A Digital Video Primer

from the Adobe Dynamic Media Group
Analog Versus Digital Video

One of the first things you should understand is the difference between analog and digital video. Your television (the video display with which we are all most familiar) is an analog device. The video it displays is transmitted to it as an analog signal, via the air or a cable. Analog signals are made up of continuously varying waveforms. In other words, the value of the signal, at any given time, can be anywhere in the range between the minimum and maximum allowed. Digital signals, by contrast, are transmitted only as precise points selected at intervals on the curve. The type of digital signal that can be used by your computer is binary, describing these points as a series of minimum or maximum values -- the minimum value represents zero; the maximum value represents one. These series of zeroes and ones can then be interpreted at the receiving end as the numbers representing the original information. (Figure 1).

There are several benefits to digital signals. One of the most important is the very high fidelity of the transmission, as opposed to analog. With an analog signal, there is no way for the receiving end to distinguish between the original signal and any noise that may be introduced during transmission. And with each repeated transmission or duplication, there is inevitably more noise accumulated, resulting in the poor fidelity that is attributable to generation loss. With a digital signal, it is much easier to distinguish the original information from the noise. So a digital signal can be transmitted and duplicated as often as we wish with no loss in fidelity. (Figure 2).

The world of video is in the middle of a massive transition from analog to digital. This transition is happening at every level of the industry. In broadcasting, standards have been set and stations are moving towards digital television (DTV). Many homes already receive digital cable or digital satellite signals. Video editing has moved from the world of analog tape-to-tape editing and into the world of digital non-linear editing (NLE). Home viewers watch crystal clear video on digital versatile disk (DVD) players. In consumer electronics, digital video cameras (DV) have introduced impressive quality at an affordable price. The advantages of using a computer for video production activities such as non-linear editing are enormous. Traditional tape-to-tape editing was like writing a letter with a typewriter. If you wanted to insert video at the beginning of a project, you had to start from scratch. Desktop video, however, enables you to work with moving images in much the same way you write with a word processor. Your movie “document” can quickly and easily be edited and re-edited to your heart’s content, including adding music, titles, and special effects.

Frame Rates and Resolution

When a series of sequential pictures is shown to the human eye, an amazing thing happens. If the pictures are being shown rapidly enough, instead of seeing each separate image, we perceive a smoothly moving animation. This is the basis for film and video. The number of pictures being shown per second is called the frame rate. It takes a frame rate of about 10 frames per second for us to perceive smooth motion. Below that speed, we notice jerkiness. Higher frame rates make for smoother playback. The movies you see in a theatre are filmed and projected at a rate of 24 frames per second. The movies you see on television are projected at about 30 frames per second, depending on the country in which you live and the video standard in use there.
The quality of the movies you watch is not only dependent upon frame rate, however. The amount of information in each frame is also a factor. This is known as the **resolution** of the image. Resolution is normally represented by the number of individual picture elements (pixels) that are on the screen, and is expressed as a number of horizontal pixels times the number of vertical pixels (e.g. 640x480 or 720x480). All other things being equal, a higher resolution will result in a better quality image.

You may find yourself working with a wide variety of frame rates and resolutions. For example, if you are producing a video that is going to be shown on VHS tape, CD-ROM, and the Web, then you are going to be producing videos in three different resolutions and at three different frame rates. The frame rate and the resolution are very important in digital video, because they determine how much data needs to be transmitted and stored in order to view your video. There will often be trade-offs between the desire for great quality video and the requirements imposed by storage and bandwidth limitations.

### Interlaced and Non-interlaced Video

If your video is intended to be displayed on a standard television set (as opposed to a digital TV or a computer monitor), then there is one more thing you should know about video frame rates. Standard (non-digital) televisions display **interlaced** video. An electron beam scans across the inside of the screen, striking a phosphor coating. The phosphors then give off light we can see. The intensity of the beam controls the intensity of the released light. It takes a certain amount of time for the electron beam to scan across each line of the television set before it reaches the bottom and returns to begin again. When televisions were first invented, the phosphors available had a very short persistence (i.e., the amount of time they would remain illuminated). Consequently, in the time it took the electron beam to scan to the bottom of the screen, the phosphors at the top were already going dark. To combat this, the early television engineers designed an interlaced system. This meant that the electron beam would only scan every other line the first time, and then return to the top and scan the intermediate lines. These two alternating sets of lines are known as the “upper” (or “odd”) and “lower” (or “even”) fields in the television signal. Therefore a television that is displaying 30 frames per second is really displaying 60 fields per second.

Why is the frame/field issue of importance? Imagine that you are watching a video of a ball flying across the screen. In the first 1/60th of a second, the TV paints all of the even lines in the screen and shows the ball in its position at that instant. Because the ball continues to move, the odd lines in the TV that are painted in the next 1/60th of a second will show the ball in a slightly different position. If you are using a computer to create animations or moving text, then your software must calculate images for the two sets of fields, for each frame of video, in order to achieve the smoothest motion. Software like Adobe® Premiere® and Adobe® After Effects® handle this correctly. The frames/fields issue is generally only of concern for video which will be displayed on televisions. If your video is going to be displayed only on computers, there is no issue, since computer monitors use non-interlaced video signals.

### RGB and YCC Color

Most of us are familiar with the concept of **RGB** color. What this stands for is the Red, Green, and Blue components of a color. Our computer monitors display RGB color. Each pixel we see is actually the product of the light coming from a red, a green, and a blue phosphor placed very close together. Because these phosphors are so close together, our eyes blend the primary light colors so that we perceive a single colored dot. The three different color components — Red, Green, and Blue — are often referred to as the **channels** of a computer image.
Computers store and transmit color with 8 bits of information for each of the Red, Green, and Blue components. With these 24 bits of information, over a million different variations of color can be represented for each pixel (that is 2 raised to the 24th power). This type of representation is known as **24-bit color**.

Television also display video using the red, green, and blue phosphors described above. Television signals are not transmitted or stored in RGB, however. Why not?

When television was first invented, it worked only in black and white. The term “black and white” is actually something of a misnomer, because what you really see are the shades of gray between black and white. That means that the only piece of information being sent is the brightness (known as the **luminance**) for each dot.

When color television was being developed, it was imperative that color broadcasts could be viewed on black and white televisions, so that millions of people didn’t have to throw out the sets they already owned. Rather, there could be a gradual transition to the new technology. So, instead of transmitting the new color broadcasts in RGB, they were (and still are) transmitted in something called **YCC**. The “Y” was the same old luminance signal that was used by black and white televisions, while the “C’s” stood for the color components. The two color components would determine the hue of a pixel, while the luminance signal would determine its brightness. Thus both color transmission and black and white compatibility were maintained.

Should you care about the differences between RGB and YCC color? For most applications, you probably won’t ever need to think about it. Products like **Adobe Premiere** and **Adobe After Effects** can mix and match video in the different formats without a problem. It is good to understand the differences, however, when you have honed your basic skills and are ready to tackle more sophisticated technical challenges like color sampling and compositing.

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**Analog Video Formats**

At some point almost all video will be digital, in the same way that most music today is mastered, edited and distributed (via CD or the Web) in a digital form. These changes are happening, but it doesn’t mean that you can ignore the analog video world. Many professional video devices are still analog, as well as tens of millions of consumer cameras and tape machines. You should understand the basics of analog video.

Because of the noise concerns discussed earlier, in analog video the type of connection between devices is extremely important. There are three basic types of analog video connections.

**Composite:** The simplest type of analog connection is the composite cable. This cable uses a single wire to transmit the video signal. The luminance and color signal are composited together and transmitted simultaneously. This is the lowest quality connection because of the merging of the two signals.

**S-Video:** The next higher quality analog connection is called S-Video. This cable separates the luminance signal onto one wire and the combined color signals onto another wire. The separate wires are encased in a single cable.

**Component:** The best type of analog connection is the component video system, where each of the YCC signals is given its own cable.

How do you know which type of connection to use? Typically, the higher the quality of the recording format, the higher the quality of the connection type. The chart on the next page outlines the basic analog video formats and their typical connections.
The basic analog video formats and their typical connections

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<td>VHS</td>
<td>Composite</td>
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<td>S-VHS, Hi-8</td>
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<td>Component</td>
<td>Best</td>
<td>industrial video, broadcast</td>
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Broadcast Standards

There are three television standards in use around the world. These are known by the acronyms NTSC, PAL, and SECAM. Most of us never have to worry about these different standards. The cameras, televisions, and video peripherals that you buy in your own country will conform to the standards of that country. It will become a concern for you, however, if you begin producing content for international consumption, or if you wish to incorporate foreign content into your production. You can translate between the various standards, but quality can be an issue because of differences in frame rate and resolution. The multiple video standards exist for both technical and political reasons. The table below gives you the basic information on the major standards in use today around the world.

### Broadcast standards

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<th>Countries</th>
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<th>Frame Rate</th>
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<tr>
<td>NTSC</td>
<td>USA, Canada, Japan, Korea, Mexico</td>
<td>525 lines</td>
<td>29.97 frames/sec</td>
</tr>
<tr>
<td>PAL</td>
<td>Australia, China, Most of Europe, South America</td>
<td>625 lines</td>
<td>25 frames/sec</td>
</tr>
<tr>
<td>SECAM</td>
<td>France, Middle East, much of Africa</td>
<td>625 lines</td>
<td>25 frames/sec</td>
</tr>
</tbody>
</table>

The SECAM format is only used for broadcasting. In countries employing the SECAM standard, PAL format cameras and decks are used. Remember that the video standard is different from the videotape format. For example, a VHS format video can have either NTSC or PAL video recorded on it.

### Getting Video Into Your Computer

Since your computer only “understands” digital (binary) information, any video with which you would like to work will have to be in, or be converted to, a digital format.

**Analog:** Traditional (analog) video camcorders “record” what they “see and hear” in the real world in analog format. So, if you are working with an analog video camera or other analog source material (such as videotape), then you will need a video capture device that can “digitize” the analog video. This will usually be a video capture card that you install in your computer. A wide variety of analog video capture cards are available. The differences between them include the type of video signal that can be digitized (e.g. composite or component), as well as the quality of the digitized video. The digitization process may be driven by software such as Adobe Premiere. Once the video has been digitized, it can be manipulated in your computer with Adobe Premiere and Adobe After Effects, or other software. After you are done editing, you can then output your video for distribution. This output might be in a digital format for the Web, or you might output back to an analog format like VHS or Beta-SP.

**Digital:** Recently, digital video camcorders have become widely available and affordable. Digital camcorders “translate” what they record into digital format right inside the camera. So your computer can work with this digital information as it is fed straight from the camera. The most popular digital video camcorders use a format called DV. To get DV from the camera into the computer is a simpler process than for analog video because the video has already been digitized. Therefore the camera just needs a way
to communicate with your computer (and vice versa). The most common form of connection is known as the IEEE 1394 interface. This is covered in more detail in a later section.

Video Compression

Whether you use a capture card or a digital camcorder, in most cases, when your video is digitized it will also be compressed. Compression is necessary because of the enormous amount of data that comprises uncompressed video.

A single frame of uncompressed video takes about 1 megabyte (MB) of space to store. You can calculate this by multiplying the horizontal resolution (720 pixels) by the vertical resolution (486 pixels), and then multiplying by 3 bytes for the RGB color information. At the standard video rate of 29.97 frames per second, this would result in around 30 MB of storage required for each and every second of uncompressed video! It would take over 1.5 gigabytes (GB) to hold a minute of uncompressed video! In order to view and work with uncompressed video, you would need an extremely fast and expensive disk array, capable of delivering that much data to your computer processor rapidly enough.

The goal of compression is to reduce the data rate while still keeping the image quality high. The amount of compression used depends on how the video will be used. The DV format compresses at a 5:1 ratio (i.e. the video is compressed to one-fifth of its original size). Video you access on the Web might be compressed at 50:1 or even more.

Types of Compression

There are many different ways of compressing video. One method is to simply reduce the size of each video frame. A 320x240 image has only one-fourth the number of pixels as a 640x480 image. Or we could reduce the frame rate of the video. A 15 frame-per-second video has only half the data of a 30 frame-per-second video. These simple compression schemes won’t work, however, if we want our video to be displayed on a television monitor at full resolution and frame-rate. What we need is another way of approaching the compression problem…

It turns out that the human eye is much more sensitive to changes in the luminance of an image than to changes in the color. Almost all video compression schemes take advantage of this characteristic of human perception. These schemes work by discarding much of the color information in the picture. As long as this type of compression is not too severe, it is generally unnoticeable. In fact, in even the highest quality “uncompressed” video used by broadcasters, some of the original color information has been discarded.

When each frame is compressed separately, it is known as “intra-frame” compression. But some video compression systems utilize what is known as “inter-frame” compression. Inter-frame compression takes advantage of the fact that any given frame of video is probably very similar to the frames around it. So, instead of storing the entire frame, we can store just the differences between it and the frame that came before.

The compression and decompression of video is handled by something called a codec. Codecs may be found in hardware — for example, in DV camcorders or capture cards — or in software. Some codecs have a fixed compression ratio and therefore a fixed data rate. Others can compress each frame a different amount depending on its content, resulting in a data rate that can vary over time. Some codecs allow you to choose a quality setting that controls the data rate. Such adjustable settings can be useful in editing. For example, you may wish to capture a large quantity of video at a low quality setting in order to generate a rough edit of your program, and then recapture just the bits you want to use at a high quality setting. This allows you to edit large quantities of video without needing a drive large enough to hold the entire set at high-quality. The chart on the next page lists some sample types of video codecs and their typical applications.
What is DV?

One of the most exciting changes in the world of video has been the arrival of the DV camcorder. What is DV and why is it so important? The term “DV” is commonly applied to a variety of different things.

**DV Tape:** First, the DV designation is used for a special type of tape cartridge used in DV camcorders and DV tape decks. A DV tape is about the size of a typical audio cassette. Most of us are actually more familiar with the mini-DV tape, which is smaller than the basic DV tape -- about half the size of an audio cassette.

**DV Compression:** DV also connotes the type of compression used by DV systems. Video that has been compressed into the DV format can actually be stored on any digital storage device, such as a hard drive or a CD-ROM. The most common form of DV compression uses a fixed data rate of 25 megabits/sec for video. This compression is called “DV25.”

**DV Camcorders (Cameras):** Finally, DV is applied to camcorders that employ the DV format. When someone refers to a “standard” DV camcorder, they are talking about a video camcorder that uses mini-DV tape, compresses the video using the DV25 standard, and has a port for connecting to a desktop computer. Today, such DV camcorders are in use by both consumers and professionals.

Benefits of DV

There are many benefits to DV, particularly when compared to analog devices like VHS decks or Hi-8 cameras.

**Superior images and sound:** A DV camcorder can capture much higher quality video than other consumer video devices. DV video provides 500 lines of vertical resolution (compared to about 250 for VHS), resulting in a much crisper and more attractive image. Not only is the video resolution better, but so is the color accuracy of the DV image. DV sound, too, is of much higher quality. Instead of analog audio, DV provides CD-quality sound recorded at 48Khz with a resolution of 16 bits.

**No generation loss:** Since the connection to your computer is digital, there is no generation loss when transferring DV. You can make a copy of a copy of a copy of a DV tape and it will still be as good as the original.

**No need for a video capture card:** Because digitization occurs in the camera, there is no need for an analog-to-digital video capture card in your computer.

**Better engineering:** The quality of the DV videotape is better than for analog devices. Plus, the smaller size and smoother transport mechanism of the tape means DV cameras can be smaller and have more battery life than their analog counterparts.

**IEEE 1394**

You can directly transfer digital information back and forth between a DV camcorder and your computer. The ports and cables that enable this direct transfer use the IEEE 1394 standard. Originally developed by Apple Computer, this standard is also known by the trade names FireWire® (Apple Computer) and i.LINK (Sony Corporation). This high-speed serial interface currently allows up to 400 million bits per second to be transferred (and higher speeds are coming soon). If your computer does not come with this interface built in, then you will need to purchase an inexpensive card that provides the correct port.

The single IEEE 1394 cable transmits all of the information including video, audio, time code, and device control (allowing you to control the camera from the computer). IEEE 1394 is not exclusively used for video transfer; it is a general purpose digital interface that can also be used for other connections, such as to hard drives or networks.
analog: The principal feature of analog representations is that they are continuous. For example, clocks with hands are analog—the hands move continuously around the clock face. As the minute hand goes around, it not only touches the numbers 1 through 12, but also the infinite number of points in between. Similarly, our experience of the world, perceived in sight and sound, is analog. We perceive infinitely smooth gradations of light and shadow; infinitely smooth modulations of sound. Traditional (non-digital) video is analog.

animatic: A limited animation used to work out film or video sequences. It consists of artwork shot on film or videotape and edited to serve as an on-screen storyboard. Animatics are often used to plan out film sequences without incurring the expense of the actual shoot.

aliasing: A term used to describe the unpleasant jaggy appearance of unfiltered angled lines. Aliasing is the “beating” effects caused by sampling frequencies being too low to faithfully reproduce an image. There are several types of aliasing that can affect a video image which include temporal aliasing (e.g., wagon wheel spokes apparently reversing) and raster scan aliasing (e.g., flickering effects on sharp horizontal lines).

anti-aliasing: The manipulation of the edges of an image, graphic, or text to make them appear smoother to the eye. On zoomed inspection, anti-aliased edges appear blurred, but at normal viewing distance, the apparent smoothing is dramatic. Anti-aliasing is important when working with high quality graphics for broadcast use.

architecture: The term “architecture” in digital video (sometimes also known as format) refers to the structure of the software responsible for creating, storing, and displaying video content. An architecture may include such things as compression support, system extensions and browser plug-ins. Different multimedia architectures offer different features and compression options, and store video data in different file formats. QuickTime, RealVideo, and MPEG are examples of video architectures (although MPEG is also a type of compression).

artifact: Visible degradations of an image resulting from any of a variety of processes. In digital video, artifacts usually result from color compression and are most noticeable around sharply contrasting color boundaries such as black next to white.

aspect ratio: The ratio of an image’s width to its height. For example, a standard video display has an aspect ratio of 4:3.

AVI: Defined by Microsoft, “AVI” stands for Audio Video Interleave. AVI is the file format for video on the Microsoft® Windows® platform.

BNC connector: A connector typically used with professional video equipment for connecting cables that carry the video signal.

batch capturing: Automated process of grabbing a series of clips from an analog videotape player for computer digitization.

binary: A type of digital system used to represent computer code in which numerical places can be held only by ‘zero’ or ‘one’ (on or off).

CG: Acronym for Character Generator (see character generator).

CGI: Acronym for Computer Graphic Imagery

camcorder: A video camera, i.e., a device that records continuous pictures and generates a signal for display or recording. To avoid confusion, it is recommended that the term “camcorder” be used rather than “camera”—in contrast, a digital camera records still images, while a digital camcorder records continuous video images.

capturing: Act of converting source video, usually analog, to digital video for use on a computer. Capturing usually entails both digitization and compression.

channel: Each component color defining a computer graphic image—Red, Green, and Blue—is carried in a separate “channel,” so that each may be adjusted independently. Channels may also be added to a computer graphic file to define masks.

character generator: Stand-alone device or software program running on a computer used to create text for display over video.

chrominance: The color portion of a video signal.

clip: A digitized portion of video.

codec: Short for compressor/decompressor; comprised of algorithms that handle the compression of video to make it easier to work with and store, as well as the decompression of video for playback.

color sampling: A method of compression that reduces the amount of color information (chrominance) while maintaining the amount of intensity information (luminance) in images.

component video: A video signal with three separate signals, “Y” for luminance, “Cr” for Chroma and red, and “Cb” for Chroma and blue. Component signals offer the maximum luminance and chrominance bandwidth. Some component video, like Betacam and BetacamSP, is analog; other component video, like D1, is digital.

composite video: A video signal where chrominance and luminance are combined in the same signal.

compositing: The process of combining two or more images to yield a resulting, or “composite” image.

compression: Algorithms used by a computer to reduce the total amount of data in a digitized frame or series of frames of video and/or audio.

compression ratio: Degree of reduction of digital picture information as compared to an uncompressed digital video image.

DirectShow: Microsoft® DirectShow® is an application programming interface (API) for client-side playback, transformation, and capture of a wide variety of data formats. DirectShow is the successor to Microsoft® Video for Windows® and Microsoft® ActiveMovie™ significantly improving on these older technologies.
DTV: Digital television (and occasionally, the abbreviation “DTV” is also used to connote “desktop video”)

DV: Generally refers to digital video, but current usage suggests a variety of nuances. DV can connote the type of compression used by DV systems or a format that incorporates DV compression. DV camcorders employ a DV format; more specifically, a standard consumer DV camcorder uses mini-DV tape, compresses the video using the DV25 standard, and has a port for connecting to a desktop computer. The DV designation is also used to for a special type of tape cartridge used in DV camcorders and DV tape decks.

DVD: Abbreviation for Digital Versatile Disc, DVDs look like CDs but have a much higher storage capacity,—more than enough for a feature length film compressed with MPEG-2. DVDs require special hardware for playback.

DV25: The most common form of DV compression, using a fixed data rate of 25 megabits/sec.

data rate: Amount of data moved over a period of time, such as 10MB per second. Often used to describe a hard drive’s ability to retrieve and deliver information.

digital: In contrast to analog, digital representations consist of values measured at discrete intervals. Digital clocks go from one value to the next without displaying all intermediate values. Computers are digital machines employing a binary system, i.e., at their most basic level they can distinguish between just two values, 0 and 1 (off and on); there is no simple way to represent all the values in between, such as 0.25. All data that a computer processes must be digital, encoded as a series of zeroes and ones. Digital representations are approximations of analog events. They are useful because they are relatively easy to store and manipulate electronically.

digitizing: Act of converting an analog audio or video signal to digital information.

dissolve: A fade from one clip to another.

EDL: Edit Decision List—master list of all edit in and out points, plus any transitions, titles, and effects used in a film or video production. The EDL can be input to an edit controller which interprets the list of edits and controls the decks or other gear in the system to recreate the program from master sources.

effect: Distortion of a frame or frames of video to change its appearance.

FPS: Frames per second; a method for describing frame rate.

fields: The sets of upper (odd) and lower (even) lines drawn by the electron gun when illuminating the phosphors on the inside of a standard television screen, thereby resulting in displaying an interlaced image. In the NTSC standard, one complete vertical scan of the picture—or field—contains 262.5 lines. Two fields make up a complete television frame—the lines of field 1 are vertically interlaced with field 2 for 525 lines of resolution.

FireWire: The Apple Computer trade name for IEEE 1394

frame: A single still image in a sequence of images which, when displayed in rapid succession, creates the illusion of motion—the more frames per second (FPS), the smoother the motion appears.

frame rate: The number of images (video frames) shown within a specified time period; often represented as FPS (frames per second). A complete NTSC TV picture consisting of two fields, a total scanning of all 525 lines of the raster area, occurs every 1/30 of a second. In countries where PAL and SECAM are the video standard, a frame consists of 625 lines at 25 frames/sec.

generation loss: Incremental reduction in image and/or sound quality due to repeated copying of analog video or audio information and usually caused by noise introduced during transmission. Generation loss does not occur when copying digital video unless it is repeatedly compressed and decompressed.

IEEE 1394: The interface standard that enables the direct transfer of DV between devices such as a DV camcorder and a computer; also used to describe the cables and connectors utilizing this standard.

i.LINK: The Sony trade name for IEEE 1394.

insert edit: An edit in which a series of frames is added, lengthening the duration of the overall program.

inter-frame compression: Reduces the amount of video information by storing only the differences between a frame and those that precede it.

interlacing: System developed for early television and still in use in standard television displays. To compensate for limited persistence, the electron gun used to illuminate the phosphors coating the inside of the screen alternately draws even, then odd horizontal lines. By the time the even lines are dimming, the odd lines are illuminated. We perceive these “interlaced” fields of lines as complete pictures.

intra-frame compression: Reduces the amount of video information in each frame, on an individual basis.

JPEG: File format defined by the Joint Photographic Experts Group of the International Organization for Standardization (ISO) that sets a standard for compressing still computer images. Because video is a sequence of still computer images played on another, JPEG compression can be used to compress video (see MPEG).

keyframing: The process of creating an animated clip by selecting a beginning image and an ending image whereby the software automatically generates the frames in between (similar to “tweening”).

log: A list of shots described with information pertinent to content or other attributes.

lossy: Generally refers to a compression scheme or other process, such as duplication, that causes degradation of signal fidelity.

lossless: A process that does not affect signal fidelity; e.g. the transfer of DV via an IEEE 1394 connection.

luminance: Brightness portion of a video signal.

MJPEG: Motion JPEG.

MPEG: Motion Pictures Expert Group of the International Organization for Standardization (ISO) has defined multiple standards for compressing audio and video sequences. Setting it apart from JPEG which
compresses individual frames, MPEG compression uses a technique where the differences in what has changed between one frame and its predecessor are calculated and encoded. MPEG is both a type of compression and a video format. “MPEG-1” was initially designed to deliver near-broadcast quality video through a standard speed CD-ROM. Playback of MPEG-1 video requires either a software decoder coupled with a high-end machine, or a hardware decoder. “MPEG-2” is the broadcast quality video found on DVD’s. It requires a hardware decoder (e.g.; a DVD-ROM player) for playback.

**motion control photography:** A system for using computers to precisely control camera movements so that different elements of a shot can later be composited in a natural and believable way.

**motion effect:** Speeding up, slowing down or strobing of video.

**noise:** Distortions of the pure audio or video signal that would represent the original sounds and images recorded, usually caused by interference

**nonlinear editing:** Random-access editing of video and audio on a computer, allowing for edits to be processed and re-processed at any point in the **timeline** at any time. Traditional videotape editors are linear because they require editing video sequentially, from beginning to end.

**NLE:** A nonlinear editing computer system.

**NTSC:** National Television Standards Committee standard for color television transmission used in the United States, Japan and elsewhere. NTSC incorporates an **interlaced** display with **60 fields** per second, **29.97 frames per second**.

**PAL:** Phase-alternating line television standard popular in most European and South American countries. PAL uses an interlaced display with **50 fields** per second, **25 frames per second**.

**phosphor:** A luminescent substance, used to coat the inside of a television or computer display, that is illuminated by an electron gun in a pattern of graphical images as the display is scanned.

**pixel:** An abbreviation for **picture element**. The minimum computer display element, represented as a point with a specified color and intensity level. One way to measure image **resolution** is by the number of pixels used to create the image.

**post-production:** The phase of a film or video project that involves editing and assembling footage and adding effects, graphics, titles, and sound.

**pre-production:** The planning phase of a film or video project—usually completed prior to commencing production.

**pre-visualization:** A method of communicating a project concept by creating storyboards and/or rough animations or edits.

**print to tape:** Outputting a digital video file for recording on a videotape.

**production:** The phase of a film or video project comprised of shooting or recording raw footage.

**program monitor:** Window on the Adobe Premiere interface that displays the edited program.

**project:** File with all information pertaining to a job, including settings and source material.

**QuickTime:** Apple’s multi-platform, industry-standard, multimedia software **architecture**; used by software developers, hardware manufacturers, and content creators to author and publish synchronized graphics, sound, video, text, music, VR, and 3D media. “QuickTime 4” includes strong support for “real” (RTSP) **streaming**.

**RCA connector:** A connector typically used for cabling in both audio and video applications.

**RGB:** **Red-Green-Blue**—a way of describing images by breaking a color down in terms of the amounts of the three primary colors (in the additive color system) which must be combined to display that color on a computer monitor.

**RealMedia:** Architecture designed specifically for the web, featuring streaming and low data-rate compression options; works with or without a “RealMedia server.”

**real-time:** In computing, refers to an operating mode under which data is received, processed and the results returned so quickly as to seem instantaneous. In an NLE, refers to effects and transitions happening without an interruption for rendering.

**rendering:** The process of mathematically calculating the result of a transformation effect on a frame of video (e.g. resizing, effects, motion).

**resolution:** The amount of information in each frame of video, normally represented by the number of horizontal **pixels** times the number of vertical pixels (e.g. 640 x 480). All other things being equal, a higher resolution will result in a better quality image.

**ripple:** Automatic forward or backward movement of program material in relationship to an inserted or extracted clip.

**S-Video:** Short for **Super-Video**, a technology for transmitting video signals over a cable by dividing the video information into two separate signals: one for **luminance** and the other **chrominance**. (S-Video is synonymous with Y/C video).

**SECAM:** Similar to **PAL** at 25 FPS, the **SECAM** format is employed primarily in France, the Middle East, and Africa. It is only used for broadcasting. In countries employing the SECAM standard, PAL format cameras and decks are used.

**scrubbing:** Variable-rate backward or forward movement through audio or video material via a mouse, keyboard or other device.

**slide:** An editing feature that adjusts the previous clip’s out point, and the next clip’s in point without affecting the clip being slid or the overall program duration.

**slip:** An editing feature that adjusts the in and out points of a clip without affecting the adjacent clips or affecting overall program duration.

**source monitor:** An Adobe Premiere interface window that displays clips to be edited.
streaming: Process of sending video over the web or other network, allowing playback on the desktop as the video is received, rather than requiring that the entire file be downloaded prior to playback.

titler: See character generator.

three-point editing: In Adobe Premiere, an editing feature that lets editors insert a clip into an existing program where only three of the four in and out points of the clip to be inserted, and the portion of the program where the clip is being inserted, are known.

time code: Time reference added to video that allows for extremely accurate editing; may be thought of as the “address” on a tape that pinpoints where the clip begins (in) and ends (out).

timeline: On an NLE interface, the graphical representation of program length onto which video, audio and graphics clips are arranged.

transition: A change in video from one clip to another. Often these visual changes involve effects where elements of one clip are blended with another.

transparency: Percentage of opacity of a video clip or element.

trimming: Editing a clip on a frame-by-frame basis or editing clips in relationship to one another.

24-bit color: Type of color representation used by current computers. For each of the Red, Green, and Blue components, 8 bits of information are stored and transmitted—24 bits in total. With these 24 bits of information, over a million different variations of color can be represented.

uncompressed: Raw digitized video displayed or stored in its native size.

video capture card (or board): Installed inside a computer, adds the functionality needed to digitize analog video for use by the computer. Using a hardware or software codec, the capture card also compresses video in and decompresses video out for display on a television monitor.

XLR connector: A connector with three conductors used in professional audio applications, typically with a balanced signal.

Y/C video: A video signal where the chrominance and luminance are physically separated to provide superior images (synonymous with S-Video).

YCC: A video signal comprised of the luminance — the “Y”— component and two chrominance (color)—“C”—components.