What Is Final Cut Pro?

I am an impatient man. If you’re like me, you just want to get on with editing. You purchased Final Cut Pro, you bought this book and brought it home, and you made your way through the QuickStart. Now you just want to edit your documentary or the dream piece you’ve been shooting as your calling card in Hollywood. But wait a minute — hold your horses, Buckaroo.

If you’ve had some basic experience with nonlinear editing in the past, you may be tempted to skip this chapter. Don’t do it. I specially finagled this chapter into the book. Even though most nonlinear editing systems are based on similar principles, Final Cut Pro has its own way of dealing with video editing principles, and understanding the subtle differences are crucial to your success.

In the QuickStart, I walked you through editing a short sequence. If that were all you needed to do, this book would be much thinner. But this book is fat for a good reason — it covers a lot of information. For example, in the QuickStart, I never explained the relationship of project files to media files to clips, and so on. In this chapter, I cover the basics of video editing as well as numerous other concepts that you should know about to successfully edit your video projects. Get yourself a cup of coffee, sit back, relax, and read this chapter. Hollywood has waited for you all these years — it can wait another half-hour.

Reviewing the Fundamentals of Video Editing

My work consists of consulting for companies who are having problems with their digital editing process. I am called in to help editors and producers who have rushed into projects
without having a firm grasp of the basic concepts of digital editing. Final Cut Pro can make digital editing look so simple and easy. And in some ways, the program is that — and so much more. But when problems occur on a two-hour show that you spent weeks working on, you'll wish that you had taken the time to understand the fundamentals of digital video.

**Comparing analog and digital video**

Before you get into actual editing, you need to understand the difference between analog and digital signals. Today, the word *digital* is bandied about with reckless abandon. What does it mean, and how does it differ from *analog*?

*Analog signals* consist of varying voltage. An analog value can occupy any location along the signal voltage. Most televisions are analog devices. The video you see on a television is sent as an analog signal, either through wires or through the air.

*Digital signals*, on the other hand, use computer-based binary language and can only be represented by discrete values. Binary language consists only of zeros and ones, also known as *off* and *on* states. Think of a sloping ramp as an analog signal and a series of stair steps as a digital signal. Tossing a coin on the sloping ramp can land it anywhere on the slope. On a series of steps however, the coin can land only on discrete steps. Figure 1-1 illustrates how an analog signal compares to a digital signal. For a digital file to represent an analog signal, the analog file must first go through a process called *digitizing*.

The main disadvantage of analog signals is their capacity for deterioration, or attenuation. As a videotape is copied, the signal noise increases and the quality of the picture decreases. Make more copies of a VHS tape for a few generations, and you'll soon find the picture unviewable. A digital tape, such as the popular DV format, shows no signal loss when transferred over a digital path (such as FireWire), no matter how many times it has been copied.

For more information on the DV format and FireWire, see Chapter 2.

Analog signals are also harder to manipulate than digital signals. Analog signals can have any value along the signal voltage. Digital signals always have discrete values. Making applications based on mathematical schemes that can manipulate discrete values is far easier than making infinitely variable analog ones. Final Cut Pro works with digital files and must have analog video converted to a digital signal before any work can be started.

Be aware that the previous few paragraphs have been an exercise in gross oversimplification. There's a heck of a lot more to both analog and digital signals than I have addressed here. When an analog signal is *digitized*, or converted to a digital signal,
a host of issues comes into play, issues that I cover in the next few chapters. Some of these issues are about the conversion of color and brightness information. For now, keep in mind that the popular DV format is entirely digital, making each copy as good as the original.

Understanding linear and nonlinear editing

Digital computer editing, as done by Final Cut Pro, performs nonlinear editing on your material, whereas tape-based editing is usually linear. The best way to illustrate the difference between linear and nonlinear editing is to use the classic analogy of a typewriter versus a word processor. Both can be used to write a letter, but a typewriter uses linear editing while a word processor uses nonlinear editing. With a nonlinear editing system, you can quickly perform edits in the middle of a document and move material around with just a few mouse clicks. With a linear editor, you can only type in a linear fashion— one word at a time followed by the next word. Inserting paragraphs is difficult, as is making most any changes to the document.
In the not-too-distant past, video editing and re-editing were time-consuming and complex processes. The tape editing process often had me working through the following steps (often over and over again): Place the titles, edit the shots, then die a small death after the producer asked me to switch shots two and three and move other scenes around. I still remember breaking out in a cold sweat when a producer asked for the slightest change.

Then I heard about nonlinear editing. A guy was moving around shots on the screen with a mouse and changing their order and duration in the timeline with a click or two. I remember people gasping. The rest is a bit foggy because I was crying so hard.

The concept of nonlinear editing is based on the fact that you’ve captured your video on tape and moved it into your computer. Final Cut Pro’s capture ability enables you to easily move video from your camcorder to your computer. After you do, you have a virtual representation of a timeline—the timeline is also called sequence in Final Cut Pro—and you can move this shot anywhere you want. You can trim the shot, copy it, and paste it. The shot is nonlinear; therefore, you can work in any order that you like. You can edit the middle first and then copy and paste it next to the ending later, with just a few mouse clicks. And if you don’t like what you did, just undo it with a keyboard command. Hallelujah!

Editing in the timeline is explained in more detail in Chapter 11.

Performing nondestructive editing

Nondestructive editing is another non-term that I should explain. Editing with a program like Final Cut Pro is nondestructive because you make changes to your clips in the program without affecting the original source file on the disk. The clips in the Final Cut Pro are merely pointers to the actual media files and are not the actual media files. You can trim clips, apply effects to them, and so on and still have the original source clip safe, sound, and unchanged on your hard drive. Even if you delete the clips from within Final Cut Pro, your source media file is still on your disk.

If you delete a clip from the browser, you can drag and drop the media file back into the browser from the hard drive, or import it back into a project by using the Import command.

Here I should point out two small but very significant exceptions to nondestructive editing in Final Cut Pro. These two exceptions are:

✦ Changing the reel number of the clips
✦ Changing a clip’s timecode

If you make either of these changes to a clip, they will be saved to the media file.
Evaluating the pros and cons of digital video editing

I don’t want to oversell digital nonlinear editing. Many production houses still choose to maintain their linear editing systems, because in certain cases it is the most effective way to go. As magical as nonlinear and nondestructive editing sounds, editing in the digital domain does have its pros and cons. I’ll briefly cover a few of them here.

The pros

Don’t be fooled by this shortlist of pros — though few in number, the following points have huge implications.

✦ **Changes are easier.** The ease of making changes is perhaps the most significant advantage of digital editing. The freedom to explore various edits, try different effects, and create new effects without fear of lengthy re-edits is stupefying compared to the limitations of linear editing. Final Cut Pro provides up to 99 levels of undo. The levels of undo mean that if you’re not happy with what you just did, you can undo the action up to your past 99 edits. That kind of power is unheard of in linear, tape-based editing. In fact, that’s way more power than I ever need. I can’t even remember what I did 5 edits ago, much less 99, but that may just mean that I’m growing old. In Final Cut Pro, the Undo command shortcut is Command-Z. You can keep pressing that for additional undos.

✦ **You have more editing options.** Digital editing is a whole universe unto itself. With Final Cut Pro, you can mix Photoshop layouts and audio files with video to create a final video program. You can use effects, add plug-ins to extend the functionality of the program, exchange digital files between applications, create movie files for streaming on the Web, and more — all within this one application. Tape-based systems require stand-alone equipment to do effects. Final Cut Pro is an editor and an effects engine, all in one.

✦ **Quality remains consistent.** In a completely digital environment, no generational loss occurs. With analog video, each copy of a tape is said to have gone down one generation. Every copy, no matter how many copies of a copy it is, will look the same as long as the format and signal path remain digital. For example, with Final Cut Pro, a DV camera with FireWire, and a G4 computer, you can capture, edit, and then send the final edit back to tape without losing a single generation. In analog video, the simple act of editing from the play deck to the record deck makes you lose one generation and, with it, some quality.

✦ **It’s cheaper.** A digital editing setup based on Final Cut Pro costs a lot less than a tape-based editing system. In fact, with some care, you can put together a very respectable Final Cut Pro and DV-based editing system for under $5,000.

✦ **It’s a lot more fun.** I must admit, fun makes it a huge pro for me. The fact that I have the freedom to edit, create, and explore on my Powerbook while flying across the country is something few editors could have dreamed of just a few years ago.
The cons
As digital nonlinear editing has become the industry standard, its disadvantages are not so much irrelevant, but acceptable drawbacks to be dealt with. Still, they are worth considering, and so I list them here.

✦ Changes are easier. “Wait,” you say, “I just read that under ‘The pros.’” Well, editing ease is both a blessing and a curse. The fact that changes are so much easier causes a new disease you probably haven’t heard before. This disease comes from having too many options and too many versions. One time, a producer made me do 25 completely separate versions of a 30-second spot because she wanted to “explore” her options. Freedom, as the saying goes, is its own punishment.

✦ It can be more time-consuming. I think that one of the biggest myths that came out of the digital editing world was that it was going to be so much faster and save you so much time that you wouldn’t know what to do with all that leisure time on your hands. According to this myth, everyone goes home promptly at five o’clock, having magically met all their deadlines. Alas, that turned out not to be the case. What people forgot was that, in tape-based editing, there was no digitizing time, no repeated system crashes, no rendering time, no corrupt files, no re-digitizing, and no layback to tape. I’ve worked in completely digital production houses, but they still needed a tape-based editing system because it was the fastest and most efficient method for some projects. It is possible to save time with digital editing, but doing so requires planning and shrewd management skills.

✦ There’s more to know. The knowledge base required to successfully navigate through the thicket of digital nonlinear editing tools is quite significant. However, the unlimited options and the advent of digital video revolutionized the world of media and made it accessible to more people than ever before, making the efforts worthwhile.

✦ More problems can occur. When digital video works well, nothing compares. It’s like being in calm repose in some video heaven with angels running their fingers through your hair and harps playing in the background. However, when you run into problems, it’s like descending into a circle of Hell even Dante could not have imagined.

✦ Analog video is still relevant. In the future full of flying cars, roads made of glass, and people dressed in silver suits with zippers, there will be no analog video. Presently, however, you will continue to manage your video in a world that is a hybrid of digital and analog. In fact, that is one of the reasons that life in the digital domain is full of pitfalls. As you work on your digital video project, you’ll see how interactions between Final Cut Pro and analog video produce complex issues and require an in-depth understanding of the conversion process from analog to digital formats. In short, despite the hoopla around DVDs and the death of VHS, analog videotapes are not about to become obsolete anytime soon. You can save that silver suit for another day and age.
Editing your video: Offline or online?

You may hear these terms when working with nonlinear editing. However, both concepts of online and offline editing come from the tape-to-tape analog editing world. In the past, big production houses usually had separate online rooms and offline rooms. Online rooms were bigger, had more expensive equipment, and had more options for effects than the offline room counterparts, so consequently they cost more to operate and use. Offline rooms were small and had just enough equipment for basic editing. Offline editing rooms are also cheaper to rent. The idea was that editors first edited a project in the offline room, making decisions about what to edit to get a basic cut. Remember: You can’t just cut and paste shots; it’s time-consuming and quite a chore to try different cuts when you’re editing offline. As a result, offline editing saved money while allowing producers to use the online editing later in the process to explore options — like gee-whiz effects that weren’t even available in the offline rooms — and experiment with different cuts.

After an acceptable cut was obtained in the offline room, the project then moved to an online room for addition of effects and more complete audio work. Some online rooms looked like the bridge of the Starship Enterprise. These rooms had more buttons, knobs, levers, decks, lights, and blinking LEDs than you could count. It was quite something to be an editor in one of these rooms. It used to be badge of honor to say, “I am an online editor,” but now people just laugh at you, because the technological advancements in digital technology over the last 20 years enable you to do virtually all that an online room ever could from a modest desktop computer!

When digital video editing first appeared, the new computer systems were only capable of working with low-resolution video that was not acceptable for a final broadcast. Thus, early digital editing systems were utilized as offline systems only. Editors would digitize at low resolution and edit a basic cut. After the basic cut was created, an Edit Decision List (EDL) was generated. An EDL is a list of timecodes that shows the order of the shots, the reels they came from, and the portions that were used. The EDL was then taken to an online tape-to-tape editing room and the show was recut at a higher resolution — usually for broadcast — using the original source tapes. Online edit rooms could import EDLs and perform the edits automatically. Because most of the work was already done, the low-resolution digital offline editing system effectively saved time and money. Figure 1-2 shows a simple EDL.

Edit Decision Lists (EDLs) are covered in Chapter 22.

Computer-based digital editing systems rival and, in some cases, surpass the quality of tape-based editing systems. However, high-quality video takes up a lot of disk space and most nonlinear editing systems have limited disk space. When space is limited, video is first digitized at a low resolution. Low resolution allows more media to be stored on the drives than media digitized at a high resolution. The first offline...
cut is done this way. Having more media on the drives provides for more explorations and more choices. These days, the term *offline* generally means digitizing material at a low resolution into digital editing systems and creating an acceptable edited video program.

![Figure 1-2: An Edit Decision List (EDL) is a text file that gives the order of shots, reel numbers, and in and out points that can be exchanged between tape-based edit systems and nonlinear edit systems. This EDL text file is also another way of exchanging edits between two nonlinear edit systems.]

Then, after the final cut is performed, the low-resolution media is deleted and the program is recaptured at the highest-quality settings. This recapture process is very efficient because you capture only what will be used in the final program. For this process to work correctly, it is imperative that the following conditions be met:

- You must have the correct reel numbers.
- You should not have timecode breaks.
- You must be able to control the transport functions of your video deck via the computer, and this control must be *frame accurate*.

Final Cut Pro has a first-rate device control that is compatible with most video decks, as well as many other functions designed to help you do an offline edit in low resolution and then recapture your material, or online it, at high resolution.
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Understanding How Final Cut Pro Works

Now that you’ve mastered the fundamentals of video editing, you need to look at some basics that are specific to Final Cut Pro. If you feel that you already know the basics, take a moment to review this section anyway. The meanings of terms change, and I may use them differently than you expect. Not only are the terms crucial to understanding nonlinear editing in general, but these terms also apply to Final Cut Pro specifically.

Defining clips, sequences, bins, and project files in Final Cut Pro

Every computer program has its own jargon and terms associated with it, and Final Cut Pro is no exception. Some terms you need to know include the following:

✦ **Clip**: A clip is an individual component in your project. Audio files, video shots, and still photographs are all imported as clips.

✦ **Sequence**: A *sequence, or timeline*, is a series of clips placed together on tracks, the sum of which forms a video program. A sequence contains your audio and video tracks, dissolves, effects, text, and so on. You can have unlimited sequences in your project.

✦ **Bin**: Bins are folders in your project that enable you to store shots. Bins are essential for keeping what often becomes a countless number of clips organized. You can have bins within bins, and you can also label and color-code them as you choose.

✦ **Project file**: A *project file* holds all your clips, sequences, and any and all other files in your program. You can have more than one project open at the same time.

Figure 1-3 shows how these items appear in the Final Cut Pro program.

I explain sequences, project files, and clips in more detail in Chapter 10.

Note

Having a clip *offline* in Final Cut Pro is entirely different from *offline editing*. In the Final Cut Pro program, an offline clip is simply a clip that fails to link to the original media file, which usually happens when the media file is moved or deleted.
Comparing media files to clips and project files

The first phase in working with Final Cut Pro is capturing shots from tape to your computer. Media files are the actual digital video files that you capture and store on your hard drive. Clips in Final Cut Pro are merely representations, or pointers, of these media files inside the editing program. Figure 1-4 illustrates this relationship.

The project file My Backyard has an icon that looks like a movie slate and holds all the clips, information about the clips, and information about the edits that you create. The project file also contains all the bins and sequences. Clips first appear in the Final Cut Pro Browser and can then be used in the timeline. In Figure 1-4, Dogs Running is the original media file digitized to disk. It appears in the Browser, and it was used twice in the timeline. All three occurrences of Dogs Running (one in the Browser, two in the timeline) are linked to the same media file. You can manipulate, trim, and make changes to the clips in the Browser or the timeline without affecting the original media files on the disk, because your edits are stored and saved in the project file.
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Figure 1-4: Project files hold the information about the clips and edits you create. Clips in the Browser or timeline are merely virtual representations of the actual media files that are stored on the disk. Editing allows for manipulation of the clips while leaving your media files untouched.

Caution

If you delete the media file from the disk, all clips linked to it in the project lose their reference. In short, they’ll be blank. Nada.

In the sample project shown in Figure 1-4, notice that I used the clip Dogs Running in the timeline twice. In the second occurrence of that clip, I’ve shortened it a bit, which you can see by the difference in the length of the two clips. The first copy will play in its entirety, and the second occurrence will only play a part of the clip. All that has taken place is that the application has sent a command to the media file to first play in full, and the second time to play only up to a certain point.

Digitizing video

The term *digitizing* can have many different meanings, but generally this term refers to the conversion of an analog signal to a digital signal. The computer that you’re using only understands the digital, also known as *binary*, language. Anything you want to bring into your computer, such as video or still images, has to be digitized into your computer. For instance, you have an old still photograph of Grandma Edith that you want to bring into the computer, airbrush a bit, and e-mail over to Cousin Bobby. Grandma Edith’s photograph is considered analog because it is printed on a
paper with color dyes and emulsions. To convert the photograph to a digital image, you must first digitize it with a scanner. After the scanner digitizes it, you can open the picture in a graphics program, such as Photoshop, and airbrush it to your heart’s content, as I’ve illustrated in Figure 1-5. The digital file of Grandma can now be sent via e-mail, another digital-format medium, to Bobby.

Figure 1-5: Digitizing is the process of converting an analog signal into a digital one because computers only understand digital (also known as binary) language.

Complete your digitizing, or capturing, of video by using the Log and Capture window in Final Cut Pro. The Log and Capture window is explained in detail in Chapter 7.

Digitizing an analog format

To digitize video from an analog format, say a Betacam SP tape, you need a digitizing card. These cards, also referred to as capture cards, are available from many manufacturers and can be installed easily in your computer’s PCI slot. These cards often have numerous video and audio input points, and after the outputs of the Betacam deck are connected to these points, you can play your tape, digitize it, and play and edit it in Final Cut Pro.

Like a scanner, capture cards offer numerous controls for managing color and brightness. These controls appear within Final Cut Pro for calibration of color bars to ensure accurate color reproduction during digitizing. These cards can also convert the digital signal back into an analog one, meaning that, after you’ve edited your video inside your computer, you can send it back out through the card to an analog deck of your choice, such as a VHS recorder.

After you’ve installed a capture card and its appropriate drivers (a driver is a tiny piece of software that helps the added-on card talk to your Macintosh and Final Cut Pro), all of its functions and settings are accessible within Final Cut Pro. You never have to leave Final Cut Pro to accomplish tweaking, calibrating, controlling, and digitizing of your video.
The performance and price of capture cards vary widely, depending on their quality and interface features. A basic card, which only has a composite input for VHS, costs considerably less than a card with component interfaces for a Betacam SP deck. Apple has certified numerous video cards for use with Final Cut Pro, and I cover them later in this book. You can also go to Apple's Final Cut Pro Web site (www.apple.com/finalcutpro) to find a list of approved cards.

Digitizing cards is covered in Chapter 3.

Using Final Cut Pro to capture your digital format

When it comes to capturing a digital format (such as the ever-popular DV format) into your computer via Final Cut Pro, no actual digitizing is involved, because the video signal is already digital on the tape. You're basically just copying a digital file from the tape to your computer.

If you're working with a digital tape format, all you need is a digital path to move the data from the digital camera to your computer. The most common path is known as FireWire (see Figure 1-6). FireWire is the Apple trade name for the technical designation of IEEE-1394, which is the much more boring but "official" name for this technology. It is also called iLink on some Sony cameras. FireWire, originally developed by Apple, is a high-performance digital serial bus and is in wide use with DV formats. Almost all DV cameras have a FireWire port on them. All new Apple computers, such as G-5’s, G4’s, iMacs, iBooks and Powerbooks come with built-in FireWire ports. Figure 1-6 shows two FireWire cable connectors. FireWire ports are recognized worldwide by a sort of nuclear-looking symbol. Don't worry; it's not really dangerous. This symbol is just Apple's way of letting you know that something very fast and cool is happening.

Recently, Apple has implemented its new FireWire protocol called FireWire 800, technically known as IEEE-1394b. This new protocol can deliver up to 800Mbs of data—twice that of the current FireWire, now retro-named FireWire 400. FireWire 400 and 800 are covered in detail in Chapter 2.

To capture material into your computer, you attach a FireWire cable between your DV camera and the FireWire port on your computer. Rather than digitizing DV footage, you're actually transferring video and sound that is already digital on the tape to the computer's hard drive. If you really want to sound sophisticated, you can say that you're bit copying the video. The process of bit copying is like moving the binary zeros and ones from one location to another. Think of copying a simple text file inside your computer—that's a bit copy. Figure 1-7 shows the capture of analog versus digital material. Again, all this happens in real time.

For basic analog formats such as VHS, you can also use a Sony DA-2 converter to convert the analog signal to a DV signal. Keep in mind, though, that doing so turns your analog signal into DV at the DV data and compression rate. This approach may be okay for formats such as VHS or Hi-8, but it may not be the right approach for Betacam SP or higher-resolution formats.
Figure 1-6: FireWire, also known as IEEE-1394 and iLink, is a digital, high-speed serial connection developed by Apple. With a cable between a DV camera and a computer with a FireWire port, you can capture your video into the computer by using Final Cut Pro.

Figure 1-7: Capture of analog material requires a digitizing card. Digital formats, such as DV, simply require a FireWire cable and a port to move the data from the tape to the computer.
Managing data rates

One key difference between scanning a single photograph and digitizing video is easy to discover. Whereas a photograph is just one picture, you have to remember that video has 30 pictures per second! Video runs at 29.97 frames per second (fps), and capturing each of these frames is similar to scanning a picture. To be able to play and edit video on the computer, each frame must be captured completely and accurately. The capture process occurs in real time as the video is played.

You must be extremely careful not to “drop,” or skip, frames while capturing the video, or your clips will stutter and skip when you’re playing them back. Also, it’s important that your clips maintain a constant data rate. The data rate measures how much material per second goes through the pipeline of a computer. This pipeline is limited by the bus speed of the CPU and other factors, such as the speed of the hard disk. If the pipeline is too small, you’ll wind up with dropped frames and stuttering video.

Another consideration is the sheer size of a video stream. Just one second of video, if captured uncompressed, can fill approximately 20MB of space! Yes, that’s 20 megabytes—the big ones. To capture video at such a high data rate, you not only need a very fast drive but also a big one. For every minute of uncompressed video, you’ll need over 1 gigabyte (GB) of disk space. These numbers are approximations, but they give you an idea of just how much data you’re dealing with when you capture video. Bear in mind that the data rate is affected by hardware and not necessarily software such as Final Cut Pro. Final Cut Pro can handle uncompressed video just fine. The responsibility for adequate data rate falls on the hardware, including your hard drives and capture card. Often the basic drives that a computer is purchased with are not sufficient to capture high-end video. To sustain data rates when you edit digital video, you must use the best equipment you can afford and use capture settings that make optimum use of the hardware you have.

The average drive in a Macintosh is simply unable to handle data rates required when working with high-quality video. Your video will refuse to play and stall or fall out of sync. Somehow, you have to find a way to make this data rate manageable. Of course, the ideal solution is to work with fast drives.

The drives that new G4 Macs ship with are considered sufficient to support the data rate of DV video. However, for safety and additional space you may want to install more internal drives into your G4, or better yet, get yourself one of the newer external FireWire drives—they seem to be getting cheaper and faster every month!

Compression and decompression

One solution to the data rate conundrum is compression. To make the data rates acceptable during the process of digitizing, you usually have to apply compression to your video. Compression is the act of reducing the size of a video file inside the computer. The trick is to find a balance that makes the files small enough to optimize data rates and storage space without making visible sacrifices in quality.
Because of the enormous amounts of data that a stream of video contains, compression is necessary. During the capture of video through a card, the video is compressed in real time and stored as movie files or media files in the computer. The file is decompressed during playback. Most compression and decompression in video cards occurs in real time and is handled by codecs. The term codec comes from a shortening of compression/decompression, just as the word modem is short for modulation/demodulation. Codecs can be software- or hardware-based. Common codecs include MJPEG and DV (now regarded as DV25); Sorensons are also codecs, except that they’re not used for capture but for delivery, such as on CD-ROMs or in Web streaming.

Compression technology is a very sophisticated science and has been an area of tremendous development in the past few years. However, its basic principles generally remain the same. Compression is based on the fundamentals of human vision. For example, it turns out that the human eye is more sensitive to changes in luminance values than changes in chrominance values. That’s just a pointy-headed way of saying that human beings notice changes in brightness much more than they notice changes in color values. Thus, many compression techniques are based on throwing away more color values from the video being captured while retaining more of the brightness values. When I say “throwing away” you might imagine your color video turning into black and white after being captured into the computer, but that’s just not so. Information that is discarded during the capture process is usually not noticeable to the human eye.

As a Final Cut Pro user, compression affects you by determining the quality of your video. A video that is highly compressed looks jaggy, or artifacted and has low resolution. It does, however, take up less storage space than a high-resolution video that utilizes less compression. Keep these formulas in your head:

More compression = smaller data rates = smaller files = lower quality
Less compression = higher data rates = larger files = better quality

Figure 1-8 illustrates the relationship between compression, data rates, file sizes, and image quality.

**Compression in the DV domain**

More and more these days, you’re probably seeing video cameras that have the DV symbol on them. They use small, compact videotapes that also have the DV symbol on them. This new format is known as the **DV format**. The tapes and the cameras look somewhat like the 8mm or the Hi-8 camcorders that came out years before. However, you’ll find one very significant difference: The picture quality of a DV format video is superior to the quality of Hi-8 or VHS analog video.
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A high level of compression produces smaller data rates, small file sizes, and low-quality images. Low compression gives higher data rates, large file sizes, and higher quality pictures.

![Diagram](image)

**Figure 1-8:** A high level of compression produces smaller data rates, small file sizes, and low-quality images. Low compression gives higher data rates, large file sizes, and higher quality pictures.

The DV format and compression is discussed in much more detail in Chapter 2.

The most common version of the DV format is the MiniDV, but you also find variations, such as DVCAM and DVC-PRO, and most recently, DVCPRO50. Another variation of the DV format is the Digital 8 format, which is basically a DV signal recorded onto a Hi-8 tape. The quality on these different types of tapes is essentially the same.

Why does DV video look as good as it does? The simple answer is that the picture is encoded digitally to the tape by using a very efficient compression scheme called DV compression. The codec is called the DV codec.

In the case of DV, a hardware codec is built into the camera that compresses the picture. The data rate of DV is 3.6MB per second (including DV audio), significantly lower than the 20MB per second data rate for uncompressed video. Even the basic drives that accompany a G4 or an iMac can handle that kind of data rate. In other words, with an Apple G4 computer, Final Cut Pro, a basic DV camera, and a FireWire cable, you can have an editing system.
Rendering versus real time in Final Cut Pro

Final Cut Pro can handle numerous audio and video layers in a sequence, and you can apply transitions and effects to your clips. However, because the software is relying mostly on the power of your computer and the processor to make calculations and play the video, applying effects to video can exceed the capacity of the computer. Imagine juggling six balls in the air while trying to eat soup and wipe your nose at the same time. That probably exceeds your capacity.

If your video sequence involves cuts only, you can play it in real time in Final Cut Pro with no problems. But if you add a transition or an effect to a clip, you have to render the sequence before you can view the transition or effect smoothly.

Rendering is the process of combining your original media files with the transitions or effects to create a render media file, also called a render cache file. This is the file that plays during the duration of an effect or transition between two clips. The process of rendering takes a bit of time, but after the transition is complete, it takes the pressure off the processor and enables your timeline to play seamlessly without glitches and skipping. Figure 1-9 shows how this process works.

Figure 1-9: When Final Cut Pro displays a Writing Video status bar, it is making a render cache file, in this case for a dissolve – a type of transition. This cache file plays during the playback of the dissolve area in the timeline.
Since version 2.0, Final Cut Pro has been built on a real-time architecture, meaning certain video cards approved by Apple allow certain effects to display in real time, without the need for rendering. Not content to sit on its laurels, Apple has retooled Final Cut Pro’s render engine, dubbed RT Extreme, which now yields even more real-time effects and previews over FireWire, without the need for any additional hardware.

Although real-time playback is limited to using Apple’s DV and Offline codecs, the number of real-time effects you can display is only limited by the speed of your system’s processor. In other words, the faster your CPU (and dual processor G4’s reign supreme in this area), the more simultaneous real-time effects you can preview.

Rendering is explained in greater detail in Chapter 18.

Before you start jumping for joy at the mention of real time, consider this: The reality of real time is subject to the limitations of any nonlinear editing system. Final Cut Pro, for example, can have 99 layers of video. So, does the implementation of real time in Final Cut Pro allow you to play these 99 layers without rendering? Well, do pigs fly? Whether real-time playback is software-based or hardware-based, you can expect it will have some limitations. For example, only certain transitions may be real time while other effects will still have to be rendered. Some real-time systems, like Final Cut Pro’s RT Extreme, will only work within the DV format.

Know your needs and then scrutinize closely what the cards offer in real time before you run out and buy one. Real-time effects, like anything else in digital video, are full of exceptions and small print.

**Workflow considerations**

*Workflow* is the process or order in which you perform editing tasks. It’s like remembering to put underwear on before the pants and not after. To be honest, if some video editors I know dressed like they work, they’d have their underwear outside their pants. I’m here to save you from that fate.

Before proceeding with a project in Final Cut Pro, you must evaluate your workflow from beginning to end. Earlier in this chapter, I mentioned that more errors occur in the digital domain. Keep that rule about errors in mind as you move forward. Here are the four basic steps you should follow whenever you’re working in Final Cut Pro:

1. Gather your media.
2. Edit the media.
3. Process the media.
4. Output your program.
Gather your media

When you edit with Final Cut Pro, you’ll be working with many different types of media. If you have the right hardware setup, you can capture a variety of video formats into Final Cut Pro. The most common format, DV, can be captured with a FireWire interface. For other formats you may require video capture cards. You need to consider your format choices. What tape and video formats are you bringing in? DV? Betacam? Digital Beta? High Definition? Each format can have a variety of paths into Final Cut Pro, and you need to consider which path is best.

You can also import a variety of other digital media formats, such as audio, still graphics, and QuickTime files into Final Cut Pro. These should all be considered carefully because some of these file formats need conversion, while others have to be formatted and created correctly to avoid distortion when used with video. For example, files created in Photoshop or other such programs can suffer slight distortion after being mixed with video unless they’re prepared properly.

See Chapter 26 for working with Final Cut Pro and other applications.

Another acquisition step that you’ll take part in is logging. Logging is a process that consists of viewing your tapes carefully and making selections by jotting down accurate timecodes and reel numbers. With the advent of nonlinear editing, some producers and editors got a bit lazy about logging their tapes. Being able to just digitize hours and hours of material at low resolution, play around with it for days, get a program you’re happy with, and then just re-digitize it in high resolution for output to tape seemed too good to be true. Logging seemed like a thing of the past.

Careful logging and preparation for editing is more relevant now than ever before, and I have the scars to prove it. As a naive and innocent nonlinear editor, I too believed the utopian promise of such an ideal scenario. I learned the hard way about disk storage limitations, timecode breaks, inconsistencies in reel numbering, and other fiascos that made my life difficult. Digitizing a whole lot of material can turn out to be an organizational nightmare. I found that even the best of drives can be bogged down with too much material and slow my project to a crawl.

Be vigilant about careless digitizing. Even if you have seemingly unlimited disk space, failure to log can have unanticipated consequences. For example, with too much media on your drives, you can have slowdowns in your system, and your drives may not work at their advertised efficiency. And it is a lot harder to go back after the fact and delete unused media. Start right, and you’ll be a happy camper. I’ve seen enough teary-eyed campers in my time to be able to relay that message.

Logging has never been easier than it is in Final Cut Pro. With some ingenuity, you can set up a Final Cut Pro–based logging system where you view your tapes and mark your selections for later digitizing. This is also a good stage to determine if you have enough material for your edit. Do you have all the shots and cutaways you need per your script?
Chapter 1  What Is Final Cut Pro?

Editing the media

Editing is the most obvious step in your workflow, and you’ll spend a majority of your time doing this step. Some editors like to start with a basic rough cut and leave the effects and transitions for later. Others work with refined edits from the very start, pausing at each stage to finalize their edits. You can choose what method works best for you, but remember the considerations of rendering time. For example, if you work with low-resolution media and create a timeline where you’ve rendered out numerous effects and transitions, when you recapture that timeline in high resolution, all those effects have to be re-rendered in high resolution. This process is automatic, but it takes time nevertheless.

High resolution versus low resolution is not an issue if you’re working strictly with DV media and the DV Codec. The DV format and the DV Codec always remain at their set resolution.

Process the media

You can add some snazzy effects to your edit. Some editors also leave the audio work for after the basic edit is done. Final Cut Pro offers a practically unlimited choice of effects, transitions, and filters for this part of the workflow. You can also add third-party effects or make your own by using the Final Cut Pro’s FX Builder.

Some people still prefer to do their effects and compositing in programs, like After Effects (you can use a lot of After Effects filters within Final Cut Pro). If this sounds like you, make sure that you answer these questions:

✦ Do you know the correct settings to export the video for After Effects?
✦ Do you have the correct settings for creating a composite in After Effects and rendering back the video for Final Cut Pro?

If I have any doubts that I have used the correct settings, I do a short test of the entire workflow. For example, if the After Effects artist needs video exported by me that they will render back to me through After Effects, I often do a small test by sending the artist a short piece from Final Cut Pro and then asking them to send me the final render. If I do this well in advance of the actual project, I identify any potential problem and resolve it before it becomes a crisis.

Cross-Reference

Turn to Chapter 26 for more information on working with After Effects.
Output your program
Finally, you’ve wrapped up your work. How are you going to output your final edit? Is the final output going to be back to tape? Is it for Web streaming, CD-ROM or DVD playback? Fear not. Final Cut Pro accommodates all these options and then some with Apple’s addition of its brand-new video-compression application called Compressor. However, as I said at the top, plan carefully in advance. A whole host of choices you make at the acquisition, editing, or processing stage can affect your distribution stage. Read this book carefully and be prepared. Sleep with this book next to you if you need to.

Turn to Chapter 23 for more information about working with Compressor.

Separating Final Cut Pro from Other Nonlinear Editing Systems
I’ve spent a lot of time in this chapter talking about nonlinear editing systems and how wonderful they are. Nonlinear editing systems have revolutionized the world of editing and postproduction. They’ve caused people to drool and have opened up a whole new world of digital effects previously unthinkable. They’ve made people laugh. They’ve made people cry. However, even within the wonderful world of nonlinear editing systems, Final Cut Pro represents a revolution of sorts. It has turned some of the most well-known rules of the digital-editing world on their heads. And the beneficiaries of this revolution are people like you and me, the average Joe and Jane editors of the world.

Final Cut Pro is very different from other digital editing systems. Some of these differences may simply be of academic value, while others will affect you quite dramatically.

Final Cut Pro is not tied to proprietary hardware
Before Final Cut Pro arrived on the scene, if you wanted to go and buy an editing system, your choices were quite limited. The most well-known brand — let’s call it Edit Composter — was pretty much your only choice. When you bought an Edit Composter, you had to buy an entire editing system — and I mean a system. It wasn’t just a box of software that said Edit Composter. You had to buy the computer, usually a Macintosh, the video cards, the software, the drives, the monitors, and even the cables, all as one big Edit Composter package.
These systems cost anywhere from $80,000 to $500,000, and some of the cables cost over $200. If you didn’t buy its cables, the company insisted that it couldn’t guarantee the performance of the system. Similarly, the drives were expensive. Yet drives were nothing more than generic industry drives, put in a nice plastic box with a really cool Edit Composter logo. This hardware was known as proprietary hardware. Big resellers sold these systems to big companies with big money. A troop of people showed up to deliver and install the system. Bills ran into the hundreds of thousands of dollars.

For ordinary editors like me, owning systems like Edit Composter was unthinkable. Digital editing was strictly the domain of big editing houses and commercial production facilities with millions of dollars.

More choices appeared on the market, but the formula remained generally the same. A nonlinear editing system was not just any piece of software you ran on your computer. You had to buy the whole “turnkey” package: their video card, their drives, their cables, and their software. Most editing software was tied to very particular hardware, and it was unthinkable to run it on anything other than what the company wanted to sell you. For example, you couldn’t just buy the software from our mythical company Edit Composter and run it on hardware sold by another company. Doing so was considered insane.

Then along came Final Cut Pro. Here was a piece of editing software made by Apple, a company famous for its commitment to multimedia and creative professionals. Best of all, it was not tied to proprietary hardware. If you had a FireWire-capable Mac, Final Cut Pro, and a DV camera, you had yourself an edit system.

Apple’s continued philosophy and dedication to keep Final Cut Pro a premium, software-based, nonlinear editor is evident in version 4.0, which includes more than 300 added features—none requiring a stitch of additional hardware in order to function. The most obvious example of this is the Final Cut Pro 4.0 RT Extreme render engine that adds preview output and dozens of real-time effects right out of the box.

So, with the right hardware and Final Cut Pro, you can pretty much edit anything you want. What’s different is that Apple is not tying its software to its own video card and drives sold to you at a vastly inflated price. It also continues to keep Final Cut Pro open to third-party developers. Many companies now sell cards that are compatible with Final Cut Pro, and a vast variety of drives work with the program as well.

A complete list of compatible cards and drives is available at the Apple Web site.
Final Cut Pro provides all kinds of options previously not available. For example, you can now edit with Final Cut Pro on your Powerbook while you’re on the road. These edits can be brought back to the edit facility, where another high-end system configured with Final Cut Pro can recapture and output a high-resolution version to tape. In fact, I know an editor in Hollywood who edits portions of his films this way. This kind of portability was unthinkable in the pre–Final Cut Pro days.

You can find information on film editing with Final Cut Pro in Chapter 27.

**Final Cut Pro works with many formats and standards**

Most nonlinear edit systems, despite their big price tags, work with a limited number of formats and standards. For example, if you have an edit system from our mythical company, Edit Composter, you can edit broadcast-quality video from Betacam SP. But to capture DV, you often have to buy another card as an add-on. And if you want to work in a different frame rate or aspect ratio, good luck. Edit Composter only supports one frame rate and one aspect ratio. Only spending thousands of additional dollars will give you the new capability, if at all.

Final Cut Pro is dramatically different. To paraphrase the Final Cut Pro designers in Apple’s Cupertino campus, Final Cut Pro works with everything from DV to HDTV. With the proper drive and hardware support, you can use Final Cut Pro to edit almost any frame rate, aspect ratio, and standard. Some of the formats that Final Cut Pro works with include

✦ **DV format with FireWire.** This includes the MiniDV, DVCAM, DVCPRO and DVCPRO50 cameras, decks, and tapes.

✦ **NTSC and PAL.** Apple-approved third-party cards are required to work with NTSC and PAL video with composite, component, and serial digital (SDI) signal paths.

✦ **QuickTime standard file formats.** These include MJPEG (a popular video codec), Sorenson, and Cinepak, among others. Final Cut Pro also supports numerous frame rates, compression schemes, and aspect ratios.

✦ **24 fps film.** Final Cut Pro has 24 fps support for film editing. Numerous films have been edited by using Final Cut Pro. Big Hollywood releases, such as *George Washington, Bo Jangles, Full Frontal,* and *Rules of Attraction,* were edited with Final Cut Pro.

✦ **HDTV.** Recently Apple showed Final Cut Pro systems being used to edit High-Definition Television (HDTV). High-Definition Television is the wave of the future. HDTV delivers high-quality video at many different aspect ratios and frame rates. Final Cut Pro supports all the major HDTV standards.

Next we’ll see how other important technologies converged to popularize Final Cut Pro.
Other Technologies and Final Cut Pro

Timing, as they say, is everything. This phrase is true in comedy as well as making history. Final Cut Pro appeared at a very appropriate time. Final Cut Pro relies heavily on a whole host of technologies such as FireWire and DV that were in development for many years. These technologies matured just in time for Final Cut Pro to materialize. This convergence, illustrated in Figure 1-10, is one the reasons for Final Cut Pro’s popularity.

Steve Jobs, Apple’s CEO, has referred to digital video as “the next big thing.” Whenever Steve says something like that, the world listens. This statement also reflects Apple’s deep commitment to digital video and multimedia. Apple has led the way in the development of many of the technologies used by Final Cut Pro. In the next few sections I briefly cover the technologies used in the making of Final Cut Pro so that you can see what the big deal is and why I’m as excited as a kid in a candy store.

The G4 processor

Final Cut Pro is an editing program that relies heavily on the computer processor to do all its calculations. The G4 processor, developed by Motorola, has become the central processor in most of the recent Apple PowerMac computers. Without the G4 processor, Final Cut Pro would be hard-pressed to perform its miracles. This processor contains several key features:

✦ The G4 performs in the gigaflop range. A gigaflop is one billion calculations per second. Processing digital video, even DV with its lean data rate, is extremely calculation-intensive. Final Cut Pro is specially optimized to take advantage of all the benefits offered by the G4.

✦ The G4 Processor is ideally suited for multimedia. The instruction set for the G4 chip shows its biggest gains in the area of multimedia performance. Numerous software companies have offered G4 plug-ins to speed up their software. The Final Cut Pro team continues to revise the code for its software to take advantage of the G4 instruction set.

✦ The architecture of the G4 supports multiprocessor configurations. The G4 is designed to support multiprocessing. This allows for more than one processor to work in tandem. The older processors in the Apple Macintosh were not well suited to multiprocessing. Apple now offers dual processor G4s that include two of these processors. Rumors persist of quad (four processors) and dual-quad (eight processors) machines in the future. This development bodes well for Final Cut Pro.
FireWire

FireWire is Apple’s brand name for the technology also known as IEEE-1394. Those people at Apple are masters at coming up with zippy names for fancy technologies, aren’t they? Sony calls this technology iLink on its cameras. FireWire offers many important features to the Final Cut Pro editor:

- **It is the fastest I/O standard.** IEEE-1394 is the fastest serial input/output standard ever developed. This allows for very high data rate transfers and is especially useful for video, audio, or other data transfers that need to occur between computer hardware. You can currently purchase FireWire scanners, cameras, and hard drives, among other items. Hopefully, FireWire will one day replace the older SCSI standard.

- **It allows integration of consumer electronics with personal computers.** A few years ago, a camcorder was a camcorder and a computer was a computer. The idea of plugging a camera into a computer was pretty far-fetched. With FireWire, a new bridge has been built between computers and electronics such as video cameras.

Recently, Apple has implemented its new FireWire protocol called FireWire 800, technically known as IEEE-1394b. This new protocol can deliver up to 800Mbs of data—twice that of the current FireWire, now retro-named FireWire 400. FireWire 400 and 800 are covered in detail in Chapter 2.
✦ **It's hot-pluggable!** I don’t know how many people appreciate this, but writing these words brought tears to my eyes. If you’ve ever lived with SCSI drives and connectors and have spent hours fiddling with huge connectors that look like bear paws that skin your knuckles, and have constantly had to restart your computer to mount SCSI drives, you’ll be very happy to read this. Being *hot-pluggable* means that you don’t have to power down your computer to “mount” a FireWire component. Just plug it in and it shows up on your desktop. And the FireWire cable connectors are no bigger than a phone jack and are just as easy to plug in. No more cursing as you switch drives at the back of your computer!

✦ **There are no IDs to set.** In SCSI-based drives, you had to set ID numbers for each SCSI item, which caused numerous conflicts and problems. And then there was the whole termination issue. SCSI chains had to be physically terminated with a termination plug or switch or else they caused massive headaches for users. Occasionally the terminator plugs used for this purpose would be of low quality and cause even further problems. FireWire handles all these ID and termination conflicts automatically.

✦ **It supports numerous devices.** FireWire can handle up to 63 devices on a single port.

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**A word on Apple and Macintosh**

If you’re a longtime Mac user, this sidebar may not be all that relevant to you. But if you’re a PC or Windows user, and for some bizarre reason you find yourself holding this book, you may want to read on.

Final Cut Pro is designed and sold by Apple Computers and only works in Apple’s machines. Final Cut Pro does not work on any machines running DOS, Windows, Windows NT, or UNIX variants. The true irony is that Final Cut Pro started out its early days as a Windows application over at Macromedia, the makers of Flash and other wonderful products. It used to be called Key Grip. (I know, I know . . . like I said earlier, Apple people are much better at finding snappy names for their products.) However, Steve Jobs bought it from Macromedia and turned it into an entirely Apple product. Apple also renamed it Final Cut Pro. (What the heck does a *key grip* have to do with editing videos anyway?)

Final Cut Pro is so heavily dependent on Apple technologies that I cannot foresee a day when it may be available on Windows. However, even as I write this, I realize that much stranger things have come to pass. If you’re a Windows owner and have plans to work with digital video, I strongly suggest buying an Apple Mac capable of running Final Cut Pro. If you can’t or don’t want to buy a Mac, buy this book. Take it home and read it from cover to cover. Then put your best thinking hat on and ponder this question: Can your nonlinear editing system do everything Final Cut Pro can do?
QuickTime

Steve Jobs once remarked that QuickTime was the best thing Apple ever did. I agree. QuickTime is considered a kind of Swiss army knife of multimedia. Most users may be familiar with the QuickTime Player and QuickTime Movies, but what they may not know is that QuickTime is an enabling technology and a sophisticated architecture that allows for multimedia management, programming, and delivery. Enabling technologies work in the background and allow other programs to work faster, better, and stronger. QuickTime also happens to be the backbone of Final Cut Pro. Final Cut Pro can work with so many different types of media on the input side as well as output all kinds of different formats. Advantages of QuickTime include

✦ **QuickTime enables many formats.** QuickTime works with video, audio, MIDI music, 3-D files, and virtual-reality files. This aspect of the program allows for flexibility and exchangeability with many applications. Countless multimedia applications, such as Adobe’s After Effects and Adobe Premiere, are based on QuickTime.

✦ **QuickTime is generally transparent to the user.** Users of QuickTime may not always know that it made your program better. However, chances are that if you’re doing any kind of multimedia work on an Apple Macintosh with any kind of an application, you’re being helped by QuickTime. For example, when you’re exporting or importing files in Final Cut Pro, QuickTime is being employed in this process, it’s just working unseen in the background.

✦ **QuickTime is easy to use.** As transparent as it may be, occasionally you need to interact with QuickTime and understand how it works. QuickTime is easy to use and understand. For example, using the QuickTime player, you can view and export movies. The player is a great example of how easy a technology QuickTime can be.

DV

One of the key reasons for Final Cut Pro’s popularity is its high level of compatibility with the DV format. The DV recording format has exploded in popularity in the last few years, boosting Final Cut Pro’s own popularity. I do advise you to keep in mind that Final Cut Pro can work with far more than just the DV format, but this format does offer a variety of advantages:

✦ **DV is a recording format and a compression standard.** For this reason DV is seen as a tape format for DV-compatible cameras as well as a software codec that is used for compression and decompression when working on a computer in multimedia applications.
✦ DV is digital and has no generational loss. DV is a digital method of recording the video signal on the tape. The signal is recorded in the computer’s binary language of zeros and ones. Analog formats store the signal as a fluctuation of a voltage signal. A DV signal, when transferred over a digital path, remains free of any deterioration. Having a clean signal is one of the most important advantages of DV.

✦ DV requires a relatively low data rate. The biggest hurdle for working with digital video is its data rate. However, DV25’s data rate of 3.6MB per second and DVCPRO50’s data rate of 7MB per second are relatively lean. Even the basic drive in a Macintosh computer can handle this data rate.

✦ DV is high resolution. Low data rate mostly equates with low-quality video. However, DV compression maintains a very high image and sound quality, despite the low data rate. Video in DV is almost twice as sharp as a VHS. Some people say it rivals Sony’s Betacam SP format. I am not one of those people.

✦ DV blurs the line between professional- and consumer-level video. Despite the raging debate over whether DV rivals Betacam SP or whether it’s as good as other reigning formats, undoubtedly DV blurs the line between professional-level video and consumer-level camcorders. The fact that a debate exists reveals how superior the DV format is to its predecessors. I never remember hearing any debate over whether my VHS-C Handycam was as good as a Betacam SP deck. As a result of DV’s high quality, numerous documentaries, network programs, and even feature films are being shot in DV format. DV has gained acceptance in many networks and broadcast houses.