentation since it takes up only minimal bandwidth.

Publishing Video to the Web

The Web Connection

Most home Internet users today use a dial-up connection through a standard 28.8K or 56.6K modem. Watching video through a 28.8K modem connection can be a challenge, at best. The quality and size of the video must be substantially reduced in frame rate and size.

The evolution to broadband connections, such as Digital Subscriber Line (DSL) and cable-modem service through the television cable, is rapidly changing the way people think about and utilize the Internet. These high-speed digital connections allow for a better overall video experience, by way of offering from 20-50 times more speed than a standard dial-up internet connection.

The new services are available in many metropolitan areas, and provide dramatically faster connections with little or no tradeoff, other than slightly higher access charges per month. An excellent side-benefit is that your standard telephone line is no longer tied up when online, and the connection is on at all times with no need to dial up to access the internet. Your Internet connection and the connection your friends use will largely determine the maximum quality level of your web video efforts.

A high-speed connection will shorten your upload/download times, while giving you the ability to view higher quality video; a combination of more frames per second, larger frames, and less compression.

Putting Your Video on the Web

Many Internet users today have their own personal websites. But when you produce a web video, it isn't necessary to have your own website in order to make it available and easy to view. Special sites exist on the Internet that have a sole purpose of being a site to share digital pictures and movies with your friends. These sites provide the storage space for your files, while you provide the actual content.

Most are available at no cost to you or to the viewers of your video. One such site, www.digitalfridge.com, provides a password setup so that only the people you invite to see your work will actually be able to access it. Or if you're feeling like having an audience, you can make your work public, and anyone who wants to can view it.

How Your Friends Will See Your Video

In order to see the video you've made available, your friends and family will need to have their computers set up to enable them to play web movies.

Having the appropriate media player installed, such as QuickTime, will make the process seamless for future trips to see video on the web. The media players are free of charge, and easy to install once downloaded from the respective companies who produce them.

QuickTime, from Apple Computer, can be downloaded from Apple's website at www.apple.com/quicktime/. The installation places the QuickTime player application and appropriate web-browser plugins into the proper places on your hard disk. Once installed, the functionality is integrated into the web navigation process. When a QuickTime media file is accessed on the web, it is played through the QuickTime player automatically within your browser.

Glossary Full Version

Numerical

1394
IEEE-1394 is an external bus standard that provides high-speed data connections between devices, generally a computer and a DV camcorder. Devices conforming to this standard are capable of transmitting digital data at 100-400 Mbps. Also known under the names "FireWire" or "i-Link". Other devices adopting 1394 are high-end professional color printers and mass storage devices.

3:2 pull-down
The process of converting film's 24 progressive frames per second into the 30 interlaced fps (60 fields per second) of video to meet the requirements of the NTSC television standard. The process can be reversed, and the original frames reconstructed, through inverse telecine.

4:1:1
Ratio of sampling frequencies used to digitize the luminance and color difference components (Y, R-Y, B-Y) of a video signal. The "4" represents 13.5 MHz for the sampling frequency of the Y channel and the "1"s represent 3.75 MHz for both the R-Y, B-Y channels. Color information is sampled at half the rate of the 4:2:2 system in a fashion more efficient for 525 line television formats.

4:2:0
Ratio of sampling frequencies used to digitize the luminance and color difference components (Y, R-Y, B-Y) of a video signal. The "4" represents 13.5 MHz for the sampling frequency of Y, and the "2" and "0" represent the sampling of R-Y and B-Y at 6.75 MHz, between every other line only. Color information is sampled at half the rate of the 4:2:2 system in a fashion more efficient for 625 line television formats.

4:2:2
Ratio of sampling frequencies used to digitize the luminance and color difference components (Y, R-Y, B-Y) of a video signal, and often used synonymously component digital format, ITU-R 601, 601, CCIR-601 and SMPTE-125. The "4" represents 13.5 MHz for the sampling frequency of the Y channel and the "2"s represent 6.75 MHz for the R-Y and B-Y channels. This format has best support for high-quality chromakeying used in video production.

5.1
Surround sound using five and one additional discrete audio channels: left, center, right, left rear/side Surround, right rear/side Surround, and a subwoofer (the ".1" in "5.1").

8-VSB

Eight discrete amplitude level Vestigial Side-Band broadcast transmission standard, the ATSC digital television transmission standard currently used in the United States.

Glossary Full Version

Alphabetical

AAC
Advanced Audio Coding is a codec standard (ISO/IEC 13818-4,5) for MPEG-2 audio compression similar to MP3, but considered by some to provide higher quality at lower bitrates. Also part of the MPEG-4 audio specification.

AC-3
Older term for Dolby Digital, the 5.1 channel surround-sound audio standard for ATSC digital television and DVD video in the U.S. achieves approximately 13:1 compression.

ADPCM
Adaptive Delta Pulse Code Modulation, a codec used for the compression of audio files. It achieves superior compression by encoding only the difference between samples.

ADSL
Asymmetrical Digital Subscriber Line, a technology for transmission of digital data over standard twisted-pair copper phone lines used for consumer TV applications with "VCR-like" quality. Generally provides speeds of to 6 Mbps up to 12,000 feet, or 1.5 Mbps up to 18,000 feet.

Algorithm
A formula used to simplify, modify, or predict data to selectively reduce the high data rate required by digital audio and video.

Aliasing
Defects in a video image that usually appear as jagged edges on diagonal lines.

Alpha Channel
The optional grayscale layer in image or video files used to isolate portions of the image, generally for mattes and compositing.

Analog
A system, signal or device that represents and/or transmits information via waves carried over the air or recorded onto a magnetic tape. Analog systems are limited in their ability to duplicate information accurately.

Anamorphic

The enhancement to DVD Video that allows proper, full resolution display of a 16:9 ratio video image on a widescreen display. When viewed on a 4:3 standard television display, the DVD Video player can adjust accordingly and present the image as "letterboxed" (black bars across the top and bottom).

Anti-aliasing

When pixels in an image are averaged so that their colors are more similar to surrounding pixels, in order to reduce jagged edges.

API

An Application Program Interface is the specific method prescribed by a computer operating system or by another program through which a programmer writing an application can make requests of the operating system, hardware or other application.

Artifacts

Unwanted noise or defects in digital images or video, usually the result of poor (or simply heavy) compression.

ASF

Advanced Streaming Format, one of Microsoft's media file formats for streaming video and audio over networks and the Internet.

Aspect Ratio

The expression of the relationship of width to height for a given pixel or image, either expressed as a ratio (example: 4:3) or as a decimal (example: 1.33, 4 divided by 3). NTSC and PAL video are considered 4:3, and widescreen video is typically 16:9.

Asynchronous reader filter

In Microsoft's DirectShow, a file source filter that reads data off the disk for playing back media files, and the source filter used for most filter graphs.

Asynchronous

A type of transmission in which data is transmitted independently without reference to a standard clock. Also used in reference to different capacities for data transfer in each direction (such as ADSL).

ATM

Asynchronous Transfer Mode, a form of fast packet switching that allows for data transmission of 25 and 155 Mbps. The internationally agreed basis for broadband ISDN.

ATSC

Advanced Television Systems Committee that establishes the technical standards for advanced television systems, including digital and high definition television transmission in the United States.

AVI

Audio-Video Interleave, a media file format for storage of digital video and audio on the Microsoft Windows platform.

AVO

In MPEG-4, an individual Audio-Visual object is anything that can be seen, heard or experienced as part of an MPEG-4 presentation. Optimal coding algorithms and delivery schemes can be employed based on unique characteristics of each AVO.

B-Frame

In MPEG, a Bi-directional Predictive picture composed by evaluating only the differences between the immediate previous and next I- or P- frames in a video sequence. B-frames provide the best compression of the three (IPB) frame types.

Bandwidth

In digital communications networks, the data transfer capacity of a system expressed in the number of bits per second. In broadcast networks (television, radio, wireless), the capacity is expressed in MHz and the amount of spectrum available to each communications licensee.

Batch Processing

A feature common in many digital video applications that automates (based on input from the user) repetitive or similar functions such as video capture or export to multiple formats.

BIFS

Binary format for scenes. In MPEG-4, a set of elements called nodes that describe the layout of a multimedia layout, organized in a tree-style hierarchical scene graph node structure.

Bit

Short for binary digit, this is the unit of measure for the smallest element of digital data, with a value of 1 or 0.

Bitmap

An image comprised of a pattern of different colored dots or pixels.

Bit Rate

The speed at which digital data is streamed across a network, usually measured in kilobits per second (Kbps) or megabits per second (Mbps).

Block

In digital video, a rectangular area of picture, usually 8 x 8 pixels in size, which is subjected to DCT coding as part of the compression process. Also used to refer to visible compression artifacts between adjacent blocks in a DCT-based compression.

Bob

A method of displaying interlaced video fields on a progressive monitor by doubling or interpolating alternate fields and displaying them for 1/60 of a second, similar to television. In Windows, DirectDraw automatically shifts every other field by one half pixel vertically, and then stretches each field by a factor of two vertically.

Bps

Bits per second, a general measurement for data transfer rate

Broadband

High-speed data transmission, usually referring to services at 1.5 Mbps or greater

Broadcast

The delivery of media or presentation, live or prerecorded, in which all viewers join the presentation in progress. Also used to refer to the part of the television industry that provides content directly to the home or alternate providers (cable, satellite, etc.).

Buffering

The process by which streaming media is cached in memory before beginning to play.

Bus

A system data bus acts as a communication channel between the motherboard and other system components. Within the processor of a computer, data passes along a set of parallel lines known as an internal data bus. An external data bus provides an interface with the system's motherboard. In terms of a Local Area Network (LAN), a bus topology consists of a single two-directional cable, which is connected to each of the workstations and file servers.

Byte

Short for binary term, a unit of data made of eight bits.

Cable modem

A data modem that uses the bandwidth of a given cable system (primarily fiber optic or coaxial cable) that provides bandwidth generally up to 30 Mbps.

CATV

Community Antenna Television, or simply Cable, a television system that distributes programming over coaxial or fiber-optic cable.

CBR

Constant Bit Rate, the encoding or delivery of media at a specific given data rate.

CCD

Charge coupled device, a chip or set of chips that samples analog signals, and used in cameras and video cameras.

CCIR

Comit Consultatif International des Radiocommunications (International Radio Consultative Committee), an international standards group replaced by the International Telecommunications Union (ITU).

CCIR 601

The recommendation developed by the CCIR specifying the digitization of color video signals, color space conversion, the 13.5MHz sample rate and the 720-pixel horizontal resolution of broadcast television. Also known as Recommendation ITU-R BT.601.

CD-I

CD Interactive, one of the original multimedia formats for compact disc.

CD-R

Recordable CD. A CD-R has inside a dye, sensitive to a laser beam. The Laser writes the information (pits) into an optical pregroove, and the dye changes the reflectivity of the gold layer to form the pits. A CD-R cannot be erased, and is thus known as WORM (Write Once, Read Many times).

CD-ROM

A CD with data used by computers to load programs or to read stored data. A CD-ROM (Read Only Memory) cannot be overwritten (Yellow book).

CD quality

An audio stream that is encoded by using uncompressed PCM at 44.1 kHz and 16 bit stereo.

Cache

Computer memory used to store information that is most frequently used, usually stored in a section of main memory or in a separate device for faster access.

Caption

Text that accompanies an image or video stream.

CELP

Code-Excited Linear Prediction, an audio encoding method for low-bit rate (2400 bps) speech coding.

Channel

A single component of an audio or video that creates the desired image or sound produced by the decoder/player when combined with other elements.

Chroma/Chrominance

The characteristics of color information based on the combination of hue and saturation, independent of the luminance intensity.

CIF

Common image format for digital video, defined as a resolution of 352 horizontal x 240 vertical pixels.

Cinepak

An older, widely used software codec for CD-ROM video. It was generally associated with 320 x 240 resolution video, 15 frames per second, at 150 Kbps. Modern codecs produce much better results.

Client

The device, computer, or software that originates requests to the server in a network environment.

Clip

In editing, a single media item to be used as part of the larger project.

CMYK

A color model that uses subtractive colors (Cyan, Magenta, and Yellow) to create all the other colors, and a fourth channel, Black (K) used to create varying grayscale shades. Used primarily in post-process printing.

Codec

A Compressor/Decompressor is a software or hardware component used to digitally compress video and audio data to minimize the file size, and to decompresses media files during playback. Motion-JPEG, DV, MPEG (and its various flavors), Indeo, and Sorenson are all common codecs.

COFDM

Coded orthogonal frequency division multiplexing, the broadcast transmission standard used for digital television in Europe. Generally considered to be less robust and flexible than 8-VSB, but more immune from multi-path interference.

Color Model or Color Space

Term describing how elements are combined in an image to produce a color. Examples are: RGB which combines red, green, and blue to form other colors; CMYK, which combines cyan, magenta, yellow, and black, and; HSB, which combines hue, saturation, and brightness. Moving between color spaces requires conversion, and certain models are best suited for different applications (example, RGB for video, CMYK for printing).

Component Video

A color video signal that separates luminance and chrominance into different parts. RGB, 4:2:2 and YUV are examples of component video systems. Betacam video employs a component video signal system. Systems using component video are considered to provide better quality than composite video systems.

Composite Video

A color video signal that contains all of the color information (luminance and chrominance) in one signal, used as a type of analog compression. NTSC, PAL and SECAM are examples of composite video systems, and RCA style ports on devices like a VCR are considered composite.

Compression

The process of reducing file size for storage by finding patterns of data that can be classified more efficiently. There are two general categories of compression, lossless and lossy. A codec (Compressor/Decompressor) is an algorithm or scheme used when recording digital video or audio. For example, when video is transmitted over the Internet, it must be compressed on the sending end and decompressed on the receiving end. A codec can be chosen based upon the user's audio or image quality and image size preferences. Windows Media Technologies provides numerous codecs for streaming media content.

Compression filter

A specialized type of transform filter. Compression filters (compressors) accept data, use a compression scheme to transform the data, and pass the compressed data downstream.

Concatenation

End-to-end linking together of different digital streams, often complicated by differences (bitrate, structure, etc.) of the different streams.

Cropping

The process of trimming away the edges of images, retaining only the inside portion and resizing the image's dimensions accordingly.

D1

A format for component digital video tape recording working to the ITU-R 601, 4:2:2 standard using 8-bit sampling. Also used to refer to video resolution of 720x480 (NTSC) or 720x576 (PAL), often as Full-D1.

DAI

DMIF-Application Interface. In MPEG-4, an application interface that allows access to AVOs regardless of the method of transmission.

Data Broadcasting

The distribution of text and/or graphics via the spare capacity in the broadcast, cable or satellite transmission system.

Data Rate

The speed at which data passes between devices or systems, generally measured in bits per second.

DBS

Digital Broadcast System (or Satellite). A digital satellite reception system utilizing a fixed small dish focused on a geostationary satellite. DBS units are able to receive multiple channels of multiplexed video and audio signals (usually MPEG-2 transport streams via COFDM) as well as programming information, and (sometimes) data such as Internet and e-mail.

DCT

Discrete cosine transform, a method of video compression used in DV, MPEG and others that evaluates 8x8 pixel blocks in the picture.

Demultiplex

Separating the elementary streams of data (for instance, video and audio) from a single
multi-channel stream.

DivX

A set of homebrew media codecs for Windows the AVI file format. They are based on a cracked version of Microsoft's "MPEG-4" codec, and named after the failed Circuit City pay-per-view DVD scheme or 10:1 compression (depending on who you ask). Confusingly, DivX has little to do with DVD or true MPEG-4, but nevertheless provides excellent quality and compression.

DMIF

Delivery Multimedia Integration Framework, the part of the MPEG-4 specification that separates content from delivery method, and ensures transparent access to the content irrespective of the delivery technology, environment, or network.

DSL

Digital Subscriber Lines, high speed Internet access lines for connections directly from a telephone switching station to the client. There are many varieties, and the most common, ADSL, offers download rates up to 1.5 Mbps.

Decrypt

Conversion of encrypted content into accessible content.

Deinterlace

The process of combining two interlaced fields sets into a single frame, usually to remove artifacts and scanlines to improve the quality of video when displayed on progressive systems.

Delta Frame

Encoded video frames that contain only data of the changes from the previous frame.

Device Control

A system or software driver that gives applications the ability to control video source devices like a camcorder or VCR.

Digital

The method of data storage where analog information is converted into numerical values to be processed by computers.

Digitizing

The process of converting analog input to a digital form.

DirectDraw

DirectDraw is a Microsoft DirectX SDK component that enables direct manipulation of display memory, the hardware blitter, hardware overlay support, and flipping surface support. DirectDraw provides more efficient use of system resources to create full-screen video.

DirectShow

Successor to Microsoft's Video for Windows and ActiveMovie that supports the capture, storage and playback of video and audio files. At the heart of the DirectShow services is a modular system of pluggable components called filters, arranged in a configuration called a filter graph. A component called the filter graph manager oversees the connection of these filters and controls the stream's data flow. Applications control the filter graph's activities by communicating with the filter graph manager.

DirectX

The group of technologies designed by Microsoft for running and displaying, on the Windows platform, applications and interactive multimedia content, such as full-color graphics, video, 3-D animation, and surround sound. Through the DirectX API, developers are given a common set of instructions, components, and tools to integrate a wide range of multimedia elements.

Dithering

A process that arranges pixels of different colors close together to simulate colors not directly supported by an image data type.

Dolby Digital

Formerly Dolby AC-3, the approved 5.1 channel (surround-sound) audio standard for ATSC digital television, achieving approximately 13:1 compression. The system uses multiple channels and speakers in front of and behind the listener to create the illusion of audio depth (3 in front, 2 behind the listener and 1 sub-woofer for low frequencies). This is also the standard that the US uses for DVD Movies.

Download

The delivery of content over a network in which the content is copied to a client computer from another client or the server (unlike streaming, in which the source data is not copied to the client computer).

Downstream Filter

In DirectX, the next filter in line to receive data from an upstream filter. An upstream filter sends data from its output pin to the connected input pin of the downstream filter.

DPI

Dots Per Inch is a measure of screen, image and printer resolution that is expressed as the number of dots that a device can print or display per linear inch.

Driver

Software that manages control of and communication with a hardware device.

DRM

Digital Rights Management, a system that packages and manages access to media content, such as decryption or license management.

DSP

A Digital Signal Processor is a processor that is usually dedicated for handling audio or video signals commonly found in consumer electronics.

DTV

Digital Television refers to transmitting a broadcast signal by encoding it digitally, gaining a number of benefits in the process. DTV can be compressed to provide four, five or more channels in the same bandwidth required for one channel of the current standard television. For digital conversion, the "Grand Alliance" plan approved by the FCC calls for the allocation of 6 MHz of the broadcast spectrum for each television broadcaster. It can be used for multiple standard definition signals, or one HDTV signal, and/or data transmission.

DV

Digital Video, or DV, is a very specific format and codec for video. The format can be stored on and played back by camcorder and computer, transferred between the two via IEEE 1394 digital I/O.

DVB

Digital Video Broadcasting, the group that developed the preferred scheme for digital broadcasting in Europe.

DVD

Digital Versatile Disc (aka Digital Video Disc), a disc format that stores 4.7 GB of data on a single sided, single layer CD size disc (equivalent to up to 3 hours of video and multi-channel audio). DVDs can also be double sided or dual layer-storing even more data.

DVD-R

A recordable (write once) DVD format using dye sublimation recording technology, capable of storing 3.95 GB on a single sided, single layer CD size disc. Generally used for DVD pre-mastering.

DVD-RAM

A recordable (write once) DVD format using phase-change recording technology, now capable of storing 4.7 GB on a single sided, single layer CD size disc. Generally used for archiving data on PCs, and a more affordable option than DVD-R. Although currently limited to drives for PCs, the backers of the format plan on releasing DVD-Video players compatible with the DVD-RAM format for recording and playback in the immediate future.

EDL

In video editing, an Edit Decision List is a list of all clips, effects, and transitions in a video project included in a video project, including notation of sources. EDLs are generally transferable between systems.

EPG

An Electronic Programming Guide is an interactive on-screen listing of programming available to a television service subscriber.

Encode
The conversion of data into a specified digital format for storage and retrieval, usually involving compression and sometimes encryption technologies.

Encrypt
In digital media, a software system used to protect sensitive data, often using a password or code.

Export
The process of converting data into a format that is recognizable by other applications.

FCC
The Federal Communications Commission is the federal regulatory agency that establishes policies to govern interstate and international communications by radio, television, wire, satellite, and cable.

Fiber Optics
A data transmission system that accepts an electrical signal, converts and transmits it by light pulses and then reconverts the output to an electrical signal at the receiving end. Fiber optics provide extremely high bandwidth and can run for long distances between repeaters. Fiber systems have three components, a transmission medium (fused silica or an ultra thin fibers of glass), the light source (LED or laser) that produces pulses representing the data, and a photodiode detector.

Field
A set of alternating scanlines of an interlaced video frame, most commonly used in television. This approach was originally invented as a form of compression for analog transmission, and also provides twice the images per second (at half the resolution) to achieve smoother fast motion. NTSC (29.97 frames per second), for example, provides a series of 59.94 interlaced fields per second.

Field dominance
Scan lines of the even-numbered (lower) fields fall spatially halfway between the scan lines of the odd-numbered (upper) fields, but are separated temporally. The field displayed first determines the field dominance (for instance, "lower field first").

File Format
A file structure that defines the way information is stored. Examples are ASCII text, AVI, MPEG, and QuickTime.

Filter
An effect applied to an image, video, or sound that changes its appearance or sound quality. Also, a key component in the Microsoft DirectShow architecture, a filter is a COM object that supports DirectShow interfaces or base classes. It might operate on streams of data in a variety of ways, such as reading, copying, modifying, or writing the data to a file. Sources, transform filters, and renderers are all particular types of filters. A filter contains pins that it uses to connect to other filters.

Filter Graph

In DirectShow, a collection of filters that are connected to perform a particular operation, such as playing back a media file, or capturing to the hard disc. The Filter Graph Editor is a graphical tool included with the Microsoft DirectX Media SDK that creates and manages DirectShow filter graphs.

Firewall

A firewall is a system used as a security measure between the Internet and an internal network.

FireWire

Trademarked name given by Apple Computers for the IEEE 1394 digital I/O standard.

FlexMux

The optional Flexible Multiplexing layer of MPEG-4, a tool that provides simple packet syntax and lightweight multiplexing for low bit rate, low delay streams.

FMV

Full Motion Video, the ability to play video at the broadcast frame rate of 30 fps for NTSC signals or 25 frames per second for PAL signals.

Frame

A single image in a video sequence containing the entire set of scanlines. NTSC video displays at roughly 30 frames per second.

Frame Drop

Frame Drop is when a decoding or encoding system cannot keep up with the true frame rate of the source video, resulting in "jerky" playback.

Frame Rate

The number of frames captured or displayed in one second of a video sequence.

Frame Size

The size (resolution in pixels or lines) of the captured or displayed frame in a video sequence.

FPS

Frames Per Second, the number of frames captured or displayed per second in a video sequence.

Frequency

The number of times an electromagnetic signal repeats an identical unit of time, measured in hertz (Hz).

Gamma
The range of possible colors and values portrayed on a display.

GoMotion
A DirectShow-based SDK by Ligos used by developers to add scalable, real-time MPEG-1 and MPEG-2 encoding to Windows-based PC software applications.

Grayscale
Color model for image data containing a 1 - 256 different shades of gray (including black and white).

GOP
In MPEG, a Group Of Pictures representing frames between successive I frames, with P and/or B frames in between.

H.263
ITU standard for variable low bit rate, low resolution coding of video for videoconferencing over packet networks like the Internet. Less flexible than MPEG, but requires less overhead for processing.

HDTV
High Definition Television, any format that is at least twice the horizontal and vertical resolution of the current standard definition signals, displayed in a 16:9 aspect ratio.

HSB
A color model that specifies colors as: H representing the hue or basic color; S representing the saturation or purity of the color; and B representing the Brightness or amount of light the color appears to emit.

HSP
Host Signal Processor, a device or system that depends on the host CPU for part or most of the data processing.

HTTP
Hypertext Transfer Protocol, the main protocol used on the World Wide Web that defines the rules for transmission of web pages (and related content) in TCP packets.

Hue
The color of light or a pixel, the property that sets it apart from other colors in a wavelength of light.

I/O
Input/Output, typically refers to sending data signals to and from devices.

I-Frame

One of the three types of frames that are used in MPEG coded signals. These contain data to represent an entire frame image (intraframe), compressed using DCT.

IEEE

Institute of Electrical and Electronics Engineers, a non-profit organization that sets and reviews standards for the electronics industry.

IEEE 1394

IEEE-1394 is an external bus standard that provides high-speed data connections between devices, generally a computer and a DV camcorder. Devices conforming to this standard are capable of transmitting digital data at 100 -400 Mbps. Also known under the names "FireWire" or "i-Link". Other devices adopting 1394 are high-end professional color printers and mass storage devices.

Import

The process of bringing data of a non-native format into an application, usually through a translation filter.

Indeo

A set of video and audio codecs originally developed by Intel for PC multimedia applications, and featuring progressive download features for the Internet.

Input Pin

In a filter graph, a pin that accepts data into the filter.

InfiniBand

A next-generation digital I/O architecture currently under development promising transmission rates of 500MB/s to 6GB/s per link.

Intelligent Streaming

A type of multiple bit rate streaming that adjusts the quality properties of the video and/or audio stream according to network conditions.

Interactive Television

The combination of standard television and enhancements (such as Internet access and interactive content).

Interframe

Data reduction based on coding the differences and predictions between frames.

Interlace

Interlaced video uses two alternating video fields to make a single frame of video, most commonly used in television. This approach was originally invented as a form of compression for analog transmission, and also provides twice the images per second (at half the resolution) to achieve smoother fast motion. NTSC (29.97 frames per second), for example, provides a series of 59.94 interlaced fields per second.

Interleave

A process of arranging audio and video data during compression used to obtain smoother playback and synchronization.

Interpolation

The method of generating missing information by estimating intermediate values between two known values in a sequence.

Intraframe

Data reduction based on coding only the information within a single frame, regardless of surrounding frames.

Inverse Telecine

The process that reconstructs the frames that were added when 24 fps film was converted to 29.97 fps (59.94 fields per second) video.

IP

Internet Protocol, the base protocol for the Internet designed to operate over a wide range of network technologies that defines an addressing plan and delivery service, but does not guarantee arrival of packets. Also used as an abbreviation for Intellectual Property.

IPMP

The optional Intellectual Property Protection and Management layer of MPEG-4, used to provide management of authorized access to encrypted content.

ISDN

Integrated Services Digital Network is a telecommunications service evolved from the existing public telephone network that provides access at 128 Kbps per line.

Isochronous

Data transfer at a consistent, specified rate suitable for continuous data such as video and voice.

ITU

The International Telecommunications Union, headquartered in Geneva, Switzerland is an international organization within which governments and the private sector coordinate telecommunications standardization. In many cases, it is the successor to the CCIR.

Jaggies
Undesired jagged edges that appear around the edge of objects in video or an image, commonly seen when interlaced video is displayed in a progressive video environment (example, television video captured and played back on a computer).

Joint Stereo
A specific coding method in MPEG Layer-II audio where the upper frequencies of the stereo signal are joined and coded as intensity stereo in order to conserve bandwidth and improve quality.

JPEG
Named after the Joint Photographic Experts Group that created the standard, a compression technique for images that reduces them to a small percentage of the original file size.

Kbps
Kilobits per second, a general measurement for data transfer rate at thousands of bits per second.

KBps
Kilobytes per second, a general measurement for data transfer rate at thousands of bytes per second.

Key
The piece of data required to unlock a media file packaged with encryption, usually obtainable separately.

Keyframe
A frame of digital video that contains all the data required to reconstruct that frame. Also, one of two or more frame in a sequence that is used for interpolation of motion or information between frames.

kHz
Kilohertz, or one thousand Hertz, a measurement of frequency.

Linear Editing
Traditional "cut and splice" editing done on a flatbed where the sources are edited in the order presented. Changes to any edit require re-recording all of the succeeding edits or using the master as the source.

Lossless Compression
Any compression method that reduces file size without changing any data when the file is reopened.

Lossy Compression
Any compression method that reduces file size by selectively discarding what is determined to be nonessential data.

M1V

A standard abbreviation or file extension for an MPEG-1 elementary video stream.

M2V

A standard abbreviation or file extension for an MPEG-2 elementary video stream.

M-JPEG

Motion JPEG, a video compression scheme and codec that treats each field or frame in a sequence as a separate image, and performs separate compression on each. Popular in older digital editing systems before the advent of DV formats.

Macroblock

In MPEG, the basic unit used for motion compensated prediction. A macroblock consists of four eight by eight blocks of luminance data (arranged in a 16 by 16 sample array) and two 8 by 8 blocks of color difference data, which correspond to the area covered by the 16 by 16 section luminance portion of the picture.

MB

A Megabyte, one million bytes (actually 1,048,576), or one thousand kilobytes.

Mbps

Megabits per second, a general measurement for data transfer rate at millions of bits per second.

MBps

Megabytes per second, a general measurement for data transfer rate at millions of bytes per second.

MCI

Media Controller Interface, a software driver designed by Microsoft to allow media files to be played in Windows and device control from the PC.

Metadata

Information about the data itself. In digital media, information about the properties of audio and in the signal's data stream used for efficient decoding and databasing functions.

MHz

Megahertz, or one million Hertz, a measurement of frequency.

Motion Compensation

In video compression, the process of analyzing previous/future frames to identify motion vectors, and create the prediction and the error difference signal for interframe encoding.

Motion Estimation
In video compression, the process of evaluating and describing only the differences between adjacent frames, thus eliminating the need to convey redundant information.

Motion Vector
Two-dimensional vector used for motion compensation and motion estimation that provides an offset from the coordinate position in the current picture to the coordinates in a reference picture.

MPEG
Moving Picture Experts Group, the organization involved with defining open standards for digital media. Also used as the name of the formats and compression methods defined by this group.

MPEG-1
A widely used set of standards for the coded representation of video and audio, primarily for PC multimedia applications. The basis of formats such as CD-I and VideoCD. The ISO standards are organized under the designation ISO/IEC 11172.

MPEG-2
A widely used set of standards for the coded representation of video and audio, primarily for digital television and digital broadcast satellite. Intended for applications requiring support for interlaced video, and larger frame sizes and bitrates than supported by MPEG-1. The basis of formats such as Super VideoCD and DVD Video. ISO standards are organized under the designation ISO/IEC 13818.

MPEG-4
A next-generation set of standards for the coded representation of the combination of streamed elementary audiovisual data in the form of natural or synthetic, audio or visual, 2D and 3D objects. It is a departure from previous MPEG standards as it concentrates more on the architecture of a multimedia system rather than pure compression issues. MPEG-4 provides standardized elements enabling the integration of production, distribution and content access, independent of the transmission method. ISO standards are organized under the designation ISO/IEC 14496.

MPEG-J
A programmatic system that specifies an API for interoperation of MPEG-4 media and Java applications.

MP2
A standard abbreviation or file extension for an MPEG Level II elementary audio stream.

MP3
A standard abbreviation or file extension for an MPEG Level III elementary audio stream.

MP4
Abbreviation used by many to describe a file containing MPEG-4 video and/or audio information.

Multicast
A connection in which multiple clients simultaneously receive the same broadcast stream from a server on a multicast-enabled network.

Multiplex
The process of combining separate elementary video and audio streams into a single synchronized signal or stream. Also known as "mux".

NAB
The National Association of Broadcasters is an industry group representing the radio and television industries to the government, public and other industry groups.

Noise
Visual or audible discrepancies that adversely affect media that has been recorded or encoded badly.

Non-linear Editing
The method of combining multiple digital media clips to produce a finished product. NLE offers random access at anytime to all source material in the project until the final recording is published to tape.

NTSC
National Television Standards Committee is the standards body that defined the commercial broadcast standards for television used in the United States (and some other parts of the world such as Canada and Japan). It describes a system for video that is 29.97 frames (59.94 interlaced fields) per second and 525 scan lines per frame. The standard includes the specifications for the composite color encoding system, often considered to be difficult to work with.

Object Descriptor (OD)
In MPEG-4, a structure similar to a URL, containing pointers to elementary streams and containing Quality of Service parameters.

OC-3
A fiber optic line capable of transmitting 155 megabits per second.

OC-48
A fiber optic line capable of transmitting 2400 megabits per second.

Off-line

The process of editing video away from the source material to create an edit decision list. This is often considered a more economical method of planning an editing project without tying up more expensive or complex online systems.

OHCI

Open Host Controller Interface, a specification for the interaction between Host Controller hardware (such as found on an IEEE 1394 card) and the Host Controller software driver.

On-line

The process of editing directly with the source material in real-time. The process can largely be automated by using an EDL generated in an offline edit session.

Open Cable

An industry initiative aimed at producing standards-based set-top boxes that are interoperable and enable interactive services for cable customers.

OpenDML

An extension to the AVI file format developed by Matrox to remove the 2 GB file length restrictions imposed by the AVI format. Type-1 DV AVI files are built on OpenDML, and thus are limited in length only by the file systems used by the operating system. The NTFS file system supported on Windows NT and 2000 can store OpenDML files of almost unlimited length. The FAT32 file system supported on Windows 98 only supports files up to 4 GB.

Output Pin

In a filter graph, a pin that provides data to other filters.

Overlay

The process of rendering part of one image transparent to allow a second image to appear through this transparent area, used on PC graphics systems to provide high quality video without compromising the performance.

P-Frames

In MPEG, a Predicted frame that contains only predictive information generated by evaluating the difference between the present frame and the previous one. They contain much less data than I-frames and help achieve the low data rates, quality and efficiency associated with the MPEG signal.

Packet

A unit of information transmitted as a whole from one device to another on a network, consisting of binary digits representing both data and a header.

PAL

Phase Alternation Line is the television standard used in Europe, Africa, and South America characterized by 25 frames (50 interlaced fields) per second and 625 scan lines per frame.

Pan-scan

DVD-Video display format in which a 16:9 video is cropped for a 4:3 display.

Parser Filter

In Microsoft's DirectShow, a filter that pulls information from a disc by using the asynchronous file reader filter, or from the Internet by using the URL moniker filter.

PCM

Pulse Code Modulation, a method by which analog sound is digitally sampled and recorded. Changing the playback rate and reproduced with a varying pitch and amplitude.

Pel

Video term for picture element, also known as pixel, the smallest component that makes up an image.

Pin

In Microsoft’s DirectShow, a COM object created by the filter that represents a point of connection for a data stream on the filter.

Pixel

The smallest component that makes up an image, each of which can be a different color. Used as the unit of measurement for an image, and derived from the shortening of the words "picture element" or "picture cell."

Post-Production

In video and audio, the process of merging media sources from tape or film into the finished program. Post-production includes editing, special effects, dubbing, and titling.

POTS

Plain Old Telephone Service. Regular analog phone service, as opposed to ISDN, ADSL, and other digital phone services.

Primary Surface

The area in memory containing the image being displayed on the monitor.

Production

In video, refers to the process of creating programs. In more specific usage, production is the process of getting original video onto tape or film, ready for post-production.

Profile

A predefined group of settings that match content type and bit rate with appropriate audio and video codecs and settings.

Protocol

Protocols are the procedures required for communication between computers, controlling transmission speeds, direction of transmission, error detection and correction, etc.

Pull-down

Also called 3:2 pull-down, the technique for displaying 24 frame-per-second progressive film content on an interlaced 29.97 frames (59.94 fields) per second monitor. The first frame is show for 3 fields (1.5 frames), and then the second frame is shown for 2 fields (1 frame).

QoS

Quality of Service, the concept that transmission rates, error rates, and other characteristics can be measured, improved, and, to some extent, guaranteed in advance.

QCIF

Quarter Common source Intermediate Format, a resolution of 176x144 and common standard for PSTN videophone.

QSIF

Quarter Source Input Format, 176x140 pixels for NTSC and 176x144 pixels for PAL.

Quantization

In the encoding of digital video, the process by which pixels from the sampled video signal are assigned a value within a defined range. Quantization determines the extent of frequencies to be analyzed in the video as part of the compression process.

QuickTime

A media architecture developed by Apple Computer, which allows you to compress video files. QuickTime files are referred to as movies and have an MOV extension.

RTSP

Real-time Streaming Protocol, a standard Internet protocol for interaction between the server and the client for delivery of streamed media.

Real-time

The actual time an event takes place. For example, real time can refer to the live capture from a video source, with no time required for encoding.

RealMedia

Streaming technology architecture developed by Real Networks for delivering live video to users over the Internet at low bit rates to be played in RealPlayer.

Render

The process of combining source information into a single file after applying transitions and other effects for output.

Resolution

The resolution of an image determines the size of the individual pixels in an image, and thus the size of the whole image when displayed or printed. Resolution is shown in pixels per inch (PPI) or dots per inch (DPI). Common resolutions are 72 DPI for computer video, and 600 DPI for print material.

RGB

The model used in televisions, computer monitors and image formats to display color. It mixes varying amounts of Red, Green, and Blue to create other colors in the spectrum.

S-VHS

Super VHS, the second-generation VHS standard that improves the picture quality by processing the brightness and the color separately. It is unrelated to the S-Video video signal.

S-Video

A type of video signal and analog I/O system that transmits luminance and color portions separately, using multiple wires. S-video avoids the NTSC encoding process and the inevitable loss of picture quality that results from it.

Saturation

The degree of a color's purity. A color that is highly saturated will be more pure and appear stronger. Increasing a color's saturation makes it appear quite vivid while reducing saturation makes the color seem washed out. Saturation Color purity. For example, a color that is completely blue has a 100% saturation, while white, which is composed of all colors, has a zero saturation.

SCSI

Small Computer Systems Interface, a widely used high data rate general-purpose parallel digital I/O interface. Up to eight devices can be connected to one bus, and different flavors support up to 20 Mbps.

SDI

Serial Digital Interface, a popular digital I/O interface for video in broadcast and post-production environments, capable of transfer up to 270 Mbps.

SECAM

System Electronic Pour Coleur Avec Mmoire, the television standard used in France, Russia, and Africa characterized by 25 frames (50 interlaced fields) per second and 625 scan lines per frame.

Server

A storage system that provides audio and video storage for a network of clients.

SIF

Source Input Format, 352x240 at 30fps (NTSC) and 352x288 at 25fps (PAL). Commonly used in MPEG-1 coding.

SMPTE

Society of Motion Picture and Television Engineers, an organization based in the United States that makes recommendations for video standards to be adopted by the industry.

Splicing

In MPEG, the ability to cut at random into a bit stream for switching and editing, regardless of type of frames (I, B, or P).

SDTV

Standard Definition Television, an alternative to HDTV-resolution digital television. Offers the ability to transmit four or more standard-quality programs in the same bandwidth.

STB

A Set-top Box is a receiver device that converts a digital signal and passes it on to the television. The main function is the decoding of the incoming MPEG-2 signal, though some STBs may support extended functionality such as Internet connectivity and interactive content.

Stream

Data and associated properties transmitted across a network or system. Also, a general term for a piece of media.

Streaming

The process of sending multimedia files in a continuous flow over networks from server to client. Data is generally not copied to the client for storage, and the user can start viewing the content without waiting for the stream to be fully downloaded.

Subsampling

The process of interpreting image data by grouping and averaging color data over a block of pixels, to enhance compression. Subsampling reduces the number of bytes required to store a pixel’s color information by averaging color and luminance information.

SVCD

Super VideoCD (or Super VCD), a Compact Disc MPEG-2 video format to succeed Video CD, and developed by the China Recording Standards Committee. Quality is generally considered to be between VHS and DVD, providing resolutions of 480x480 (NTSC) or 480x576 (PAL), and supporting interlaced video. Also supports variable bitrate (VBR) MPEG-2 video at up to 2.6 Mbps, and up to two MPEG-2 Layer II stereo audio streams. A typical SVCD can hold about 18 - 40 minutes of media, and can be played on many set top DVD video players.

Sync Layer (SL)

In MPEG-4, the common mechanism for conveying timing information, and the wrapper layer around elementary streams.

Synchronous

A transmission procedure by which the bit and character stream are slaved to accurately synchronized clocks, both at the receiving and sending end.

T-1

In North America, a digital carrier for a DS1-formatted signal.

T-3

In North America, a digital carrier for a DS3-formatted signal.

Telecine

The technique of converting 24 frame-per-second progressive filmed content to interlaced 29.97 frame (59.94 fields) per second video.

Timecode

A universal method used throughout professional video production to identify a specific frame's location relative to other frames in the project. It is standardized as Hours:Minutes:Seconds:Frames, based on the 24 hour clock (example - 01:33:16:29 is the 29th frame at the time mark of 1 hour, 33 minutes and 16 seconds).

Transcode

The process of converting a file or program from one format or resolution to another.

Transform Filter

In DirectShow, a filter that takes data, processes it, and then passes it along to the next filter in the filter graph.

Transport Stream

A type of stream supported by MPEG-2 used for transmission applications such as cable and satellite. TS are well suited for delivery of multiple video and audio streams in error-prone environments.

Twisted Pair
The most common medium for transmission, consisting of two insulated copper wires twisted together in a helical form. Most common in the connection between telephones and the telephone company office by a twisted pair, Twisted Pair can be used for either analog voice or digital transmission.

Type-1 DV AVI
In Microsoft Windows, OpenDML AVI files using a DV codec where the video and audio are stored in their native, interleaved format. As they are based on OpenDML, they are limited in length only by the file systems used by the operating system. The NTFS file system supported on Windows NT and 2000 can store Type-1 files of almost unlimited length. The FAT32 file system supported on Windows 98 only supports files up to 4 GB. However, because the Type-1 format stores data as a single AVI stream, Type-1 DV AVI files are not compatible with Video for Windows. These files are currently only compatible with applications and IEEE-1394 cards that use the DirectShow media system. Type-1 DV files are typically created by DirectShow-compatible OHCI IEEE-1394 PCI cards.

Type-2 DV AVI
In Microsoft Windows, AVI files using a DV codec where the video and audio are not stored in their native, interleaved format, but rather split into a single video stream and one to four audio streams within the file. Type-2 DV AVIs have the advantage of being backward compatible with Video for Windows. However, this format requires a small amount of redundant size, and additional processing to split/multiplex the DV stream during the functions of capture/transmit to IEEE 1394 devices. In addition, they are limited by the same restrictions in file size associated with the non-OpenDML AVI file format.

URL
Uniform Resource Locator, an address that identifies a protocol, host computer, directory, and file to access that file from another computer on a network.

USB
Universal Serial Bus is an external bus standard that provides high-speed data connections between a computer and peripherals (usually keyboards, mice, etc.). Often compared to IEEE 1394, but only capable of transmitting digital data at 12 Mbps. USB 2.0 will raise the transfer speed to 480 Mbps.

UDP
User Datagram Protocol, a communication protocol that can send media data from one computer to another. It does not sequence the arrival of the data packets, but does provide the capability to verify that the data arrived intact.

VBI
The Vertical Blanking Interval is a synchronizing period in the broadcast video signal when no active picture information is transmitted, and often used to carry data.

VBR

Variable Bit Rate encoding is a method that ensures consistent high video and audio quality throughout an encoded stream by allocating extra bits to more complex sections. VBR generally produces an overall higher and more consistent quality level than Constant Bit Rate (CBR) encoding.

VCD

VideoCD is a Compact Disc MPEG-1 format that was defined by Philips and JVC, and is also known as 'White Book'. VideoCD can store about an hour of video sequences and sound in up to 98 A/V tracks. It is generally playable on all CD-ROM players and the most recent generation of DVD (Digital Versatile Disc) players. Frame size and rate must conform to must be either 352x240 29.97 fps (NTSC) or 352x288 25 fps (PAL), with audio (mono or stereo) at a sampling frequency of 11, 22, or 44 kHz. Quality of video is generally considered to be less than VHS due to the low bit rate restrictions (@1100 kbps).

VHS

Video Home System, the most widely used video recording format for consumers.

Video 1

Video 1 is an early Microsoft Video for Windows software codec originally developed by MediaVision.

Video for Windows

Video for Windows was the first multimedia architecture developed by Microsoft. It is one of the most common formats (through the AVI file format) for playing video files on the PC.

VO

In MPEG-4, a scalable Video Object that corresponds to a particular 2D object in a scene, made up of one or more Video Object Layers (VOL).

VOD

In broadcast, Video-On-Demand is a program sent immediately and independently to a customer in response to his individual request. This contrasts with scheduled broadcast television (and even Pay Per View), which is made available simultaneously to all customers able to receive it.

VOP

In MPEG-4, a Video Object Plane is a time sample of a video object that may contain shape information, texture data and motion parameters. VOPs may be encoded independently of each other, or dependant on each other using motion compensation. Similar to MPEG-2 syntax, these are known as I-VOPs, P-VOPs, and B-VOPs. VOPs are grouped together in GOVs, Groups of VOPs

VTR

A Video Tape Recorder is the general term for any device capable of recording visual information onto magnetic tape so that it can be played back and shown on a television display.

Waveform

A visual representation of sound, often used in the process of sound editing.

Wavelet Compression

An asymmetrical image compression method that is scalable and provides high quality. Wavelet compression assumes that an image contains "trends" and "outliers". Trends have large areas of slowly varying gradation, and outliers are areas of highly concentrated changes. The wavelet transform encodes the trends at low resolution, and the outliers at high resolution. Wavelet zero, and then efficiently encodes the zeros.

WDM

Windows Driver Model, a standard driver model for Windows that is implemented in Windows 98 and Windows 2000, and supports new classes such as USB, 1394 and streaming devices.

Weave

A method of displaying interlaced video fields on a progressive monitor by blending two interlaced images into a frame.

Windows Media Technologies

The family of interoperable Windows streaming media applications. Windows Media Tools create Windows Media content that can be served by Windows Media Services and played by a Windows Media Player client.

XML

Extensible Markup Language, a simple dialect of SGML suitable for use on the World Wide Web and elsewhere for the creation of custom markup languages. It allows users to define their own customized markup languages for limitless different classes of documents.

YUV

A color model that describes color information in terms of luminance (Y) and chrominance, as defined as the difference between a color and reference white at the same luminance (represented by U and V, where U=B-Y, and V=R-Y). YUV uses properties of the human eye to prioritize information.